Citation Sovereign



Pilot Training Manual

Revision 2

CAE

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Introduction

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Welcome to CAE

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Our best wishes are with you for a most successful and rewarding training experience.

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Using this Manual

This manual is a stand-alone document appropriate for various levels of training. Its purpose is to serve as an informational resource and study aid.

The **Quick Reference** section provides limitations, memory items from procedural checklists, and other data for quick review.

The **Operating Procedures** section contains sub-chapters that provide a pictorial preflight inspection of the aircraft, normal procedures in an expanded format, standard operating procedures, maneuvers, and other information for day-to-day operations.

The **Flight Planning** chapter covers weight and balance and performance; a sample problem is included.

The **Systems** section is subdivided by aircraft system. Each system chapter contains a discussion of components, preflight and servicing procedures, and abnormal and emergency procedures.

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Quick Reference

Contents

Quick Reference

This section applies to Cessna Model 680 Citation Sovereign unit numbers 680-0001 and subsequent. Specific differences in aircraft configurations affected by Cessna Service Bulletins are identified throughout the section as appropriate.

- The General Limitations subsection contains information and limitations that pertain to the aircraft as a whole.
- The Operational Limits subsection presents functional and structural limits such as weight, speed, takeoff, landing, and enroute operations; and load factors.
- The System Data subsection presents information and limitations that pertain to specific aircraft systems.
- The EICAS and Instrument Markings subsection summarizes system parameters by showing the manufacturer's markings on specific gauges.

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General Limitations

The limits presented in this section focus primarily on the operational capabilities of the aircraft. Specific system limits and instrument markings are presented in this section.

NOTE: CERTIFICATION AND OPERATIONAL LIMITATIONS ARE CONDITIONS OF THE TYPE AND AIRWORTHINESS CERTIFICATES AND MUST BE COMPLIED WITH AT ALL TIMES AS REQUIRED BY LAW.

Authorized Operations

- Day and night.
- VFR and IFR flight.
- Flight into known icing conditions.
- This aircraft is not certified for ditching under 14 CFR Part 25.801.
- This aircraft is eligible for over-water operations with applicable equipment specified in the appropriate operating rules.

Certification Status

- The Citation Sovereign is certified in accordance with 14 CFR Part 25 and JAR-25.

Maneuver Limits

- Acrobatic maneuvers, including spins, are prohibited.
- Intentional stalls are prohibited above FL250. Intentional full stalls are limited to idle thrust only.
- Intentional uncoordinated flight of greater than one slip/skid indicator bar width for longer than 20 seconds is prohibited.

  Refer to "Figure 2-2: Maximum Maneuvering Speeds" on page 2-10.

Minimum Crew

Minimum Flight Crew for All Operations . . . . 1 Pilot and 1 Copilot

Passenger Compartment

For taxi, takeoff, and landing, seatbacks must be fully upright, head rests extended, seat controls inboard, seat tracked away from the table and then outboard, and passenger seat belts and shoulder harnesses must be fastened.

The maximum number of occupants in the passenger compartment is twelve.

The lavatory door must be latched open for taxi, takeoff, and landing.

The use of the lavatory is prohibited for taxi, takeoff, and landing and is limited to one occupant in flight.

Baggage Compartment

The baggage compartment smoke detection and fire extinguishing systems must be operational if baggage is to be carried in the compartment.

The maximum total weight of baggage in the tailcone baggage compartment is 1,000 pounds (453 kg).Total weight includes baggage in the forward and aft compartments plus any on the coat rod.

The maximum floor loading distribution is 150 pounds per square foot.

Operational Limits

Weight Limits

Maximum Design Ramp Weight . . . . .30,550 POUNDS
Maximum Design Takeoff Weight . . . . .30,300 POUNDS
Maximum Design Landing Weight. . . . . .27,100 POUNDS
Maximum Design Zero Fuel Weight .20,800 POUNDS
Minimum Flight Weight . . . . .17,345 POUNDS
Maximum Tailcone Baggage Weight . . . . .1,000 POUNDS
Takeoff weight is limited by most restrictive of:

Maximum Certified Takeoff Weight (Flaps 7° or 15°). . . . . .30,300 POUNDS
Maximum T/O weight permitted by
Climb Requirements . . . . REFER TO AFM SECTION IV, PERFORMANCE, TAKEOFF
Takeoff Field Length . . . . REFER TO AFM SECTION IV, PERFORMANCE, TAKEOFF

Landing weight is limited by most restrictive of:

Maximum Certified Landing Weight. . . . . .27,100 POUNDS
Maximum Landing Weight Permitted by Climb
Requirements or Brake Energy Limits. . . . . . REFER TO AFM SECTION IV, PERFORMANCE, LANDING
Landing Distance. . . . . REFER TO AFM SECTION IV, PERFORMANCE, LANDING

Center-of-Gravity Limits

Center-of-Gravity Moment Envelope . . . REFER TO "FIGURE 2-1: CENTER OF GRAVITY LIMITS" ON PAGE 2-8.

Weight and Balance Data

The aircraft must be operated in accordance with the approved loading schedule. Refer to the Weight and Balance Data Sheet and FAA-Approved Weight and Balance Manual for the Model 680 Citation Sovereign.

Performance Configuration

The aircraft configuration must be as presented in AFM, Section IV, Performance, STANDARD PERFORMANCE CONDITIONS.

Center-of-Gravity Limits

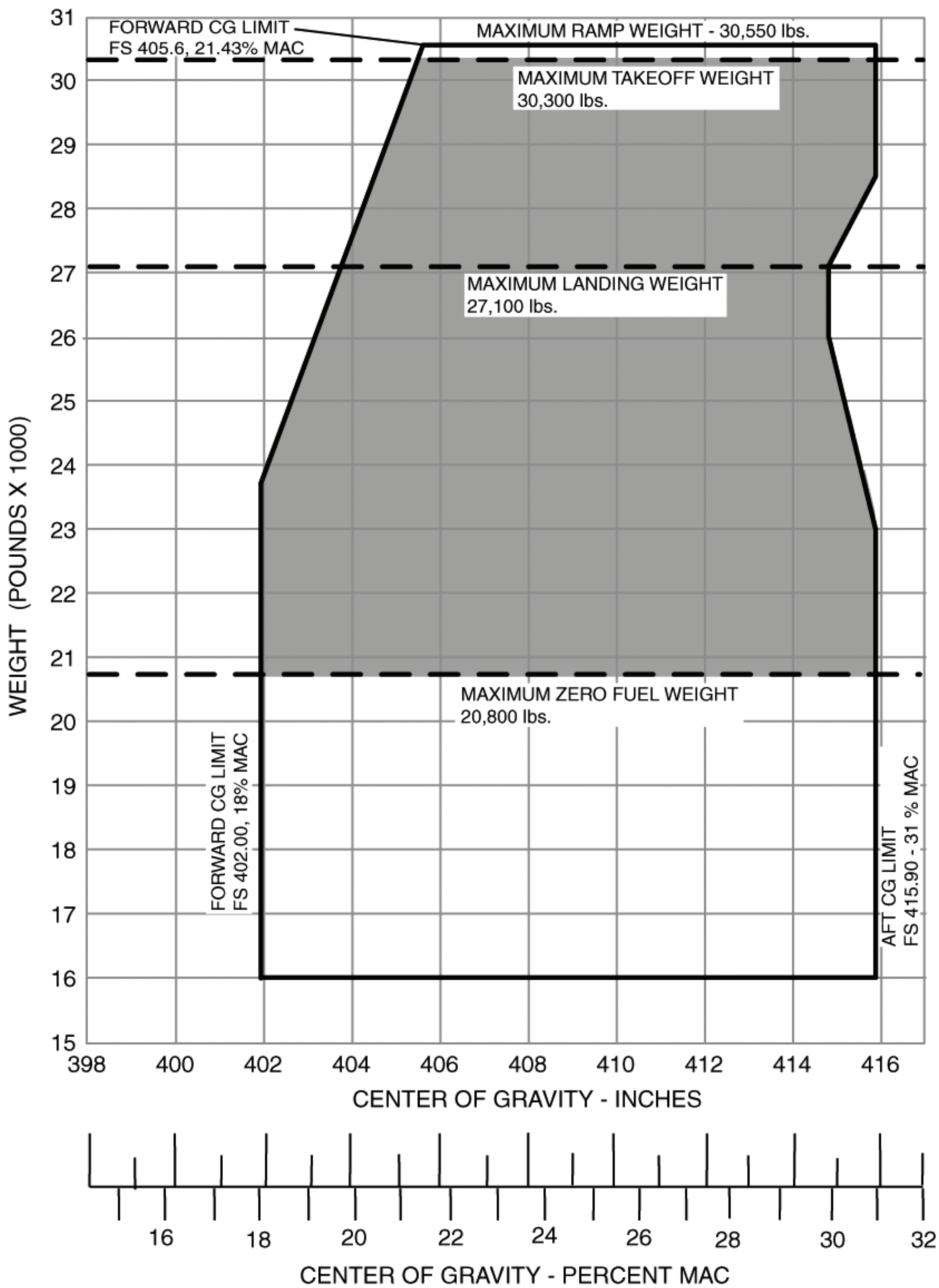

Figure 2-1: Center of Gravity Limits

Speed Limits

Maximum Operating Mach - (M_{MO}) above 29,833 ft. . . 0.80 MACH (INDICATED)

Maximum Operating Kts - (V_{MO}) 8,000 ft. to 29,833 ft. . . . . 305 KIAS

Maximum Operating Kts - (V_{MO}) below 8,000 ft. . . . . 270 KIAS

> ***NOTE:*** The M_{MO} and V_{MO} limits are lower for certain equipment failures. Refer to AFM Section III, Emergency or Abnormal Procedures.

> ***NOTE:*** The maximum operating limit speeds may not be deliberately exceeded in any regime of flight (climb, cruise or descent) unless a higher speed is authorized for flight test or pilot training.

Maximum Maneuvering Speed - V_A . . . . REFER TO "FIGURE 2-2: MAXIMUM MANEUVERING SPEEDS" ON PAGE 2-10

WARNING

Avoid rapid and large alternating control inputs, especially in combination with large changes in pitch, roll, or yaw (e.g., large sideslip angles), as they may result in structural failures at any speed, including below V_A.

> ***NOTE:*** Full application of rudder and aileron controls, as well as maneuvers that involve angles-of-attack (AOA) near the stall, should be confined to speeds below maximum maneuvering speed.

Maximum Altitude for Extension of Flaps . . . . 18,000 FT.

Maximum Flap Extended Speed - V_{FE}

Partial Flaps 7° Position . . . . 250 KIAS

15° Position . . . . 200 KIAS

Full Flaps 35° Position . . . . 175 KIAS

Maximum Landing Gear Extended/Operating Speed – V_{LE}/V_{LO}. . . . . . . 210 KIAS

> ***NOTE:*** This is the maximum speed at which the landing gear may be lowered or raised as well as the maximum speed with landing gear extended.

Maximum Turbulent Air Penetration Speed. . . . . 225 KIAS/0.80 MACH

Maximum Speed Brake Extension Speed. . . . . NO LIMIT

Minimum Speed Brake Extension Speed (10 Panels). . . . . V_{REF} +15 KIAS

Minimum Single Engine Enroute Climb Speed . . . . 180 KIAS

Maximum Tire Ground Speed . . . . 165 KTS

Minimum Speed For Sustained Flight In Icing
Conditions (except takeoff, approach and landing) . . . . 180 KIAS

Minimum Control Speeds
V_{MCA}, V_{MCL}, and V_{MCG} . . . . REFER TO AFM, SECTION IV, PERFORMANCE, GENERAL

Maximum Maneuvering Speeds

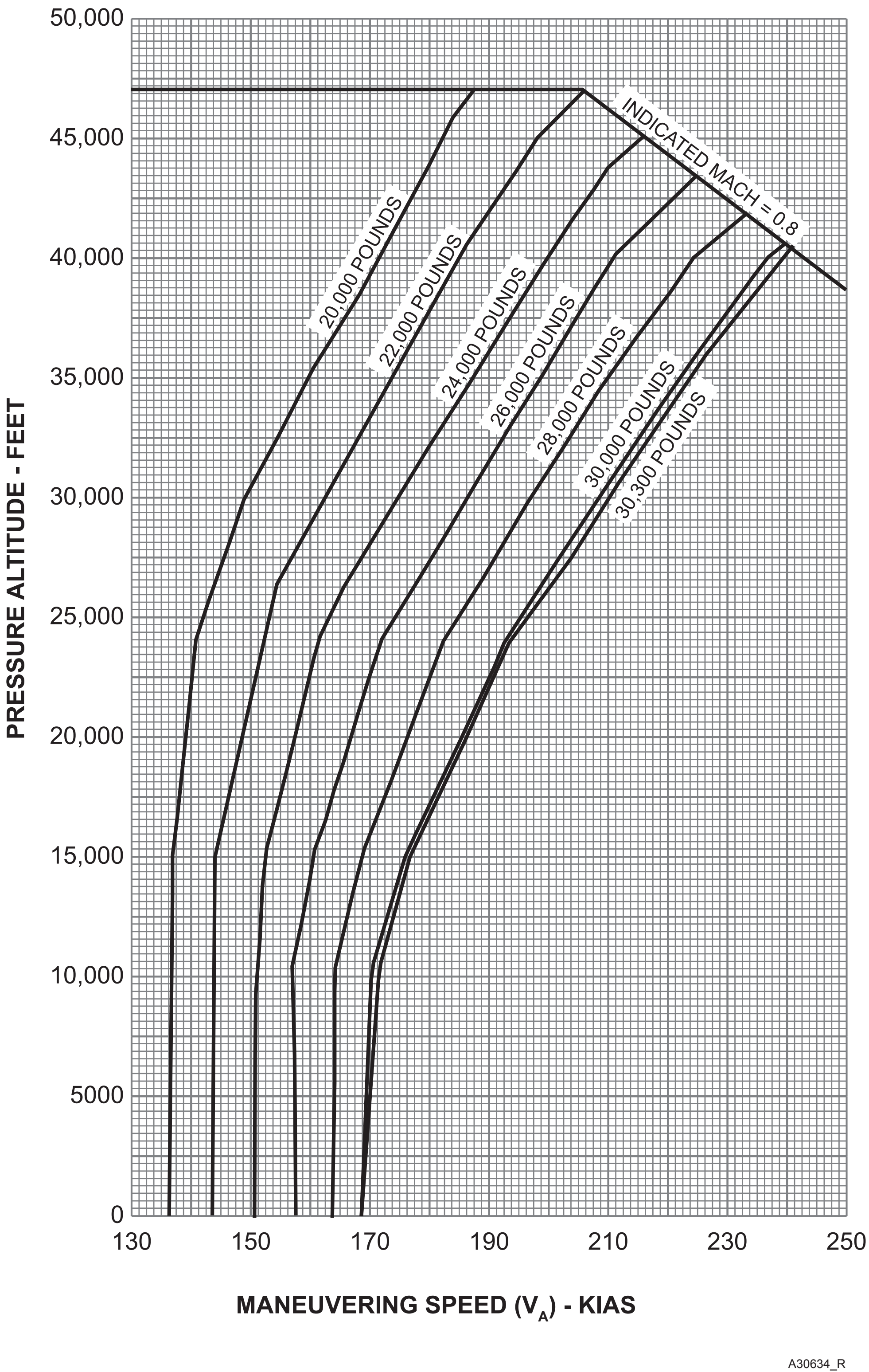

Figure 2-2: Maximum Maneuvering Speeds

Takeoff and Landing Operational Limits

Maximum Altitude Limit . . . . 14,000 FT.

Maximum Tailwind Component . . . . 10 KTS

Maximum Ambient Temperature . . . . REFER TO "FIGURE 2-4: TAKEOFF/LANDING/ENROUTE TEMPERATURE LIMITATIONS" ON PAGE 2-13

Maximum Demonstrated Crosswind Component
(Not Limiting; with or without thrust reversers) . . . . 25 KTS

The stabilizer trim must be set in accordance with the following figure.

Stabilizer Trim

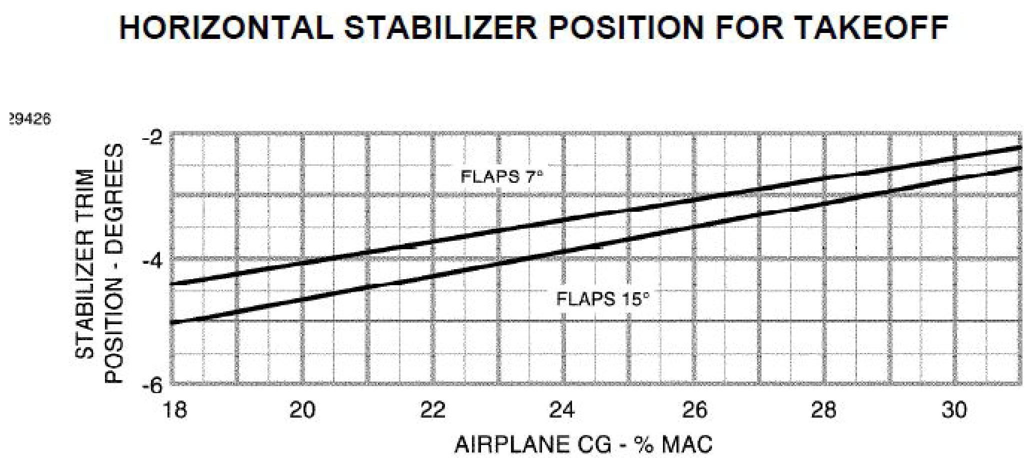

Figure 2-3: Stabilizer Trim

The autopilot and yaw damper must be disengaged for takeoff and landing.

A satisfactory preflight check of each of the following systems must be accomplished in accordance with AFM Section III, Normal Procedures, prior to take off:

- AOA and Stall Warning
- Bleed Air System
- Glareshield Cooling Fans
- Rudder Bias
- Standby Power
- Stabilizer Trim

The lavatory doors must be latched open for takeoff and landing.

Takeoff and landings are limited to paved runway surfaces.

Anti-skid must be operational for takeoff.

Except where otherwise specified by AFM procedures, speed brakes must be stowed prior to 500 feet AGL for landing.

Takeoff is prohibited with a red CAS message displayed. Takeoff is prohibited with an amber CAS message displayed unless relief is specifically authorized in a Minimum Equipment List (MEL).

Takeoff is prohibited with the following forms of contamination:

- With frost adhering to the following critical areas:
  - Wing Leading Edge
  - Upper Wing Surface
  - Windshield
- With ice, snow or slush adhering to the following critical areas:
  - Wing Leading Edge and Upper Wing Surface
  - Flight Control Surfaces including all hinge gaps
  - Horizontal Stabilizer
  - Vertical Stabilizer
  - Engine Inlets
  - Top of Engine Pylons
  - Top of Fuselage
  - Windshield
  - All Static Ports
  - Angle-of-Attack Vanes
  - Upper surface of nose forward of the windshield

NOTE: Refer to AFM, Section VII for information regarding Ground Deicing and Anti-icing procedures.

Takeoff is limited to the flaps 7° configuration when Type II, III, or IV anti-ice fluid has been applied to the aircraft.

A visual and tactile (hand on surface) check of the wing leading edge and the wing upper surface must be performed to ensure the wing is free from frost, ice, snow, or slush when the outside air temperature is less than 10°C (50°F) or if it cannot be determined that the wing fuel temperature is above 0°C (32°F) and:

- There is visible moisture present (rain, drizzle, sleet, snow, fog, etc.); or
- Water is present on the wing upper surface; or
- The difference between the dew point and the outside temperature is 3°C or less; or
- The atmospheric conditions have been conducive to frost formation.

Enroute Operational Limitations

Maximum Operating Altitude . . . . 47,000 FT.

NOTE: For operations above FL410, the following conditions must be met:

- Both ENG BLD AIR selectors must be selected to NORM or HP and both engine bleed air sources must be available.
- The PRESS SOURCE selector must be selected to NORM.

Maximum Ambient Temperature . . . . REFER TO "FIGURE 2-4: TAKEOFF/ LANDING/ENROUTE TEMPERATURE LIMITATIONS" ON PAGE 2-13

Minimum Ambient Temperature. . . . . .REFER TO "FIGURE 2-4: TAKEOFF/ LANDING/ENROUTE TEMPERATURE LIMITATIONS"

When the aircraft has been exposed to prolonged ground temperatures below -9°C (15°F), the cabin must be warmed to at least 60°F (15°C), as indicated on the cabin temperature indicator on the environmental control panel, before flight above FL250.

The Mach Trim system must be operational for speeds above Mach 0.77 with the autopilot disengaged.

Load Factor

Flaps 0° . . . . –1.2 TO +3.0G

Flaps 7°, 15°, or 35° . . . . 0.0 TO +2.0G

Maximum Duration - Zero G or Less . . . . 20 SECONDS

> ***NOTE:*** These accelerations limit the angle of bank in turns, limit the severity of pull-up maneuvers, and limit the aircraft to a landing sink rate of 600 FPM.

Takeoff/Landing/Enroute Temperature Limitations

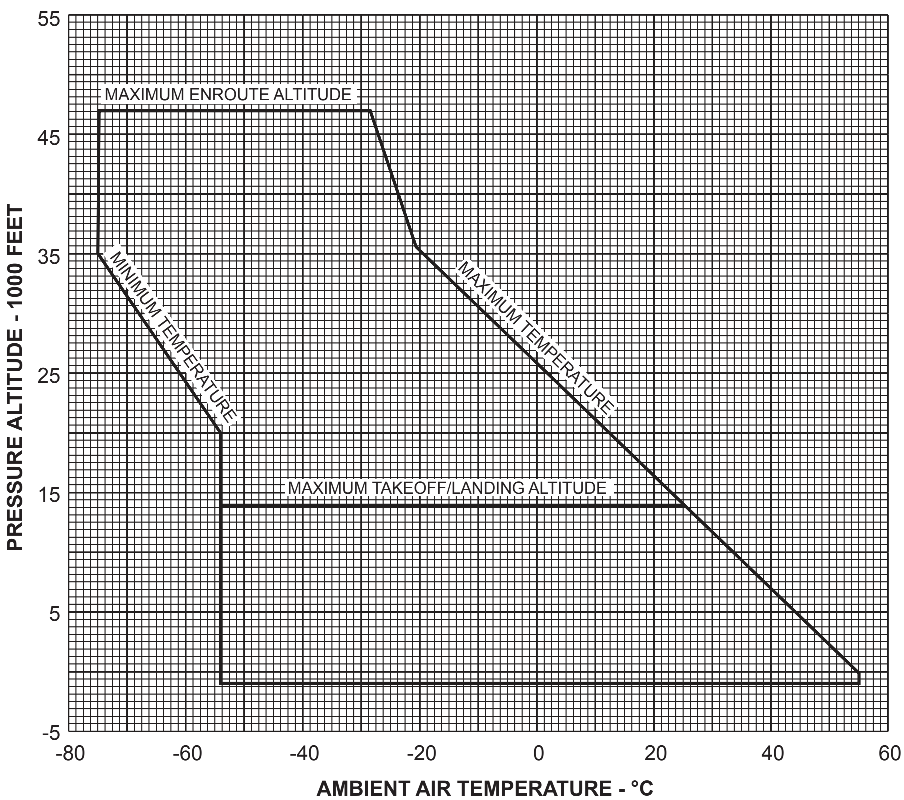

Figure 2-4: Takeoff/Landing/Enroute Temperature Limitations

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System Data

Avionics and Communications

Honeywell Primus Epic System

1. The Honeywell Primus EPIC for the Cessna Citation Sovereign Pilot's Guides, part numbers A28-1146-168 and A28-1146-183, Revision 1, or later applicable revision, must be immediately available to the flight crew.
2. Ground operation with the EICAS and/or avionics selected on without conditioned air is limited to 30 minutes when the Outside Air Temperature (OAT) is greater than 47°C (117°F).
3. Dispatch is prohibited when any of the following amber CAS messages are displayed: **DU 1-2-3-4 O'TEMP** or **MAU 1-2-3-4 O'TEMP**.
4. Dispatch is prohibited following a flight where either an amber **DU 1-2-3-4 O'TEMP** or **MAU 1-2-3-4 O'TEMP** CAS message was displayed, until the condition is identified and corrected.
5. All display units must be installed and operational.
6. Dispatch with a DU in reversionary mode is prohibited.
7. Reversion of both PFDs to DU2 and DU3 is prohibited.
8. Taxiing the aircraft is prohibited until the attitude/heading ground alignment is completed (approximately 90 seconds for AHRS or 6 minutes with optional IRS).
9. Autopilot:
   - One pilot must remain seated, with the seatbelt fastened, during all autopilot operations.
   - Autopilot operation is prohibited if any of the following is true:
     - Any comparison monitor annunciation is activated.
     - Either PFD is in ATT or HDG reversion.
     - Either attitude heading source is failed.
   - Autopilot minimum use height:
     - Enroute and Descent: 1,000 feet AGL
     - Precision Approach: 80 feet AGL
     - Non-Precision Approach: 200 feet AGL
     - Takeoff, Climb, and Missed Approach: 400 feet AGL
   - Autopilot operation is prohibited during in-flight engine starts using starter assist.
10. Configuring the aircraft displays to metric fuel and weight units is prohibited.
11. When the flight director or autopilot is coupled to VOR or ILS, HDG mode must be selected (HDG bug synced to current heading) prior to switching navigation frequencies. When the next VOR or ILS frequency is satisfactorily received, NAV mode may be re-engaged.

12. For airplanes 680-0001 through -0290 not incorporating SB680-34-20 (Epic Phase 5 Software Upgrade), the use of PREVIEW mode to auto transition from LNAV to VOR or ILS approach is prohibited.
13. HF radio transmissions are prohibited when navigation is predicated on the use of the Automatic Direction Finder (ADF).
14. Use of barometric VNAV vertical guidance is prohibited when the barometric altitude is corrected to the landing field elevation (QFE operations).
15. For airplanes 680-0001 through -0213 not incorporating SB680-34-23 (Epic Phase 4.2 Software Upgrade) or SB680-34-20 (Epic Phase 5 Software Upgrade), use of the single-cue flight director for flight guidance is prohibited when operating without the autopilot engaged.

AOA and Stick Shaker Systems

The AOA indicating system may be used as a reference, but does not replace the airspeed display in the PFD as a primary instrument.

The AOA system can be used as a reference for approach speed (V_{REF}) at all aircraft weights, CG locations, and flap positions. V_{REF} is indicated by approximately 0.6 on the AOA gauge and by the green caret on the pilot's and copilot's airspeed indicators.

Standby Flight Display

The standby flight display (including attitude, altitude and airspeed) and standby HSI must be functioning prior to takeoff.

Airplanes with Electronic Charts

1. When displayed, the geographic-referenced aircraft symbol on the optional electronic charts must not be used for navigation.

> ***NOTE:*** The aircraft symbol displayed on the electronic charts provides supplemental aircraft situational awareness information. It is not intended as a means for navigation or flight guidance. The aircraft symbol is not to be used for conducting instrument approaches or departures, and it should not be relied upon during low visibility taxi operations. Position accuracy, orientation, and related guidance must be assured by other means of required navigation.

2. Operators with the optional electronic charts must have back-up charts available to the flight crew.
3. The Data Start Date currency must be verified on the REVISION INFO window prior to use.
4. The flight crew is responsible for verifying availability of charts for the planned flight.

> ***NOTE:*** The electronic charts are not available with a PFD in reversionary mode.

Category II Limits

1. Category II operations are prohibited unless the aircraft is equipped for Category II operations (SB680-34-09, Navigation - Category II Operations or factory Category II Operations option).
2. Specific operational approval and crew qualification is required for Category II operations.
3. The green CAT2 mode annunciation must be displayed on both PFDs from the final approach fix to the decision altitude.
4. Maximum final approach speed is V_{REF} + 25 knots at the outer marker, slowing to V_{REF} (or V_{REF} adjusted for wind gust) prior to reaching the decision height.
5. Category II operations are prohibited when operating single engine.
6. Category II approaches are prohibited with flaps in any position other than 35°.
7. Wind Limits

   Maximum Tailwind Component . . . . 10 KTS

   Maximum Crosswind Component . . . . 15 KTS

   Maximum Headwind Component . . . . 15 KTS

> ***NOTE:*** If the FMS indicates a significantly different wind on final than reported on the surface, low altitude windshear may result in exceeding the localizer or glideslope Category II deviation limits.

8. EASA registered airplanes must refer to 68FM-S15-00 (or later approved revision), CATEGORY II OPERATIONS FOR EASA REGISTERED AIRPLANES for operations and limitations.
9. Flight Director only Category II approaches are prohibited. The autopilot must be engaged for all Category II approaches.

> ***NOTE:*** Manually flown flight director only approaches may be conducted to the Category II decision height, provided actual weather conditions are at or above Category I minima.

10. Use of the Touch Control Steering (TCS) is prohibited during Category II approaches.

Electrical Power Systems

Start Cycle Limits

Engine Starter Limit . . . . . . THE REST PERIODS BETWEEN ENGINE STARTS IS 2 MINUTES AFTER THE FIRST START ATTEMPT, 5 MINUTES AFTER THE SECOND, AND 30 MINUTES AFTER THE THIRD.

> ***NOTE:*** The engine starter limit is independent of starter power source (i.e., battery, generator-assisted cross start, Auxiliary Power Unit (APU), or external power) and also applies to dry and wet motoring of the engine.

Engine Starter Motoring Limit (not engine start)

- Batteries only . . . . 20 SECONDS
- Batteries with generator assist . . . . 15 SECONDS
- External Power (1,000 amps) . . . . 15 SECONDS
- External Power (1,500 amps) . . . . 7 SECONDS

APU Starter Limit . . . . THREE APU START CYCLES PER 30 MINUTES. THREE CYCLES WITH A 90-SECOND REST PERIOD BETWEEN CYCLES IS PERMITTED.

Battery Start Limit . . . . THREE ENGINE STARTS PER HOUR NINE APU START CYCLES PER HOUR.

> ***NOTE:*** If the battery limit is exceeded, ground maintenance procedures are required. Refer to Chapter 24 of the Aircraft Maintenance Manual for procedures.
>
> - Three engine external power starts (available external power current greater than or equal to 1,000 amps) are equivalent to one engine battery start.
> - One engine external power start (available external power current less than 1,000 amps) is equivalent to one engine battery start.
> - Three generator-assisted cross starts are equivalent to one engine battery start.
> - Three APU battery starts are equivalent to one engine battery start.

External Power Limits for Starting

CAUTION
Use of an external power source with voltage in excess of 28 VDC or current in excess of 1,500 amps may damage the starter.

Maximum Current . . . . 1,500 AMPS
Maximum Voltage . . . . 28 VDC

Generator Limits

STATUS	ENGINE LIMIT	APU LIMIT
Ground	300 amps	275 amps
Air	300 amps	275 amps*
> 35,000 ft.	275 amps	Not Applicable

* The maximum operating altitude for the APU is FL300. Airplanes incorporating SB680-49-02 (Configuration AF) are permitted to operate the APU generator in flight.

NOTE: Transients greater than these numbers are permissible provided the amber **DC GEN O'CURRENT** CAS message does not display.

The battery temperature indicating system must be operational for all ground and flight operations.

If the red **BATTERY O'TEMP L and/or R** CAS message displays during ground operations, even if it subsequently clears, dispatch is prohibited until after the proper maintenance procedures have been accomplished.

For generator cooling during ground operations, the engine must be operated at idle with the generator load less than 75 amps for 4 minutes prior to engine shutdown. Otherwise, a 35 minute cooling period after engine shutdown is required prior to attempting a restart.

Auxiliary Power Unit (APU) Limits

1. The maximum altitude for APU starts is FL200.
2. The maximum airspeed for APU starts is 250 KIAS.
3. The maximum operating altitude for the APU is FL300.
4. The maximum operating airspeed for the APU is 305 KIAS/Mach 0.80.
5. APU operation is prohibited until a satisfactory APU test has been accomplished as contained in AFM Section III, Normal Procedures.
6. One APU start attempt is permitted after a dual generator failure.
7. Following shutdown for any reason, an APU restart must not be attempted until 30 seconds after the RPM indicator reads 0%.
8. Applying deice/anti-ice fluid of any type is prohibited when the APU is operating.
9. Unattended operation of the APU is prohibited.

10. Operating the cockpit and cabin temperature controls in MANUAL is prohibited while APU MAX COOL is selected ON. A 30-second waiting period is required after selecting APU MAX COOL to OFF before operating the cockpit and cabin temperature controls in MANUAL.
11. For approved oils for use in the APU, refer to "Table 2-2: Approved Oils" on page 2-24. In addition, oils listed in the latest revision of the RE100 (CS) Maintenance Manual are approved.
12. The APU compartment must be inspected following an automatic shutdown of the APU.

Fuel Limits

The corresponding electric fuel boost pump must be turned ON when the **FUEL LEVEL LOW L-R** CAS message is displayed or at 600 pounds or less of indicated fuel in either tank.

"Table 2-1: Fuel Temperature Limits" on this page and "Figure 2-5: Fuel Temperature Limits" on page 2-21 list the fuel temperature limitations for fuels approved for use in the Citation Sovereign.

	JET A	JET A-1. JP-5 & JP-8	JET B, JP-4
MINIMUM FUEL TEMPERATURE	-35°C	-40°C	**
MAXIMUM FUEL TEMPERATURE FOR ENGINE START AND TAKEOFF	+57°C	+57°C	**
MAXIMUM OPERATING FUEL TEMPERATURE	+61°C	+61°C	**
MAXIMUM ALTITUDE	47,000 ft.	47,000 ft.	**
MAXIMUM ASYMMETRIC FUEL DIFFERENTIAL FOR NORMAL OPERATIONS	400 pounds	400 pounds	400 pounds
MAXIMUM ASYMMETRIC FUEL DIFFERENTIAL WITH ONE ENGINE INOPERATIVE OR FOR FLIGHT ABOVE FL300*	200 pounds*	200 pounds*	200 pounds*

Table 2-1: Fuel Temperature Limits

* Applicable only to airplanes not incorporating SB680-27-02 (Configuration AE).

** Refer to "Figure 2-5: Fuel Temperature Limits" on page 2-21 for JET-B and JP-4 temperature limitations.

NOTE: A lateral fuel imbalance of 800 pounds has been demonstrated for emergency return.

NOTE: The fuel tank temperature indication on the EICAS does not monitor for fuel temperatures out of limits.

NOTE: Under some flight conditions, the fuel flows may momentarily show amber dashes with the throttles at idle.

Fuel Temperature Limits

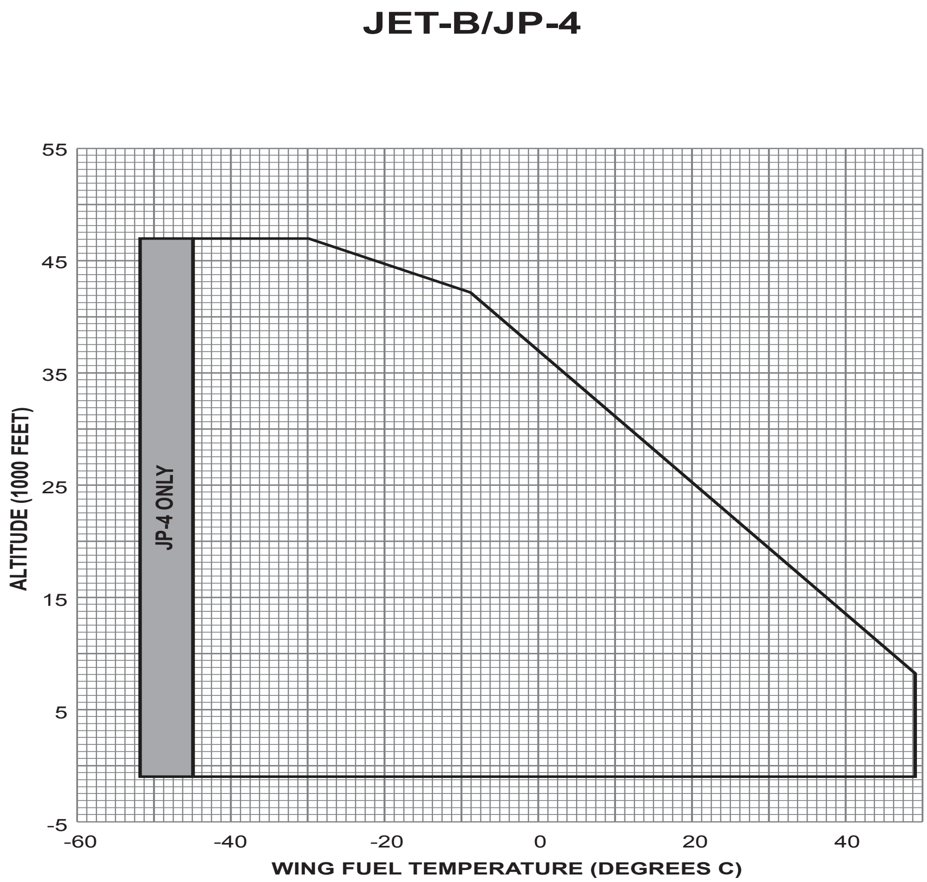


Figure 2-5: Fuel Temperature Limits

Unusable Fuel

Unusable fuel is the fuel remaining in the fuel tanks when the fuel quantity indicator reads zero. This fuel is not usable in flight.

Single Point Refueling

Single point refueling operations must be accomplished per the procedures contained on the placard installed on the single point refueling access door. Minimum refueling pressure is 10 PSI and maximum is 55 PSI. The maximum defueling pressure is -10 PSI.

Hydraulic Power Systems

The only approved hydraulic fluid for hydraulic power systems is MIL-PRF-87257.

The use of the auxiliary hydraulic pump is prohibited when the ground operating temperature is below -40°C (-40°F).

The use of the auxiliary hydraulic pump is prohibited in flight.

Ice and Rain Protection

CAUTION
To prevent possible engine damage from ingestion of ice, do not chip or scrape ice or snow from the engine air inlet. Deice these areas prior to start (refer to AFM Section VII, Advisory Information, “Ground Deice/ Anti-Ice Operations”).

In icing conditions, the aircraft must be operated, and its ice protection systems must be used, as described in AFM Section III, Normal Procedures, ANTI-ICE SYSTEMS. Specific operational speeds and performance information must be used where established for such conditions.

ANTI-ICE ENGINE/STAB buttons must be selected ON between the temperatures of 10°C to -35°C (50°F to -31°F) when in visible moisture. Use SAT for ground operations and RAT for in flight.

NOTE: The ANTI-ICE ENGINE/STAB buttons must be selected ON at least one minute prior to an idle descent into an icing environment.

Except for the ground preflight check, maximum SAT for operation of bleed air anti-ice with the throttles above idle is 20°C (68°F).

Limit the ground operation of the pitot-static heat to 2 minutes to preclude damage to the pitot tubes and AOA vanes.

Anti-ice systems must not be used to deice surfaces prior to takeoff.

NOTE: In icing conditions, operating the aircraft at other than flaps 0° for an extended period of time (except approach and landing) is prohibited.
The use of Wing Anti-Ice is prohibited above FL410.

Operations In Severe Icing Conditions

WARNING
SEVERE ICING MAY RESULT FROM ENVIRONMENTAL CONDITIONS OUTSIDE OF THOSE FOR WHICH THE AIRCRAFT IS CERTIFIED. FLIGHT IN FREEZING RAIN, FREEZING DRIZZLE, OR MIXED ICING CONDITIONS (SUPERCOOLED LIQUID WATER AND ICE CRYSTALS) MAY RESULT IN ICE BUILD-UP ON PROTECTED SURFACES EXCEEDING THE CAPABILITY OF THE ICE PROTECTION SYSTEM, OR CAN RESULT IN ICE FORMING AFT OF THE PROTECTED SURFACES. THIS ICE MAY NOT BE SHED WHEN USING THE ICE PROTECTION SYSTEMS AND MAY SERIOUSLY DEGRADE THE PERFORMANCE AND CONTROLLABILITY OF THE AIRCRAFT. RUNBACK ICE EXTENDING APPROXIMATELY 12 TO 18 INCHES AFT OF THE HEATED LEADING EDGE ON THE UPPER SURFACE OF THE WING IS NORMAL IN SOME ICING CONDITIONS, HAS BEEN EVALUATED TO ENSURE SATISFACTORY PERFORMANCE AND CONTROLLABILITY, AND IS NOT AN INDICATION OF SEVERE ICING.

During flight, severe icing conditions that exceed those for which the aircraft is certified shall be determined by the following visual cues:

- Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
- Accumulation of ice on the upper surface of the wing aft of the protected area extending more than 12 to 18 inches aft of the heated leading edge.

If one or more of these visual cues exist, immediately request priority handling from Air Traffic Control to facilitate a route or altitude change to exit the icing environment.

Miscellaneous Systems

Supplemental Oxygen System

Service the oxygen system with Aviator's Breathing Oxygen (MIL-O-27210). The use of medical oxygen is prohibited.

The following aircraft certification requirements are in addition to the requirements of applicable operating rules. The most restrictive requirements (certification or operating) must be observed:

- Crew and passenger oxygen masks are not approved for use above 40,000 feet cabin altitude. Prolonged use of passenger masks above 25,000 feet cabin altitude is not recommended.
- The pressure-demand crew oxygen masks must be properly stowed in their containers to qualify as a quick-donning oxygen mask.

Boundary Layer Energizers, Vortex Generators and Static Wicks

All Boundary Layer Energizers (BLEs) must be present for dispatch (nine per wing).

The following lists the number of vortex generators required for dispatch:

- Vertical Stabilizer – 8 installed (4 per side), 6 required
- APU Fairing – 8 installed (4 per side), 6 required
- Rudder – 24 installed (12 per side), 16 required
- Wiper Fairing – 4 installed (2 per side), 0 required

The following lists the number of static wicks that are required for dispatch. No more than two total can be missing or broken:

- Right wingtip or aileron – 4 installed, 3 required
- Left wingtip or aileron – 4 installed, 3 required
- Rudder – 3 installed, 2 required
- Right elevator – 3 installed, 2 required
- Left elevator – 3 installed, 2 required

Pneumatic and Pressurization Systems

Cabin Pressurization Limits

Normal Cabin Pressurization Limits . . . . 0.0 TO 9.3 (±0.1) PSID

Pressure Relief Valve . . . . 9.6 (±0.1) PSID

Pressure Gauge Redline . . . . 9.7 PSID

When the PRESS SOURCE selector is selected to L or R, an ENG BLD AIR selector is selected OFF, or an engine bleed air source is unavailable, the BAGGAGE HEAT button must be selected OFF.

Powerplant and Thrust Reverser Limits

Powerplant Limits

Engine Type. . . . . PRATT AND WHITNEY CANADA INC. PW306C TURBOFAN (PRODUCING 5,770 POUNDS THRUST AT SEA LEVEL UP TO 30°C)

"Table 2-3: Engine Operating Limits" on page 2-26, illustrates the engine operating limits for time, temperature, RPM, oil pressure and oil temperature under the selected operating conditions.

"Figure 2-6: Overtemperature Limits (Starting)" on page 2-28 and "Figure 2-7: Over Temperature Limits (Except Starting)" on page 2-29 illustrate the engine over temperature limits. "Figure 2-8: Engine Overspeed Limits" on page 2-30 illustrates the engine overspeed limits.

Continuous static-ground operation of the engine at takeoff thrust is limited to a maximum of 2 minutes.

Attempting an engine start is prohibited with a tailwind component greater than 10 knots.

Approved Oils

The following oils are approved for use:

MOBIL JET OIL II	BP TURBO OIL 2380	AEROSHELL TURBINE OIL 500
MOBIL JET OIL 254	ROYCO TURBINE OIL 500	AEROSHELL TURBINE OIL 560
CASTROL 5000	---	---

Table 2-2: Approved Oils

In addition, oils listed for the engine in the latest revision to PW306C Maintenance Manuals (P/N 30B4422) are approved.

CAUTION
When changing from an existing lubricant formulation to a "third generation" lubricant formulation (Aeroshell Turbine Oil 560 or Mobil Jet Oil 254), the engine manufacturer strongly recommends that such a change should only be made when an engine is new or freshly overhauled. For additional information on the use of third generation oils, refer to engine manufacturer's pertinent oil service bulletins.

Maximum oil consumption is 1 U.S. quart per 8 flight hours. When oil consumption is greater than 1 U.S. quart per 8 flight hours, refer to the Aircraft Maintenance Manual.

Oil types or brands may not be mixed unless specifically approved in the PW306C Maintenance Manuals.

Engine Operating Limits

OPERATING CONDITION		OPERATING LIMITS				
THRUST SETTING	TIME LIMIT (MINUTES)	MAX OBSERVED ITT °C	N_2 %	N_1 %	OIL PRESSURE PSI (NOTE 2)	OIL TEMP °C
TAKEOFF (TO DETENT)	5 (NOTE 1)	920	105	105	36 TO 110	16 TO 135
MAXIMUM CONTINUOUS (MCT DETENT)	CONTINUOUS	920	105	105	36 TO 110	16 TO 135
MAXIMUM CRUISE (CRU DETENT)	CONTINUOUS	920	105	105	36 TO 110	16 TO 135 (NOTE 3)
REVERSE THRUST	5 (NOTE 8)	920	105	105	36 TO 110	16 TO 135
GROUND IDLE	CONTINUOUS	---	57 (MIN) (NOTE 4)	---	20 TO 110	16 TO 135 (NOTE 6)
FLIGHT IDLE	CONTINUOUS	---	65 (MIN) (NOTE 4)	---	20 TO 110	16 TO 135 (NOTE 6)
STARTING	---	950 (REFER TO Figure 2-6 on page 2-28)	---	---	0 TO 220 (NOTE 5)	-40 (MIN) (NOTE 3)
TRANSIENT	20 SECONDS	950 (REFER TO Figure 2-6 on page 2-28)	106	106	0 TO 20	---
	90 SECONDS	---	---	---	110 TO 220	135 TO 143

Table 2-3: Engine Operating Limits

NOTE:
1. The total time during which takeoff thrust may be used is limited to 5 minutes per flight. The 5-minute time limit commences when the throttle is first advanced to the TO detent. This time may be extended to 10 minutes for one engine inoperative operation.
2. The normal differential oil pressure is 36 PSI to 110 PSI. Oil pressure less than 36 PSI but greater than or equal to 20 PSI is acceptable when the throttles are set to less than the CRU detent. Operation at a steady state oil pressure below 20 PSI could result in engine damage.
3. After completing a start under cold conditions and achieving a stabilized ground idle, it is acceptable to run the engine up to the CRU detent in order to reduce the time required for the oil to reach the minimum operating temperature of 16°C.
4. Idle speed is a function of ambient pressure.
5. After initiation of the start cycle, oil pressure should indicate an increase within 20 seconds of engine light-up, as indicated by a rise in N_2 and ITT.
6. Oil temperature may be less than 16°C after a start and before oil temperature has stabilized.
7. To preclude low oil pressure, intentional uncoordinated flight of greater than one slip/skid indicator bar width for longer than 20 seconds is prohibited.
8. After 2 minutes with the thrust reversers deployed, the throttle quadrant solenoid de-energizes and limits thrust reverser lever movement to idle or stowed. Returning the thrust reverser levers to stowed re-energizes the throttle quadrant solenoid.

Full Authority Digital Engine Control (FADEC)

Dispatch with an engine FADEC channel inoperative is prohibited.

Exceeding the time interval for a cyan **ENGINE DISPATCH LIMIT L and/or R** CAS message is prohibited.

Both air data systems must be operational for dispatch.

Thrust Reversers

A satisfactory preflight check of the thrust reversers must be accomplished in accordance with AFM Section III, Normal Procedures on the first flight of the day, and on any flight that is predicated on the use of the thrust reversers for performance or the first flight after any maintenance action has been performed on the aircraft.

Reverse thrust must be reduced to the idle reverse detent position at 65 KIAS on landing roll.

Deployment of the thrust reversers for more than 30 seconds with the APU operating is prohibited.

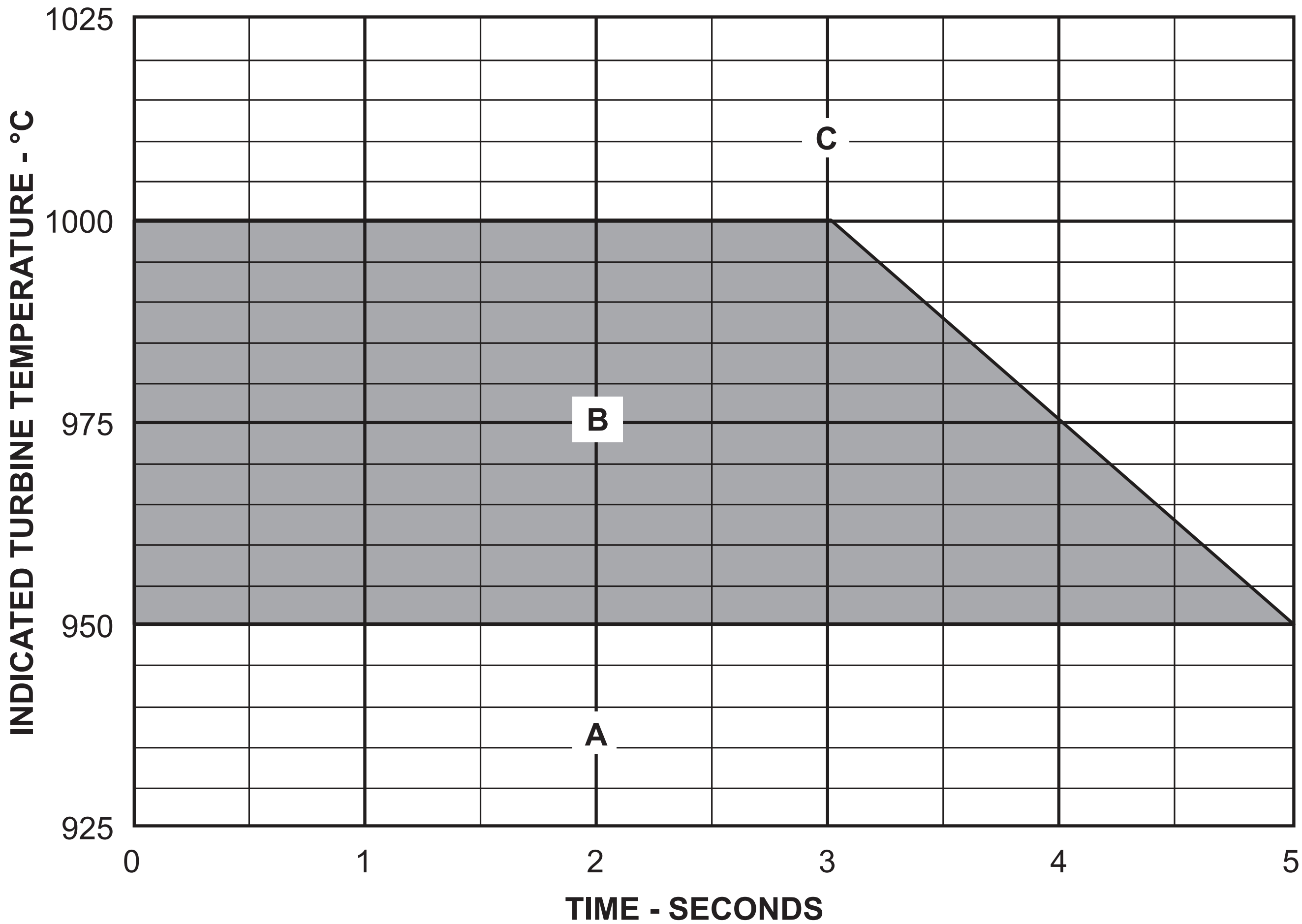
Static-ground operation of the engines is limited to IDLE if the thrust reversers are deployed.

The use of thrust reversers is prohibited during touch-and-go landings.

The use of thrust reversers to back the aircraft is prohibited.

Takeoff performance data must not be predicated on the use of the thrust reversers when the ground operating temperature is below -40°C (40°F) (-15°C (5°F) for airplanes 680-0001 through -0035 not incorporating SL680-78-01, Replacement of Thrust Reverser Door Seals).

Overtemperature Limits (Starting)



AREA A - NO ACTION REQUIRED

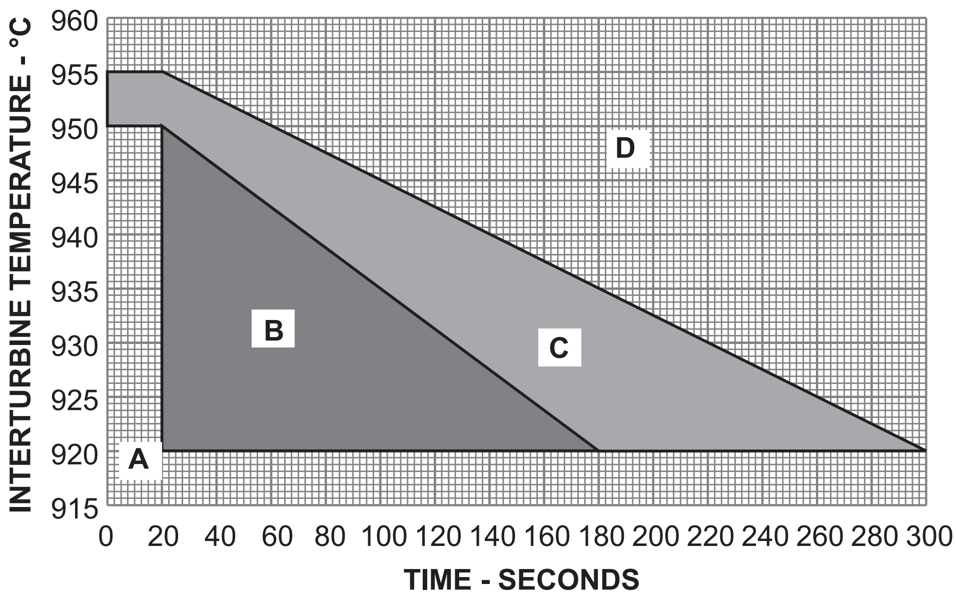
AREA B (1) DETERMINE AND CORRECT CAUSE OF OVERTEMPERATURE
(2) PERFORM HOT SECTION INSPECTION
(3) RECORD IN ENGINE LOG BOOK

AREA C - REFER TO MAINTENANCE MANUAL

CitSov_OM_A25682

Figure 2-6: Overtemperature Limits (Starting)

Overtemperature Limits (Except Starting)



NOTE

INTER TURBINE TEMPERATURES SHOWN MAKE NO ALLOWANCE FOR CORRECTION FACTORS OR INSTRUMENT ERRORS BUT DO ALLOW FOR SOME TYPICAL INSTRUMENT LAG.

AREA A - NO ACTION REQUIRED

AREA B - IF AT TAKEOFF - NO ACTION REQUIRED
- ALL OTHER POWER SETTINGS:
  (1) DETERMINE AND CORRECT CAUSE OF OVERTEMPERATURE
  (2) PERFORM HOT SECTION INSPECTION
  (3) RECORD IN ENGINE LOG BOOK

AREA C - (1) DETERMINE AND CORRECT CAUSE OF OVERTEMPERATURE
(2) PERFORM HOT SECTION INSPECTION
(3) RECORD IN ENGINE LOG BOOK

AREA D - REFER TO MAINTENANCE MANUAL

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Figure 2-7: Over Temperature Limits (Except Starting)

Engine Overspeed Limits

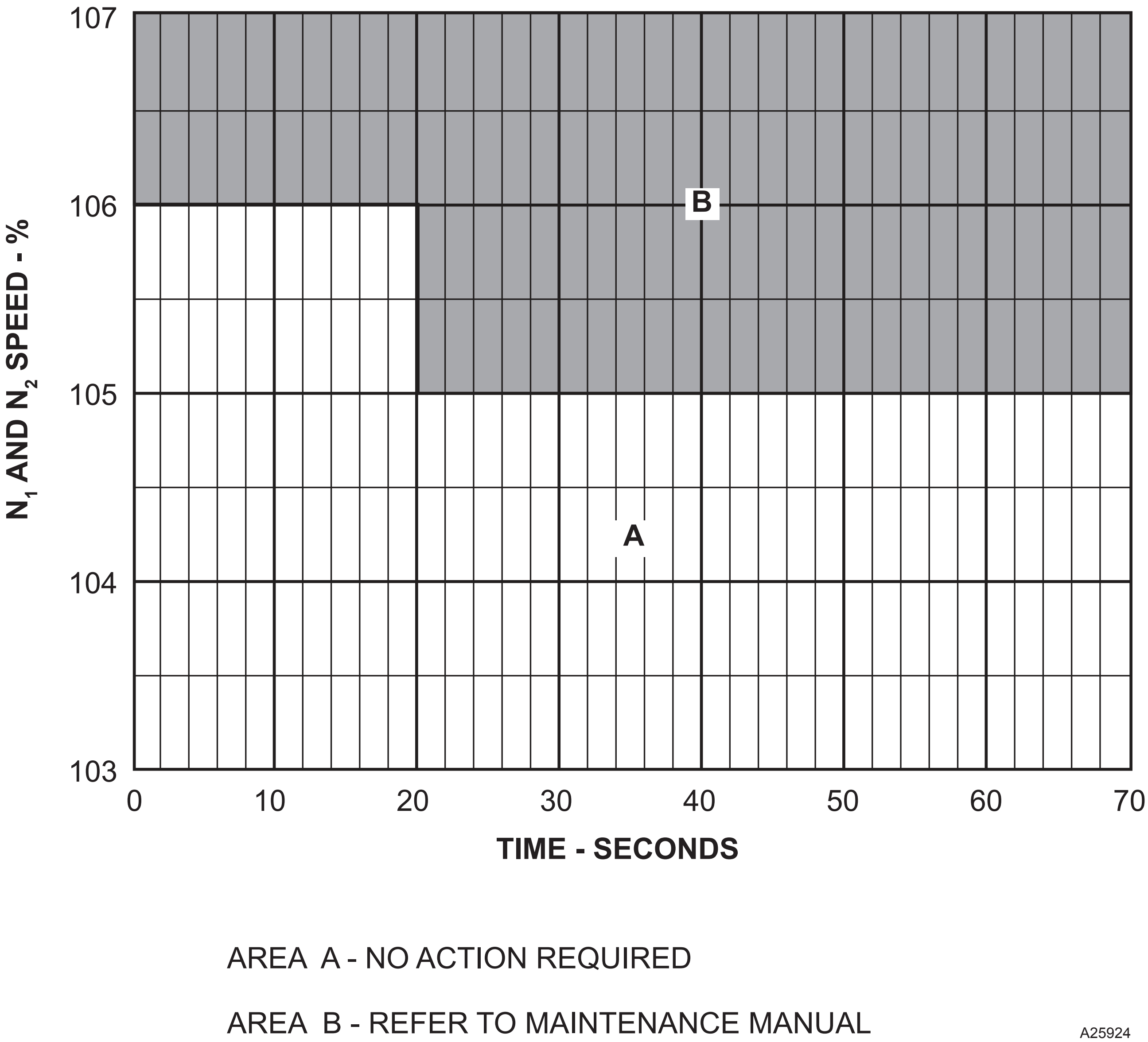

Figure 2-8: Engine Overspeed Limits

EICAS and Instrument Markings

Engine Indication System

Fan (N_1) Indicators

Scale markings

Red Line . . . . 106% RPM
105-106% RPM FOR ≥20 SEC

Tape Pointer/Digital Readout

Red . . . . >106% RPM
105-106% RPM FOR ≥20 SEC
Amber . . . . .105-106% RPM FOR <20 SEC

Tape Pointer

White . . . . ≤05% RPM

Digital Readout

Green. . . . . ≤105% RPM

NOTE: The tape pointer and digital readout will turn red or amber if outside normal operating limits. Digits will appear in inverse video.

Inter-Turbine Temperature Indicators

Engine Start

Scale Markings

Red Line . . . . 950°C

Tape Pointer/Digital Readout

Red . . . . ≥950°C

Tape Pointer

White . . . . <950°C

Digital Readout

Green. . . . . <950°C

NOTE: The tape pointer and digital readout will turn red if outside normal operating limits. Digits will appear in inverse video.

Engine Running

Scale Marking

Red Line	950°C

Tape Pointer/Digital Readout

Red	≥950°C
	920-950 °C FOR ≥20 SEC
Amber	920-950 °C FOR <20 SEC

Tape Pointer

White	<920°C

Digital Readout

Green	<920°C

> ***NOTE:*** The tape pointer and digital readout will turn red or amber if outside normal operating limits. Digits will appear in inverse video.

Turbine (N_2) RPM Indicators

Digital Readout

Red	>106% RPM
	105-106% RPM FOR ≥20 SEC
Amber	105-106% RPM FOR <20 SEC
Green	<105% RPM

> ***NOTE:*** The tape pointer and digital readout will turn red or amber if outside normal operating limits. Digits will appear in inverse video.

Oil Temperature Indicators

Scale Markings/Pointer/ Digital Readout

Red Band (Max)	>143°C
	>135-143°C FOR >90 SEC
Amber Band	>135-143°C FOR <90 SEC
Green Band	16-135°C
Amber Band	-40°C TO 16°C
Red Band (Min)	-70°C TO -41°C
	-40°C TO 16°C WITH TLA AT CRU DETENT OR HIGHER

> ***NOTE:*** Oil temperature must be above 16°C to increase thrust beyond the CRU detent.

Oil Pressure Indicators

Engine Start

Scale Markings/Pointer/Digital Readout

Red Band (Max) . . . . >220 PSI
Green Band . . . . 0-220 PSI

Engine Running

Scale Markings/Pointer/ Digital Readout

Red Band (Max) . . . . >220 PSI
110-220 PSI FOR > 90 SEC
Amber Band. . . . . 110-220 PSI
Green Band . . . . 36-110 PSI
Amber Band. . . . . 20-36 PSI
0-20 PSI FOR <20 SEC
Red Band (Min) . . . . 0-20 PSI FOR ≥20 SEC

Standby Engine Indicators

> ***NOTE:*** On the standby engine indicators, the LED display flashes to signal an exceedance.

Left and Right N_1 RPM Display

Exceedance Limit . . . . >106% RPM
105-106% RPM FOR ≥20 SEC

Left and Right N_2 RPM Display

Exceedance Limit . . . . >106% RPM
105-106% RPM FOR ≥20 SEC

Left and Right Inter-Turbine Temperature Display

Exceedance Limit
- Engine Start . . . . >950°C
- Engine Running . . . . >920°C
920-950°C FOR 20 SEC

Other Instruments

Airspeed Indicator

Red Line . . . . 305 KIAS/MACH 0.80
270 KIAS (BELOW 8,000 FT.)

Aileron Trim Display

Green Range (on ground only)	±3.3° TRAVEL

APU Ammeter

Red Line	275 AMPS

Brake and Gear Pneumatic Pressure Indicator

Per Placard According to Temperature

Cabin Differential Pressure Indicator

Green Arc	0.0-9.3 PSI
Red Line	9.7 PSI

Fuel Quantity Digital Indication

Wing Tanks:

Amber	<500 POUNDS

Total:

Amber	<1,000 POUNDS

Hydraulic Pressure Digital Display

Green Range	>2,200 PSI TO <3,800 PSI
Amber Range	-100 PSI TO 2,200 PSI 3,800 PSI TO 4,000 PSI

Hydraulic Reservoir Volume Display

Green Range	120-700 CU IN
Amber Range	<120 CU IN

Left and Right Electrical Systems Generator Voltage Digital Display

Green Range	23-29 VOLTS
Amber Range	<23 VOLTS, >29 VOLTS

Generator Current Digital Display

On Ground:

Green Range	-20 AMPS TO 300 AMPS
Amber Range	≥300 AMPS

In Air:

Green Range	-20 AMPS TO 300 AMPS ≤ FL350 -20 AMPS TO 275 AMPS > FL350
Amber Range	≥300 AMPS ≤FL350 ≥275 AMPS > FL350

Battery Temperature Digital Display

Green Range	-20°C TO 63°C
Amber Range	<-20°C
Red Range	>63°C

Battery Voltage Digital Display

Green Range . . . . 23-29 VOLTS

Amber Range . . . . <23 VOLTS, >29 VOLTS

Battery Current Digital Display

Green Range . . . . -195 AMPS TO 195 AMPS

Amber Range . . . . ≤-200 AMPS, ≥200 AMPS

Nosewheel Steering Accumulator Pressure Indicator

Per Placard According to Temperature

Oxygen Pressure Indicator

Green Arc . . . . 1,600-1,800 PSI

Amber Arc . . . . 0-400 PSI

Red Line . . . . 2,000 PSI

Rudder Trim Display

Green Range (on ground only) . . . . ±1° TRAVEL

Speedbrake Display

White Display . . . . PANELS DEPLOYED AS COMMANDED

Amber Display . . . . SENSOR FAULT OR PANEL POSITION DOES NOT MATCH HANDLE POSITION

Stabilizer Trim Display

Green Range Takeoff Band (on ground only) . . . . -2° TO -5.1° TRAVEL

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3

Operating Procedures

This section presents four individual elements of flight operations: Preflight Inspection, Expanded Normal Procedures, Standard Operating Procedures (SOPs), and Maneuvers. Although they are addressed individually in this manual, their smooth integration is critical to ensuring safe, efficient operations.

The **Preflight Inspection** chapter illustrates a step-by-step exterior inspection of the aircraft. Preflight cockpit and cabin checks are also discussed.

The **Expanded Normal Procedures** chapter presents checklists for normal phases of flight. Each item, when appropriate, is expanded to include limitations, cautions, warnings, and light indications.

The **Standard Operating Procedures** chapter details Pilot Flying/Pilot Not Flying callouts and verbal or physical responses.

The **Maneuvers** chapter pictorially illustrates common and emergency profiles. Additionally, written descriptions are included for most phases of flight with one or both engines operating.

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4

Preflight Inspection

Contents

Preflight Inspection

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Preflight Inspection

An essential part of the preparations made before any flight is the preflight inspection. During this inspection, the aircraft's physical readiness is verified. A thorough initial preflight is a later benefit in that subsequent inspections later that day can be carried out in less time.

No detail should be overlooked during the first preflight of the day. Abnormal conditions (e.g., low tire pressure) must be corrected prior to flight. Even minor discrepancies should be rectified prior to flight to ensure safety.

The preflight inspection begins inside the aircraft where the initial cockpit setup and essential functions are verified. The actual exterior inspection follows; it begins at the left side of the nose, proceeds clockwise around the aircraft, and ends at the left wing root. The pilot then returns to the interior of the aircraft to check the passenger compartment and cockpit for readiness.

Preliminary Exterior Inspection

Engine/Pitot/APU Covers . . . . REMOVED

Batteries (left and right) . . . . CONNECTED

APU Inlets and Exhaust. . . . . CLEAR

APU Oil Level (if APU will be started prior to
conducting Exterior Inspection) . . . . CHECK

APU Oil Test Switch. . . . . LAMP TEST, VERIFY LOW OIL LIGHT (AND ADD OIL LIGHT IF SB680-49-05 NOT INCORPORATED) ILLUMINATES

APU Oil Test Switch. . . . . PRE FLT

- If no lights are illuminated, the APU may be operated. The oil level is full.
- If the amber LOW OIL light is illuminated, the APU may be operated but should be serviced at the next available opportunity (within a maximum of 20 hours of APU operation).
- If the red ADD OIL light is illuminated (not applicable if SB680-49-05 has been incorporated), the APU may not be operated prior to servicing the APU.

END

Cockpit/Cabin Inspection

Documents . . . . CHECK ABOARD

- To be displayed in aircraft at all times:
  - Airworthiness and Registration Certificates.
  - Transmitter License(s) (as required).
- To be carried in the aircraft at all times:
  - FAA Approved Aircraft Flight Manual.
  - Honeywell PRIMUS EPIC Integrated Avionics System Pilot's Guide for the Cessna Citation Sovereign.
  - Honeywell PRIMUS EPIC Flight Management System (FMS) Pilot's Guide for the Cessna Citation Sovereign.
  - Other applicable pilot's manuals as required in Section II, Operating Limitations or applicable AFM Supplement(s).
  - First Aid Kit(s).

Cabin . . . . CHECK

Main Gear Uplock Release Handle (aft cabin) . . . . STOWED

Water Barrier . . . . STOWED ON BOARD

Emergency Exit . . . . SECURE/CLEAR/LOCK PIN REMOVED/COVER IN PLACE

Life Vests (if required) . . . . STOWED ON BOARD

Seats/Belts . . . . CONDITION

Cabin Fire Extinguisher . . . . SERVICED/SECURE

Circuit Breakers . . . . .IN

Throttles. . . . . CUTOFF

FLAP Selector . . . . .AGREES WITH FLAP POSITION

Portable Fire Extinguisher (under copilot's seat). . . . . SERVICED/SECURE

BATT Buttons (both) . . . . .ON

EICAS Button . . . . .ON

Battery Voltage . . . . CHECK, 24 VOLTS MINIMUM

LANDING GEAR Handle . . . . DOWN, CONFIRM 3 GREEN LIGHTS

Power Source (external power or APU, if desired)

External Power:

AVAIL Light . . . . .ILLUMINATED

EXT PWR Button . . . . .ON

APU Generator:

APU . . . . .TEST/START

REFER TO NORMAL PROCEDURES, "APU GROUND OR IN-FLIGHT START (AT OR BELOW FL200)"

APU SYSTEM GENERATOR Button. . . . . .ON

APU SYSTEM BLEED AIR Button . . . . AS DESIRED

WARNING
Operation with APU bleed air on with the cabin door closed will result in a slight positive pressure in the aircraft. To avoid potential injury to persons or damage to the cabin door, APU bleed air should be turned off or a cockpit side window opened prior to opening the cabin door.

CAUTION
The APU is not approved for unattended ground operation..

BUS TIE Button . . . . VERIFY CLOSED

Oxygen System . . . . CHECK

Smoke Goggles . . . . STOWED

Masks TEST/STOWED/100%

Oxygen Pressure . . . . CHECK PER TABLE

TEMP (°F)	-40	0	70	100	120
PRESS (PSI)	1290	1475	1800	1940	2075

PASS OXY Selector. . . . . AUTO

AVN Buttons (both) . . . . ON

Stabilizer Trim . . . . VERIFY SET TO 6.9°

Speedbrakes . . . . CHECK INDICATION

Fuel Quantity and Balance . . . . CHECK

Hydraulic Quantity . . . . CHECK, 120 TO 700 CU IN

Anti-Ice PITOT/STATIC Buttons (both) . . . . ON/CHECK PITOT STATIC
COLD L AND/OR R AND/OR STBY MESSAGE CLEARED/OFF

AVN Buttons (both) . . . . OFF

Exterior/Interior/Emergency Lights . . . . . . ON/CHECK/OFF OR AS REQUIRED

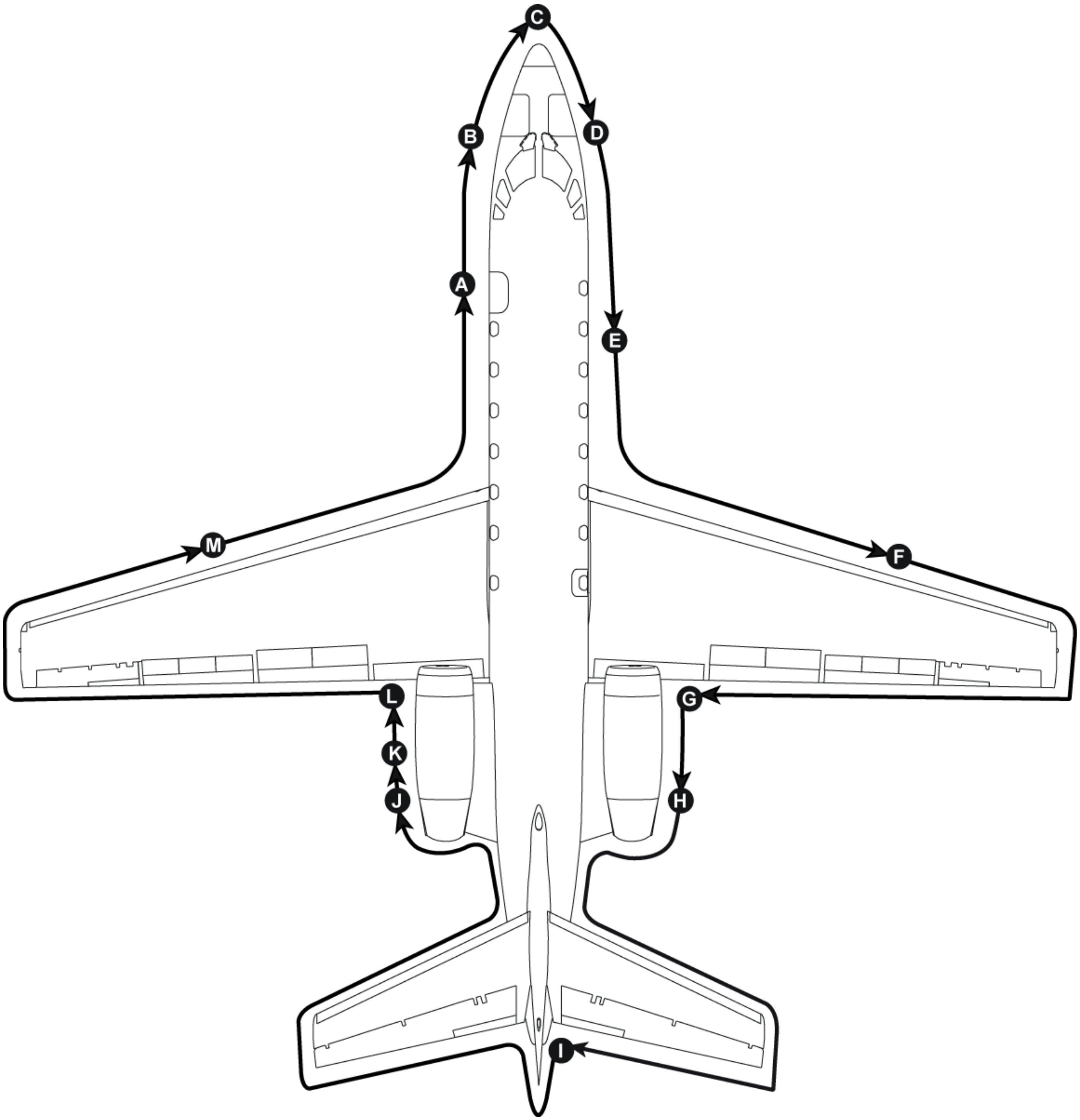
BATT Buttons (both)

If External Power and/or APU Generator ON . . . . ON

If no External Power and APU Generator OFF . . . . OFF

END

Exterior Inspection Walkaround



Exterior Inspection

In cold weather (below -10°C (+14°F) and/or icing conditions), refer to AFM, Section III, Operating Information, “Extreme Cold Weather Operations” and AFM, Section VII, Advisory Information, “Deicing Procedures.” Give particular attention to engine inlets, fan blades, wheel wells and wing trailing edge (forward of flaps), for ice/slush from previous landing.

During inspection, make a general check for security, condition, and cleanliness of the aircraft and components. Check particularly for damage, fuel, oil and hydraulic leakage, security of access panels and doors, and removal of keys from locks.


1


2


3


4

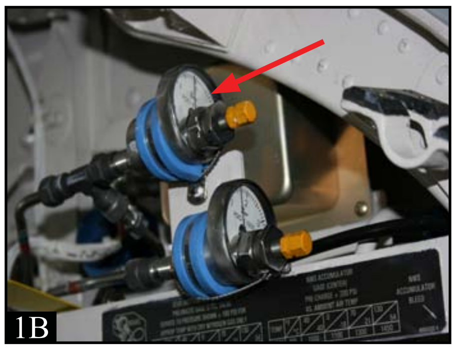

5

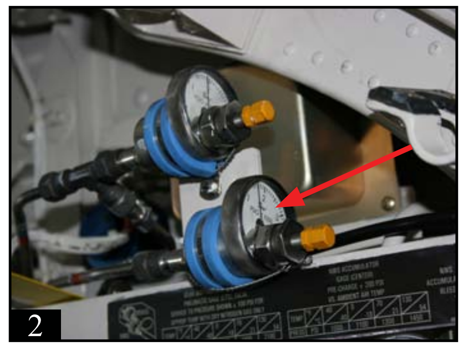
A. Left Forward Fuselage

1. **ACM Inlet (bottom of vertical fin):** Check if clear (can be viewed from standing on top of stairs).
2. **Cabin Door and Seals:** Check door seal for cuts or abrasion.
3. **AOA Probe:** Carefully check vane for heating and ease of range of rotation.
4. **Static Ports:** Inspect the ports and ensure they are clear and warm. Since it is difficult to feel heat from the static port, run the back of a finger from the aircraft skin onto the port to feel the temperature difference.
5. **Pitot Tube:** Check for warmth and that it is clear of obstructions.

WARNING
Pitot tubes and AOA probes may still be hot.

1A


1B


2


3


4

B. Left Nose Compartment

1. **Emergency Gear (1A) and Brake Pressures (1B):** Check pressures per placard.
2. **Nosewheel Steering Accumulator Pressure:** Check per placard, bleed to precharge if required.
3. **Static Drain:** Ensure the drain is closed.
4. **Nose Compartment Door:** Ensure door is firmly closed and latched.


1


2


3


4


5

C. Nose Gear

1. **Taxi Lights:** Check the taxi lights for condition and security.
2. **Wheels/Tires/Strut:** Nose strut extension should be between 2.9 and 6.5 inches (depending on aircraft weight and center-of-gravity). Ensure scissors pin is installed. Check tires for damage or excessive wear. Check general condition of tires.
3. **Wheel Well:** Check for general condition and no hydraulic leaks.
4. **Gear Doors:** Examine the door for security. The linkage is overcenter when the upper portion of the door pushrod is pointing slightly outboard and the flat lower end of the linkage assembly is against the stop bolt on each side of the nose wheel well.
5. **Radome:** Check the radome for secure attachment.

1

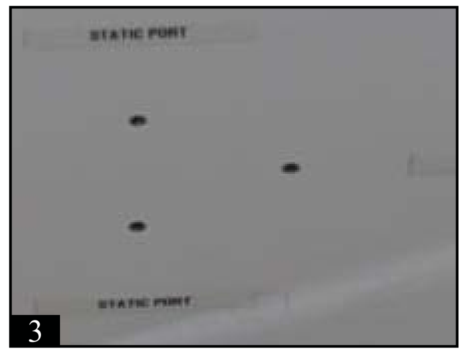
2

D. Right Nose Compartment

1. **Static Drain:** Ensure the drain is closed.
2. **Nose Compartment Door:** Ensure door is firmly closed and latched.


1


EMERGENCY
PNEUMATIC
BRAKE VENT
2


STATIC PORT
STATIC PORT
3


4


5


6

E. Right Forward Fuselage

1. **Pitot Tube:** Check that tube is clear and warm.
2. **Drain Lines:** Check that drain lines are clear.
3. **Static Ports:** Inspect the ports and ensure they are clear and warm. Since it is difficult to feel heat from the static port, run the back of a finger from the aircraft skin onto the port to feel the temperature difference.
4. **Standby Pitot Tube:** Check for warmth and that it is clear of obstructions.
5. **AOA Probe:** Carefully check vane for heating and ease of range of rotation.
6. **Oxygen Service Door:** Ensure door is firmly closed and latched.

7

8


9

10


11A


11B


12

E. Right Forward Fuselage (Contd)

7. **Oxygen Blowout Disc:** Ensure that green disc is in place. If disc is missing, oxygen bottle may be empty.
8. **Single-Point Fuel Door:** Check the single point refueling cap for proper attachment. Ensure the pre-check valves are in the correct position. Close and lock the door.
9. **Fairing Vents (3):** Ensure the vents are clear.
10. **Fuel Quick Drains (3):** Check that the drain lines are not leaking fuel.
11. **Upper (11B) and Lower (11A) Antennas:** Check antennas for condition and security.
12. **Drain Masts:** Check the condition of the drains and that they are clear of obstructions.

WARNING
Pitot tubes and AOA probes may still be hot.

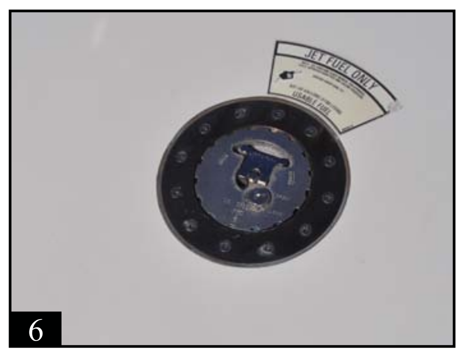

1

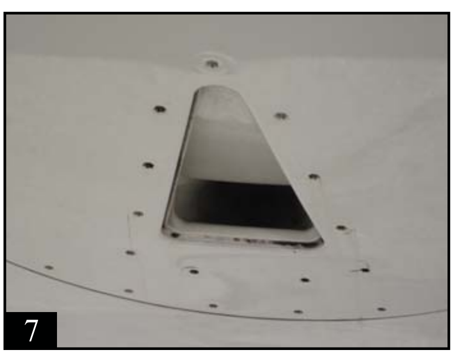

2


OPEN
3


4


5


JET FUEL ONLY
USABLE FUEL
6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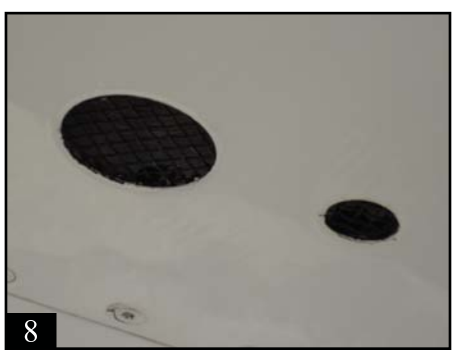
8


9

F. Right Wing

1. **Landing/Recognition Lights:** Check lenses for cracks and integrity.
2. **Engine and Generator Inlet Duct and Fan:** Check the engine air inlet for any obstructions. Check fan blades for any signs of damage.
3. **Emergency Exit:** Ensure that the door and handle are flush with the fuselage skin.
4. **Wing Leading Edge:** Check condition.
5. **Boundary Layer Energizers (9):** Check the condition of the boundary layer energizers.
6. **Fuel Filler Cap:** Inspect the filler cap for security.
7. **Fuel Tank Vent Inlet Scoop:** Ensure that the vents are clear.
8. **Fuel Tank Pressure Relief Valve:** Check and ensure no leaks.
9. **Navigation/Anticollision Lights:** Check that the glass is clean and not cracked.

continued on next page


10


11A


11B


11C


12A


12B

continued from previous page

F. Right Wing (Contd)

10. **Static Wicks (4):** Check for condition and security. Missing static wicks allow static buildup which interferes with communications. At least 3 of 4 are required.
11. **Aileron/Flaps/Spoilers/Trailing Edge:** Ensure the aileron (11A) has freedom of movement and hinge points are secure. Check the flaps (11B) and spoilers (11C) for security. Note that flaps are in same position as the indicator in the cockpit.
12. **Main Landing Gear Door/Wheels/Tires/ Brakes/Strut/Wheel Well (12B):** Examine the door for security. Check the wheel hubcap for condition and security. Inspect gear for general security and fluid leakage.
    - Strut extension should be 2.0 to 4.9 inches. Check for tire wear (no cord may show) for general condition.
    - Check brake wear indicators on top and bottom of both brake housings (12A).


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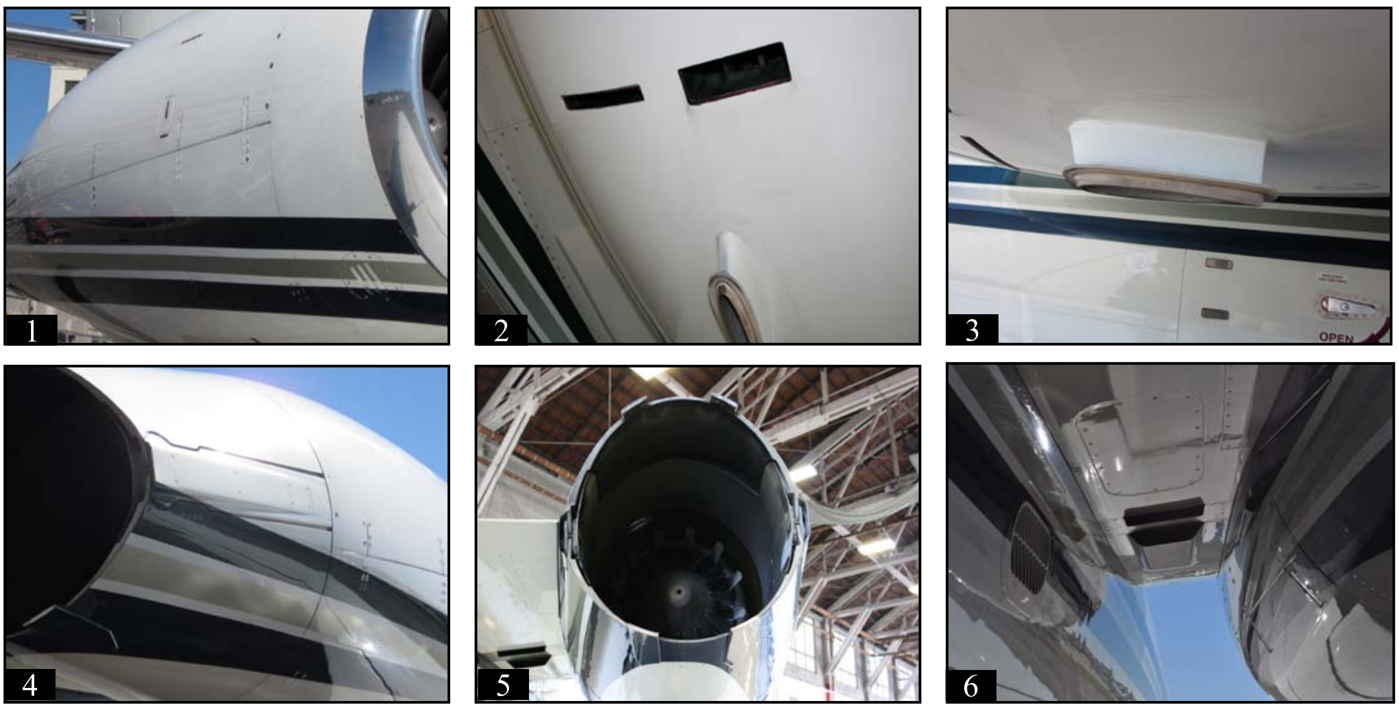
G. Right Aft Fuselage

1. **Vents:** Ensure that vents are clear.
2. **Antennas:** Check antennas for condition and security.
3. **External Power Receptacle Door (unless in use):** Close and lock the access door.
4. **Toilet Service Door:** Check that door is secure.
5. **Battery Compartment Door:** Check that door is secure.
6. **Hydraulic Reservoir Accumulator Pressure:** Check pressure per placard.
7. **Hydraulic Service Door:** Check that door is secure.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H. Right Nacelle/Pylon

1. **Cowling:** Examine cowling for signs of any fuel, oil, or hydraulic fluid leaks. Check that the latches are secure.
2. **Generator/Alternator Cooling Air Exhaust:** Ensure that the generator and alternator air exhaust openings are clear. Verify cooling inlets are free of obstructions.
3. **Drain Lines:** Ensure the drain lines are clear. Check for leaks.
4. **Thrust Reversers:** Ensure the thrust reversers are stowed. Check for cracks, damage, and general security.
5. **Engine Exhaust/Bypass Ducts:** Check for leakage, damage to turbine blades, cracks, and general security.
6. **Precooler Exhaust Duct:** Check that the duct is free of obstructions.

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I. Empennage

1. **ACM Heat Exchanger Exhaust:** Exhaust should be free of obstructions.
2. **Tailcone Positive Pressure Inlet:** Check that inlet is clear.
3. **APU Oil Level:** Check for correct level and secure door.

   APU Oil Test Switch. . . . . LAMP TEST, VERIFY LOW OIL LIGHT (AND ADD OIL LIGHT IF SB680-49-05 NOT INCORPORATED) ILLUMINATES

   APU Oil Test Switch. . . . . PRE FLT

   - (1) If no lights are illuminated, the APU may be operated. The oil level is full.
   - If the amber LOW OIL light is illuminated, the APU may be operated but should be serviced at the next available opportunity (within a maximum of 20 hours of APU operation.

   If the red ADD OIL light is illuminated (not applicable if SB680-49-05 has been incorporated), the APU may not be operated prior to servicing the APU.
4. **APU Drain:** Check drain for leaks.
5. **Tailcone Door:** Ensure door is closed and secure.
6. **Elevators/Tabs:** Check the elevator position and condition. Check hinge points for security (tabs full deflection, trailing edge down).

continued on next page


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continued from previous page

I. Empennage (Contd)

7. **APU Inlets and Exhaust:** Ensure that the inlets and exhaust of APU are clear.

CAUTION
The trailing edge of the elevator trim tab should be approximately 1 inch below the trailing edge of the elevator control surface when the stabilizer trim is set to -6.9°.

8. **Vortex Generators (44):** Observe that there are 44 vortex generators;

   Vertical Stabilizer . . . . AT LEAST 6 OF 8 REQUIRED
   APU Fairing . . . . AT LEAST 6 OF 8 REQUIRED
   Rudder . . . . AT LEAST 16 OF 24 REQUIRED
   Wiper Fairing . . . . .NONE OF 4 REQUIRED

9. **Static Wicks (9):** Observe that there are 9 static wicks;

   Rudder . . . . AT LEAST 2 OF 3 REQUIRED
   Right Elevator . . . . AT LEAST 2 OF 3 REQUIRED
   Left Elevator . . . . AT LEAST 2 OF 3 REQUIRED

10. **Rudder and Tab:** Check the general condition of the rudder and rudder tab.
11. **Aft Position Light:** Check the position lights for condition and security.
12. **Horizontal Stabilizer:** Ensure that the leading edge of the horizontal stabilizer agrees with the trim position by noting the position marks on the left side of the fuselage, forward of the horizontal stabilizer.
13. **APU Service Door:** Ensure door is secure.


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OPEN

J. Baggage Compartment

1. **Baggage:** Ensure baggage is strapped securely.
2. **Baggage Light:** Switch light off.
3. **Baggage Seal/Door:** Check seal for cuts and excessive wear. Secure the door.

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K. Left Aft Fuselage

1. **Battery Compartment Door:** Ensure battery is connected and door is secure.


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L. Left Nacelle/Pylon

1. **Precooler Exhaust Duct:** Check that the exhaust is clear.
2. **Engine Exhaust/Bypass Ducts:** Check for leakage, damage to turbine blades, cracks, and general security.
3. **Thrust Reversers:** Ensure the thrust reversers are stowed. Check for cracks, damage, and general security.
4. **Drain Lines:** Ensure the drain lines are clear. Check for leaks.
5. **Generator/Alternator Cooling Air Exhaust:** Ensure that the generator and alternator air exhaust openings are clear. Verify cooling inlets are free of obstructions.
6. **Cowling:** Examine cowling for signs of any fuel, oil, or hydraulic fluid leaks. Check that the latches are secure.


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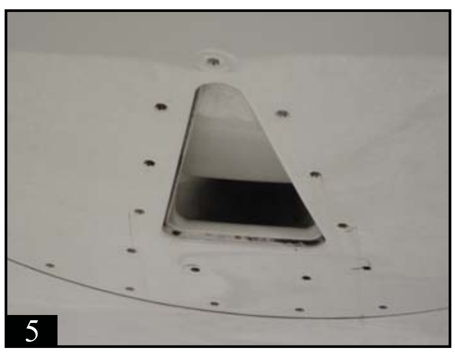
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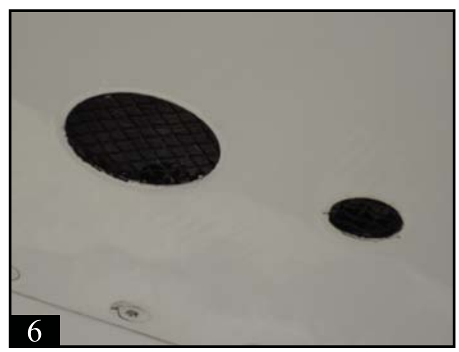
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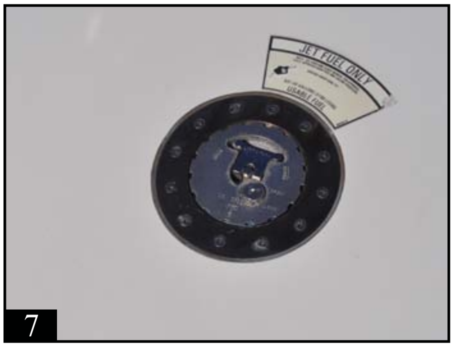
M. Left Wing

1. **Main Landing Gear Door/Wheels/Tires/ Brakes/Strut/Wheel Well:** Examine the door for security. Check the wheel hubcap for condition and security. Inspect gear for general security and fluid leakage. Strut extension should be 2.0 to 4.9 inches. Check tire wear (no cord may show) and general condition.
2. **Ailerons/Flaps/Spoilers/Trailing Edge:** Ensure the aileron has freedom of movement and hinge points are secure. Check the flaps and spoilers for security. Note that flaps are in same position as the indicator in the cockpit.
3. **Static Wicks (4):** Check for condition and security. Missing static wicks allow static buildup which interferes with communications. At least 3 of 4 required.
4. **Navigation/Anticollision Lights:** Check that the glass is clean and not cracked.
5. **Fuel Tank Vent Inlet Scoop:** Ensure inlet is clear of obstruction.
6. **Fuel Tank Pressure Relief Valve:** Ensure the valve is closed and there are no leaks.



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M. Left Wing (Contd)

7. **Fuel Filler Cap:** Inspect the filler cap for security.
8. **Boundary Layer Energizers (9):** Check condition.
9. **Wing Leading Edge:** Check condition.
10. **Landing/Recognition Lights:** Check lenses for cracks and integrity.
11. **Fuel Quick Drains (3):** Check as on right wing.
12. **Fairing Vents (2):** Ensure vents are clear.
13. **Engine and Generator Inlet Duct and Fan:** Check the engine and generator air inlet for any obstruction. Check fan blades for any signs of damage.

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5

Expanded Normal Procedures

Contents

Normal Procedures

Cockpit Preparation

1. Preflight Inspection . . . . COMPLETE

   Items of this checklist which were checked as part of the preflight inspection need not be rechecked.
2. STBY PWR Switch . . . . .TEST/ON
   a. TEST and Hold (verify green light remains on for at least 10 seconds)
   b. ON (Allow standby flight display (SFD) to complete initialization (approximately 3 minutes) before starting APU or aircraft engines.)
3. EMER LTS Switch . . . . ARM

   Check that all interior emergency lights are illuminated.
4. BATT Buttons (both) . . . . .ON
5. EICAS Button . . . . .ON
6. Battery Voltage . . . . CHECK (24V DC MIN)
7. LANDING GEAR Handle . . . . DOWN (3 GREEN)
8. EXT PWR/APU . . . . ON/START

   External Power or APU Generator, if not already available, is recommended for engine start.
   a. External Power
      1) AVAIL LIGHT . . . . .ILLUMINATED
      2) EXT PWR Button . . . . .ON
   b. APU Generator
      1) APU . . . . .TEST/START

         Refer to APU GROUND OR IN-FLIGHT START (AT OR BELOW FL200), page 5-27.
      2) APU SYSTEM GENERATOR Button. . . . . .ON
      3) APU SYSTEM BLEED AIR Button. . . . . AS DESIRED

WARNING

Operation with APU bleed air on with the cabin door closed will result in a slight positive pressure in the aircraft. To avoid potential injury to persons or damage to the cabin door, APU bleed air should be turned off or a cockpit side window opened prior to opening the cabin door.

CAUTION

The APU is not approved for unattended ground operation.

9. BUS TIE Button . . . . VERIFY PROPER INDICATION
   a. Battery Power Only . . . . OPEN
   b. APU Generator and External Power ON . . . . OPEN
   c. APU Generator or External Power ON . . . . CLOSED
10. Battery AMPS . . . . CHECK

Verify both batteries are charging (with APU generator ON and/or external power connected).

11. Cockpit Switches . . . . CHECK/SET
    a. Left MIC SEL HEADSET/MASK Button. . . . . HEADSET
    b. STBY SLAVE Switch (N/A if IRS equipped). . . . . AUTO
    c. L AHRS SLAVE Switch (N/A if IRS equipped) . . . . AUTO
    d. FUEL BOOST Buttons (both). . . . . NORM
    e. FUEL CROSSFEED Selector . . . . .OFF
    f. IGNITION Switches (both). . . . . NORM
    g. FADEC SELECT A/B Buttons (both) . . . . A OR B ILLUMINATED
    h. HYDRAULIC PUMP AUX Button . . . . .OFF
    i. HYDRAULIC PUMP ENG Buttons (both) . . . . .ON
    j. AVN Buttons (both) . . . . .ON
    k. ELEC Buttons (both) . . . . NORM
    l. INTERIOR Button
        1) External Power or APU Generator. . . . . NORM
        2) Battery Power Only . . . . .OFF
    m. GEN Switches (both) . . . . .ON
    n. SECONDARY TRIM Button. . . . . .OFF
    o. RUDDER BIAS Button. . . . . NORM
    p. ENGINE SYNC Button. . . . . NORM
    q. PITCH/ROLL RECONNECT Handle . . . . .NORM/DOWN
    r. ANTI-SKID Switch . . . . .ON
    s. LANDING GEAR BLOWDOWN Handle . . . . .IN
    t. NG UPLOCK Handle . . . . STOWED
    u. ANTI-ICE Buttons
        1) PITOT STATIC Buttons (both) . . . . .OFF
        2) WING INSP LTS Button. . . . . .OFF
        3) ENGINE/STAB Buttons (both) . . . . .OFF
        4) W/S FAN Button. . . . . .OFF
        5) WING Buttons (both) . . . . .OFF
        6) WING/STAB XFLOW Button . . . . .OFF
    v. CABIN DUMP Button. . . . . NORM
    w. CABIN PRESS MODE Buttons
        1) NORM/ALT SEL. . . . . NORM
        2) AUTO/MAN . . . . AUTO
    x. RECIRC AIR Buttons
        1) CKPT NORM/OFF . . . . AS DESIRED
        2) CABIN NORM/HI . . . . AS DESIRED
    y. BAGGAGE HEAT NORM/OFF Button. . . . . NORM
    z. CABIN TEMP CONTROL
       COCKPIT/CABIN Button . . . . AS DESIRED
    aa. CKPT TEMP SEL Knob . . . . AS DESIRED

ab. CABIN TEMP SEL Knob . . . . AS DESIRED
ac. L ENG BLD AIR Selector . . . . NORM
ad. PRESS SOURCE Selector . . . . NORM
ae. R ENG BLD AIR Selector . . . . NORM
af. R AHRS SLAVE Switch (N/A if IRS installed) . . . . AUTO
ag. Right MIC SEL HEADSET/MASK Button . . . . HEADSET
ah. APU SYSTEM MASTER Button (if APU not running) . . . . OFF

12. Cockpit Voice Recorder . . . . TEST

Press and hold the TEST button for five (5) seconds. Observe either a green PASS indicator, or red FAULT indicator.

13. Stabilizer Trim (do not check individual halves of trim switches for more than 20 seconds) . . . . CHECK/SET FOR TAKEOFF

a. SECONDARY TRIM Button . . . . ON

Verify amber ON illuminates in button, and amber **PRIMARY STAB TRIM FAIL** and **AP STAB TRIM INOP** messages display on EICAS.

b. SECONDARY TRIM Switch . . . . CHECK

Push both halves of the secondary trim switches nose down, and verify proper stabilizer trim movement on the EICAS. Repeat in the opposite direction. Push the left half of the secondary trim switch up and down, and verify no stabilizer trim movement. Repeat for the right half of the secondary trim switch.

1) The trim clacker sounds if secondary trim is activated for more than 1 second.

2) The amber **SECONDARY STAB TRIM FAIL** message will display while actuating one half of the trim switch. This message will display in one direction only on one half of the SECONDARY TRIM switch and in the opposite direction on the other half of the SECONDARY TRIM switch. Verify message clears when SECONDARY TRIM switch is released.

c. SECONDARY TRIM Button . . . . OFF

A white OFF illuminates in the button. The amber **AP STAB TRIM INOP** message clears.

d. PRIMARY TRIM . . . . CHECK

NOTE:	Do not make rapid primary trim reversals when setting stabilizer trim.

1) Pilot Stab Trim Up Down Switch . . . . .Push both halves of pilot's control wheel trim switch down and verify proper stabilizer trim movement on the EICAS display. While trimming, push and hold the AP/TRIM/NWS DISC button and verify trimming stops. Repeat in the opposite direction. Verify the amber **PRIMARY STAB TRIM FAIL** message clears. Push the left half of the PRIMARY TRIM switch up and down and verify no stabilizer movement. Repeat for the right half of the PRIMARY TRIM switch.

2) Copilot Stab Trim Up Down Switch . . . . .Push both halves of copilot's control wheel trim switch down and verify proper stabilizer trim movement on the EICAS display. While trimming, push and hold the AP/TRIM/NWS DISC button and verify trimming stops. Repeat in the opposite direction. Verify the amber **PRIMARY STAB TRIM FAIL** message clears. Push the left half of the PRIMARY TRIM switch up and down and verify no stabilizer movement. Repeat for the right half of the PRIMARY TRIM switch.

e. Stab Trim . . . . SET FOR TAKEOFF

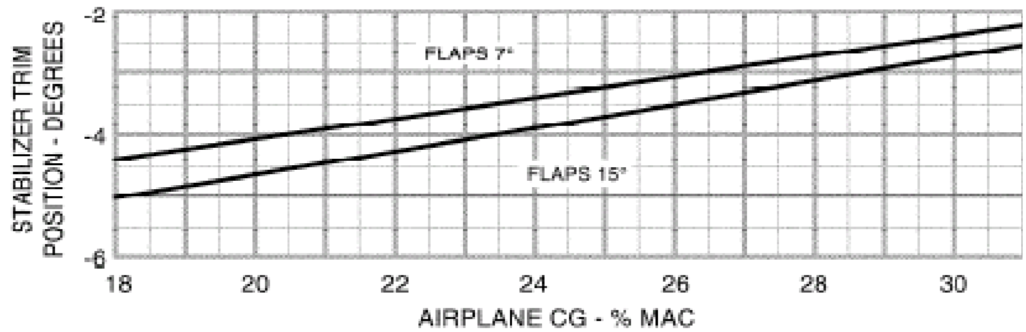

Figure 5-1: Horizontal Stabilizer Position for Takeoff

14. Aileron and Rudder Trim . . . . CHECK/SET FOR TAKEOFF
   a. AILERON TRIM Switch . . . . .Push upper half of aileron trim switch (left aileron trim tab) and verify proper aileron trim tab movement on the EICAS display.
   b. AILERON TRIM Switch . . . . Push lower half of aileron trim switch (right aileron trim tab) and verify there is no aileron trim tab movement on the EICAS display.
   c. RH AILERON TRIM DISPLAY Button . . . . Push and Hold while performing the next step.
   d. AILERON TRIM Switch . . . . Push lower half of aileron trim switch (right aileron trim tab) and verify proper aileron trim tab movement on the EICAS display.
   e. AILERON TRIM Switch . . . . Reset Both Trim Tabs to neutral as indicated on the EICAS display.
   f. RUDDER TRIM Knob . . . . Turn and verify proper rudder trim tab movement on the EICAS display.
   g. RUDDER TRIM Knob . . . . Reset rudder trim to neutral as indicated on the EICAS display.
15. Warning Systems. . . . . CHECK/OFF

   Rotate the knob to each system test position as follows:
   a. SMOKE/DET - Tests both smoke detectors, internal fans, and ability to post warning messages:
      1) Red **BAGGAGE FIRE** message displays.
      2) Both MASTER WARNING lights (flashing) illuminate.
      3) Red BAGGAGE FIRE and white SEC BAG BOTTLE lights illuminate.
      4) "Baggage Fire" aural sounds (repeats 3 times).

b. LDG GR - Tests landing gear control module 2:
   1) Green LH, NO, and RH downlock indicators illuminate.
   2) Red UNLOCK indicator illuminates.
   3) Gear warning horn sounds.

c. FIRE WARN - Tests the detection loop continuity of both engine fire loop systems and their ability to post messages:
   1) Both MASTER WARNING lights (flashing) and MASTER CAUTION lights (steady) illuminate.
   2) Red LH ENG FIRE and RH ENG FIRE lights illuminate.
   3) Red **ENGINE FIRE L** and **R** message displays.
   4) Amber **ENGINE FIRE DETECT FAIL L** and **R** message displays.
   5) "Left Engine Fire, Right Engine Fire" aural (repeats twice) and single chime sounds. Pressing MASTER WARNING and MASTER CAUTION buttons cancels aural warnings.

d. STAB TRIM - Tests the stabilizer trim system.
   1) Both MASTER CAUTION lights illuminate and a single chime sounds.
   2) Amber **STAB TRIM MONITOR WARNING** message displays.
   3) If conducted 2 minutes or more after avionics power is selected on, the amber **PRIMARY STAB TRIM FAIL** and **AP STAB TRIM INOP** messages will display.

e. FLAP - Tests the flap controller and its fault monitoring system.
   1) Both MASTER CAUTION lights illuminate and a single chime sounds.
   2) Amber **FLAPS FAIL** message displays and then clears within 6 seconds.
   3) Flap EICAS indicator turns amber then back to white within 6 seconds.
   4) Amber FLAP RESET indicator on the center pedestal illuminates then extinguishes within 6 seconds.

f. W/S TEMP - Tests the windshield sensors.
   1) Both MASTER CAUTION lights illuminate and a single chime sounds.
   2) Amber **WINDSHIELD OVERTEMP L** and **R** message displays, followed by the amber **WINDSHIELD HEAT INOP L** and **R** message. After 1 second, **WINDSHIELD OVERTEMP L** and **R** message clears. **WINDSHIELD HEAT INOP L** and **R** message remains until the test selector is moved.

g. OVER SPD - Tests the air data and overspeed indications.
   1) Overspeed warning horn sounds.
   2) Both PFDs display the following:
      - Mach 0.800
      - IAS 270 knots
      - Red barber pole on airspeed indicator
      - Red ADC TEST indication
      - VSI +5000 FPM

- Altitude 1,000 feet
- Barometric setting 29.88
- Airspeed and altitude trend vectors visible

h. AOA - Tests the stall warning angle-of-attack transducer, stick shaker, and approach indexers.
   1) Amber **TEST** appears in the AOA window.
   2) Left stick shaker activates independently and stops.
   3) Right stick shaker activates independently and stops.
   4) Both left and right stick shakers activate together and stop.
   5) AOA indexer lights sequence as the stick shakers activate.
   6) AOA pointers on both PFDs move up and down the scale as the stick shakers activate.
   7) Amber **TEST** message extinguishes, a red **X** appears over the AOA scale and dashes replace the digits on both PFDs.
   8) AOA indications return to normal after 2 seconds.

i. ANNUN - Tests the following warning lights:
   1) Both white BOTTLE 1 ARMED and BOTTLE 2 ARMED lights illuminate.
   2) Red **STAB NO TAKEOFF**, **GEN OFF**, **OIL PRESSURE L** and **R**, and amber **FUEL LEVEL LOW L** and **R** standby messages above the standby flight display illuminate.
   3) Two red O_2 SYSTEM PRESS LOW lights illuminate (optional extended range O_2 system only).

j. BLD LK DET - Tests loop continuity of all six bleed air zones and the capability to post messages.
   1) Both MASTER CAUTION lights illuminate and a single chime sounds.
   2) Amber **SUPPLY BLEED LEAK L** and **R**, **WING BLEED LEAK L** and **R**, **STAB BLEED LEAK**, and **ACM BLEED LEAK** messages display.

k. SPARE - Reserved for future use.

l. OFF - Test functions are off.

16. AVN Buttons (both), if on Battery Power Only or OAT < 0°C (+32°F) . . . . OFF
17. FUEL CROSSFEED Selector . . . . CHECK/OFF

a. FUEL CROSSFEED Selector . . . . CHECK

   Select crossfeed in either direction. Verify the **FUEL CROSSFEED** and selected tank's cyan **FUEL BOOST PUMP ON** message is displayed.

   (1). The **FUEL CROSSFEED** message may be either cyan (correcting an imbalance) or amber (aggravating an imbalance of more than 60 pounds).

b. FUEL CROSSFEED Selector . . . . .OFF

Verify the **FUEL CROSSFEED** and cyan **FUEL BOOST PUMP ON L** and **R** messages are cleared.

(1). If the APU is running, the cyan **FUEL BOOST PUMP ON R** message will remain displayed on EICAS when the FUEL CROSSFEED selector is selected to OFF.

END

Delay Before Flight Without APU/External Power

1. STBY PWR Switch . . . . .OFF
2. EMER LTS Switch . . . . .OFF
3. BATT Buttons (both) . . . . .OFF

END

Before Start

1. If Start was Delayed Without APU or External Power:

a. STBY PWR Switch . . . . .ON

Allow the SFD to complete its initialization (approximately 3 minutes) before starting the APU or aircraft engines.

b. EMER LTS Switch . . . . .ON

c. BATT Buttons (both) . . . . .ON

d. ELEC Buttons (both) . . . . VERIFY NORM

e. EXT PWR/APU . . . . ON/START

External Power or APU Generator, if not already available, is recommended for engine start.

1) External Power

a) AVAIL Light. . . . . .ILLUMINATED

b) EMER LTS Switch . . . . ARM

2) APU Generator

a) APU . . . . .TEST/START

Refer to APU GROUND OR IN-FLIGHT START (AT OR BELOW FL200), page 5-27.

b) APU SYSTEM GENERATOR Button. .ON

c) APU SYSTEM BLEED AIR Button. . . . . AS DESIRED

WARNING
Operation with APU bleed air on with the cabin door closed will result in a slight positive pressure in the aircraft. To avoid potential injury to persons or damage to the cabin door, APU bleed air should be turned off or a cockpit side window opened prior to opening the cabin door.

CAUTION
The APU is not approved for unattended ground operation.

f. BUS TIE Button . . . . VERIFY PROPER INDICATION
  1) Battery Power Only . . . . OPEN
  2) APU Generator and External Power ON . . . . OPEN
  3) APU Generator or External Power ON . . . . CLOSED

g. AVN Buttons (both) (APU generator and/or external power ON) and OAT ≥ 0°C (+32°F) . . . . ON

2. Park Brake . . . . SET
  a. HYDRAULIC PUMP AUX Button . . . . ON
     Verify 2400 PSI minimum on the EICAS hydraulic pressure indication.
  b. Brakes . . . . APPLY
  c. PARK BRAKE Handle . . . . PULL
  d. EICAS . . . . CHECK
     Verify that the cyan **PARK BRAKE ON** message is displayed.
  e. Brake Pedals . . . . RELEASE
  f. HYDRAULIC PUMP AUX Button . . . . OFF
3. Wheel Chocks . . . . REMOVED
4. Cabin Door . . . . CLOSED AND LOCKED
   Aircraft power (batteries, APU generator, or external power) must be on while the cabin door is being closed.
5. Passenger Briefing . . . . COMPLETE
6. Seats/Seat Belts/Shoulder Harnesses/Pedals . . . . ADJUSTED/SECURED
7. Cockpit Side Windows . . . . CLOSED/LATCHED
8. NAV Lights . . . . ON
9. PAX SAFETY Button . . . . ON
10. EICAS . . . . CHECK
11. Fuel Quantity and Balance . . . . CHECK
12. ATIS/Clearance/FMS (if AVN buttons ON) . . . . AS REQUIRED

END

Starting Engines

Refer to Extreme Cold Weather Operations prior to attempting to start an engine if the aircraft has been cold soaked at temperatures below -10°C (+14°F) and the engines have not been preheated.

CAUTION

In order to minimize the potential for turbine blade rub, the following is recommended for routine engine starts. Initiate start within 1 minute of engine shutdown or wait a minimum of 10 minutes after engine shutdown. Remain at idle for a minimum of 2 minutes after achieving stabilized idle if the engine had been operated above idle during the previous 30 minutes.

Engine ITT should be ≤500°C prior to start initiation.

Do not attempt an engine start with a tailwind component greater than 10 knots.

1. APU System MAX COOL Button . . . . .OFF
2. GND RECOG Light . . . . .ON
3. Engine L or R START Button (either engine). PUSH

CAUTION

Should the engine fail to light up within 15 seconds of moving the throttle to idle or if the ITT limit is exceeded, the FADEC will automatically abort the start. Should the engine fail to achieve stabilized ground idle within 90 seconds of moving the throttle to idle, the engine is deemed to have a "hung start" and the start must be manually aborted.

   a. Throttle (at 9% N_2 minimum) . . . . IDLE
   b. Abort start if no oil pressure increase within 20 seconds of engine light up (indicated by a rise in N_2 and ITT).
   c. Abort start if no indication of N_1 rotation by 40% N_2.
   d. Abort start if stabilized ground idle is not achieved within 90 seconds of engine light up (indicated by a rise in N_2 and ITT).
   e. Engine START Button . . . . LIGHT EXTINGUISHED
   f. Engine Instruments . . . . CHECK NORMAL
   g. Fuel, Oil, Generator and Hydraulic messages. . . . . NOT DISPLAYED

4. Opposite Engine START Button . . . . PUSH
   Repeat procedures in Step 3.
5. DC Amps and Volts . . . . CHECK
6. BUS TIE Button . . . . VERIFY OPEN
7. External Power (if connected) . . . . DISCONNECTED
   Check that the AVAIL light in the EXT PWR button is extinguished.

8. INTERIOR Button . . . . NORM
9. APU SYSTEM BLEED AIR Button . . . . AS DESIRED
10. APU SYSTEM GENERATOR Button. AS DESIRED

END

Before Taxi

1. AVN Buttons (both) (if not already ON) . . . . ON
   a. MCDU 2 (if required) . . . . INITIALIZE PRESENT POSITION
   b. ATIS/Clearance/FMS . . . . RECEIVED/INITIALIZED
2. COCKPIT SPEAKERS Buttons . . . . AS REQUIRED
   Select ON, or MUTE if headsets are to be used.
3. Avionics Cooling Fans . . . . CHECK FOR AIRFLOW
4. Gust Lock . . . . RELEASED
5. Flight Controls/Nosewheel
   Steering Disconnect . . . . FREE AND CORRECT/CHECK
6. Speedbrakes CHECK/0%
7. Hydraulic Pressure and Volume . . . . CHECK
8. Flaps . . . . SET FOR TAKEOFF
9. Attitude and Heading Displays . . . . ALIGNED/NO FLAGS
10. Flight Instruments . . . . CHECK
11. EICAS . . . . CHECK
    Ensure all messages are either normal or resolved.
12. V Speeds . . . . ENTERED
    Verify pilot vs. copilot vs. AFM computed speeds.
13. Anti-Ice Systems . . . . AS REQUIRED
    Maintain a minimum of 65% N_2 on both engines if bleed air anti-ice is selected on for more than 30 seconds.
14. Bleed Air System . . . . CHECK/SET
    a. Throttles. . . . . IDLE
    b. APU SYSTEM BLEED AIR Button. . . . . OFF
    c. L and R ENG BLD AIR and
       PRESS SOURCE Selectors . . . . NORMAL
    d. L ENG BLD AIR Selector . . . . OFF THEN NORMAL
       VERIFY DECREASE THEN INCREASE
       IN LEFT ENGINE ITT

e. PRESS SOURCE Selector, position as follows:
   1) OFF . . . . VERIFY DECREASE IN BOTH ENGINE ITTS
   2) EMER . . . . VERIFY INCREASE IN LEFT ENGINE ITT AND SMALL INCREASE IN NOISE
   3) L. . . . . VERIFY SMALL DECREASE IN NOISE
   4) R . . . . VERIFY DECREASE IN LEFT ENGINE ITT AND INCREASE IN RIGHT ENGINE ITT
   5) NORM . . . . VERIFY INCREASE IN LEFT ENGINE ITT

f. R ENG BLD AIR Selector . . . . OFF THEN NORMAL VERIFY DECREASE THEN INCREASE IN RIGHT ENGINE ITT

g. APU SYSTEM BLEED AIR Button. . . . . AS DESIRED

15. Environmental Controls . . . . AS REQUIRED
16. Pressurization Controller . . . . SET
    Rotate the "A" knob to set destination (or departure) field elevation.
17. Aft Divider Doors . . . . LATCHED OPEN

END

Simplified Criteria - Flaps 15° Takeoff

(Temperatures at or below 30°C (86°F))

WEIGHT RANGE- POUNDS	20,000 - 23,000	23,001 - 26,000	26,001 - 28,000	28,001 - 30,300
V_1 (KIAS)	103	103	103	109
V_R (KIAS)	104	104	106	109
V_2 (KIAS)	113	112	113	115
RUNWAY LENGTH -FEET (MINIMUM)	4,000	4,500	5,000	5,500
V_{REF} (FLAPS 35° - KIAS)	101	107	*111	*116
V_{APP} (FLAPS 15° - KIAS)	108	115	*119	*124

* For use in an emergency landing. Maximum design landing weight is 27,100 pounds (12,292 kg). Landing at weights above 27,100 pounds (12,292 kg) may exceed the Landing Brake Energy Limit.

NOTE: The above criteria apply only to takeoffs with flaps 15°, throttles in TO detent, anti-ice off, pressure altitude at or below 4,000 ft. MSL, temperatures at or below 30°C (86°F), no tailwind, zero to 2% downhill runway gradient, and dry paved runway. Aircraft Flight Manual, Section IV, Performance, Takeoff, provides takeoff data for other conditions.

The above criteria apply only to landings with flaps 35°, anti-ice off, pressure altitude at or below 4,000 ft. MSL, temperatures at or below 30°C (86°F), no tailwind, -2% downhill to 2% uphill runway gradient, and dry paved runway. Aircraft Flight Manual, Section IV, Performance, Landing, provides landing data for other conditions.

Simplified Criteria - Flaps 15° Takeoff

(Temperatures between 31°C (88°F) and 40°C (104°F))

WEIGHT RANGE-POUNDS	20,000 - 23,000	23,001 - 26,000	26,001 - 28,000	28,001 - 30,300
V_1 (KIAS)	103	103	105	110
V_R (KIAS)	104	104	106	110
V_2 (KIAS)	113	112	113	115
RUNWAY LENGTH -FEET (MINIMUM)	4,400	5,200	5,900	7,000
V_{REF} (FLAPS 35° - KIAS)	101	107	*111	*116
V_{APP} (FLAPS 15° - KIAS)	108	115	*119	*124

* For use in an emergency landing. Maximum design landing weight is 27,100 pounds (12,292 kg). Landing at weights above 27,100 pounds (12,292 kg) may exceed the Landing Brake Energy Limit.

> **NOTE:** The above criteria apply only to takeoffs with flaps 15°, throttles in TO detent, anti-ice off, pressure altitude at or below 4,000 ft. MSL, temperatures between 31°C (88°F) and 40°C (104°F), no tailwind, zero to 2% downhill runway gradient and dry paved runway. Aircraft Flight Manual, Section IV, Performance, Takeoff, provides takeoff data for other conditions.
>
> The above criteria apply only to landings with flaps 35°, anti-ice off, pressure altitude at or below 4,000 ft. MSL, temperatures between 31°C (88°F), and 40°C (104°F), no tailwind, -2% downhill to 2% uphill runway gradient, and dry paved runway. Aircraft Flight Manual, Section IV, Performance, Landing, provides landing data for other conditions.

END

Taxi

1. Exterior Lights . . . . AS REQUIRED
2. Brakes . . . . APPLY AND HOLD
3. Park Brake . . . . RELEASE
4. Brakes . . . . CHECK
5. Nosewheel Steering . . . . CHECK
6. Rudder Bias System . . . . CHECK
   a. Left Throttle . . . . APPROXIMATELY 50% N_1
   b. Left Rudder Pedal . . . . VERIFY MOVES FORWARD
   c. Left Throttle . . . . IDLE
   d. Right Throttle . . . . APPROXIMATELY 50% N_1
   e. Right Rudder Pedal . . . . VERIFY MOVES FORWARD
   f. Right Throttle . . . . IDLE
7. Thrust Reversers . . . . CHECK/STOWED
   a. Thrust Reverser Levers . . . . DEPLOY (IDLE)
   b. ARM, UNLK, DPLY Indications . . . . DISPLAY SEQUENTIALLY
   c. EMER STOW Lights . . . . FLASHING RED
   d. LH and RH EMER STOW Buttons . . . . PUSH
      1) EMER STOW Lights . . . . STEADY RED
      2) Thrust Reversers . . . . STOWED
      3) DPLY and UNLK Indications . . . . . . EXTINGUISH SEQUENTIALLY
      4) ARM Indication . . . . REMAINS DISPLAYED
   e. Thrust Reverser Levers . . . . STOW
   f. ARM Indication . . . . REMAINS DISPLAYED

g. EMER STOW Buttons . . . . PUSH
   1) EMER STOW Lights . . . . EXTINGUISHED
   2) Thrust Reversers . . . . REMAIN STOWED
h. All Thrust Reverser Indications . . . . EXTINGUISHED

8. Gust Lock . . . . AS DESIRED

END

Before Takeoff

1. Battery Amps . . . . CHECK

   Verify less than 20 amps per battery on EICAS.

2. Flaps . . . . SET FOR TAKEOFF
3. Speedbrakes 0%
4. Trim (stabilizer/aileron/rudder). . . . . SET FOR TAKEOFF
5. Anti-Ice Systems . . . . CHECK/AS REQUIRED

   The anti-ice system monitors temperature readings to determine that the system is working correctly. If the preflight test is not done with the correct power setting, there will be insufficient bleed air and the test will likely fail. Subsequent attempts at accomplishing the preflight check will likely also fail unless the system is allowed to cool to ambient conditions before reattempting the test. Maintain a minimum of 65% N_2 on both engines if bleed air anti-ice is selected on for more than 30 seconds.

   a. Throttles. . . . . 70-75% N_2
   b. Anti-Ice Systems
      1) ENGINE/STAB Buttons (both) . . . . ON
      2) WING Buttons (both) . . . . ON
   c. An ITT increase occurs and the following messages will be displayed:
      1) Cyan **INDB WING A/I COLD L** and **R**
      2) Cyan **WING ANTI-ICE COLD L** and **R**
      3) Cyan **STAB ANTI-ICE COLD L** and **R**
      4) Cyan **ENG ANTI-ICE COLD L** and **R**
      5) Cyan **ANTI-ICE ON ALL**
   d. If one or more messages turn amber after 2 minutes:
      1) Throttle (affected engine). . . . . SET A MAXIMUM OF 81% N_2
      2) Affected Amber **ANTI-ICE COLD** Message . . . . MONITOR AN ADDITIONAL 2 MINUTES
   e. If any amber anti-ice message does not clear or no ITT increase observed, the preflight check is failed.
      1) Correct prior to flight if anti-ice will be required.
   f. If all anti-ice messages except cyan **ANTI-ICE ON ALL** message clear:
      1) ANTI-ICE WING/STAB XFLOW Button . . . . **XFLOW**

Verify cyan **WING A/I CROSSFLOW OPEN** message is displayed.

2) ANTI-ICE WING/STAB XFLOW Button . . . . **OFF**

Verify cyan **WING A/I CROSSFLOW OPEN** message clears.

g. Anti-Ice Systems

1) ENGINE/STAB Buttons (both) . . . . OFF OR AS REQUIRED

2) WING Buttons (both) . . . . OFF OR AS REQUIRED

h. Throttles. . . . . IDLE

6. Takeoff Briefing . . . . COMPLETE

The takeoff briefing should include the normal call-outs during the acceleration phase to V_1 and V_R. Go/No-Go criteria should also be addressed, including specific duties during an aborted takeoff.

If Rolling Takeoff Planned . . . . ADD 500 FEET TO COMPUTED TAKEOFF DISTANCE

7. Primary and Standby Displays . . . . SET FOR DEPARTURE PROCEDURE

8. Radar. . . . . AS REQUIRED

9. Transponder/TCAS . . . . TA/RA

CLEARED FOR TAKEOFF

10. Gust Lock . . . . .RELEASED

Flight Controls
(if gust lock was engaged during taxi) . . . . .FREE

11. ANTI-ICE PITOT/STATIC Buttons (both). . . . . .ON

12. Anti-Ice . . . . AS REQUIRED

13. Exterior Lights . . . . .SET

14. EICAS . . . . .CHECKED

Ensure all messages are either normal or resolved.

15. Departure Runway Alignment . . . . .BOTH PILOTS CONFIRM

END

Takeoff

Static Takeoff

1. Throttles. . . . . TO DETENT (FADEC MODE INDICATOR - WHITE T/O)

2. Brakes . . . . RELEASE

3. EICAS . . . . CHECK NORMAL INDICATIONS (N_1 MATCHES COMMAND)

4. Elevator Control. . . . . ROTATE AT V_R (10° INITIAL PITCH/FD TO PITCH)

Rolling Takeoff

1. Brakes . . . . RELEASE
2. Throttles. . . . . TO DETENT
   WITHIN 500 FT. AFTER BRAKE RELEASE
   (FADEC MODE INDICATOR - WHITE T/O)
3. EICAS . . . . CHECK NORMAL INDICATIONS
   (N_1 MATCHES COMMAND)
4. Elevator Control. . . . . . . ROTATE AT V_R (10° INITIAL PITCH/FD TO PITCH)

END

After Takeoff/Climb

1. Landing Gear. . . . . UP
2. Flaps . . . . .0°
   Retract flaps above V_2+10 KIAS and above 400 feet AGL.
3. Throttles. . . . . MCT DETENT
4. Yaw Damper . . . . AS DESIRED
5. Autopilot (above 400 ft. AGL) . . . . AS DESIRED
6. Pressurization . . . . CHECK
7. SEAT BELTS and PAX SAFETY Buttons . . . . AS REQUIRED
8. Anti-Ice . . . . AS REQUIRED
9. Altimeters/RECOG Button (at transition altitude) . . . . .SET/OFF
10. APU (prior to climb above FL300) . . . . .OFF
    Refer to APU Shutdown, page 5-28.

END

Cruise

1. Throttles. . . . . CRU DETENT OR AS REQUIRED

> ***NOTE:*** It is recommended that the throttles be reduced to the CRU detent or below within 10 minutes after reaching an intermediate or the final cruise altitude. The use of MCT during normal operations beyond 10 minutes after reaching cruise altitude may decrease engine life and increase operator costs.

2. Pressurization . . . . CHECK
   If fuel consumption allows, it is permissible to select HP on the ENG BLD AIR selector to aid in heating the cabin when at or below FL370.

CAUTION
It may not be possible to maintain cabin pressure at high altitudes with both engine bleed air sources in LP.

3. Oxygen Mask (when required) . . . . DON/NORM
4. Anti-Ice . . . . AS REQUIRED
5. FUEL CROSSFEED Selector . . . . AS REQUIRED

   To preclude a possible minor engine surge from occurring while in flight, fuel crossfeed should be selected on with the throttles in the CRU detent or higher.

> ***NOTE:*** A panel sweep or a check for normal system operation and indication should be accomplished at top-of-climb, top-of-descent, and at regular intervals during cruise flight.

END

Descent

1. Pressurization . . . . CHECK/SET LANDING ELEVATION
   a. If the cabin altitude exceeds 12,000 ft. while operating in high elevation airfield mode, it is recommended that at least one pilot don an oxygen mask.
   b. Landing field elevation should be set to 0 ft. when barometric altitude is corrected to the landing field elevation (QFE operation).
2. Anti-Ice . . . . AS REQUIRED

   The anti-ice system must be selected ON at least one minute prior to an idle descent into an icing environment.
3. APU (below FL200) . . . . TEST/START AS DESIRED

   Refer to APU GROUND OR IN-FLIGHT START (AT OR BELOW FL200), page 5-27.
4. Altimeters/RECOG Buttons
   (at transition flight level). . . . . .SET/ON

CAUTION
Do not descend below transition level until obtaining local altimeter setting.

END

Approach

1. Landing Data . . . . CONFIRM
   a. Airspeed. . . . . V_{APP}/V_{REF}
   b. Landing Distance . . . . CALCULATE

Simplified Criteria - Flaps 35° Landing (KIAS)

WEIGHT - POUNDS	20,000	22,000	24,000	26,000	27,000
V_{REF}	94	99	103	107	110
V_{APP}	101	106	110	115	117

NOTE: The above criteria apply only to landings with flaps 35°, anti-ice off, pressure altitude at or below 4,000 ft. MSL, temperatures at or below 46°C (115°F), no tailwind, runway length 3,500 ft. or longer, -0.5% downhill to 2% uphill runway gradient, and dry paved runway. Aircraft Flight Manual, Section IV, Performance, Landing, provides landing data for other conditions.

2. Anti-Ice . . . . AS REQUIRED
3. Approach Briefing . . . . COMPLETE

   The approach review and applicable briefing should be accomplished as early as practicable after the landing runway has been determined.
4. Avionics and Flight Instruments. . . . . CHECK/SET
   a. The planned approach procedure should be loaded in the FMS to ensure proper LNAV guidance if a missed approach is initiated (airplanes incorporating Epic Phase 5 software).
   b. Auto-preview will not automatically transition to BC when an LOC BC procedure is loaded in the FMS. The pilot must manually select NAV as the active navigation source, then select BC as the AP/FD mode prior to crossing the FAF (airplanes incorporating Epic Phase 5 software).

NOTE: The actual landing length of a runway can differ from the FMS database, due to displaced threshold, stopway, or a temporarily relocated threshold. If difference is noted, insert the correct value manually into the FMS on LAND/GA INIT page 1, line 1R.

5. Minimums (RAD/BARO) . . . . SET
6. RAD/BARO Knob
   (if conducting a Category II approach) . . . . TEST

   Push to test prior to selecting APPR mode on the flight guidance panel.
7. FUEL CROSSFEED Knob. . . . . OFF
8. Exterior Lights . . . . AS REQUIRED
9. Flaps . . . . 7° OR 15°
10. Passenger Briefing . . . . COMPLETE

11. Seats/Seat Belts/Shoulder Harnesses/Aft Divider Doors . . . . CHECKED/SECURED/ LATCHED OPEN
12. PAX SAFETY Button . . . . ON

END

Before Landing

1. Landing Gear . . . . DOWN (3 GREEN)
2. Flaps . . . . 35°

   The autopilot will not engage while the flaps are in transit from 15° to 35°.
3. Speedbrakes (prior to 500 ft. AGL) 0%
4. EICAS . . . . CHECK
5. Airspeed . . . . V_{REF}

   If strong winds are present, add to V_{REF} ½ of the steady state wind plus the full gust to a maximum additive of 20 knots. V_{REF} will still be target speed at the threshold.
6. Autopilot (prior to minimum use height) . . . . DISENGAGE
7. Yaw Damper (prior to landing) . . . . DISENGAGE

END

Landing

1. Throttles . . . . IDLE
2. Speedbrakes (at touchdown) 100%
3. Elevator Control (at touchdown) . . . . FORWARD PRESSURE
4. Brakes (after nosewheel touchdown) . . . . APPLY
5. Thrust Reversers (after nosewheel touchdown) . . . . DEPLOY

   Initiate cancellation of reverse thrust so as to be at the reverse idle position by 65 KIAS.

CAUTION
After touchdown, use rudder pedal steering and/or rudder aerodynamic control to maintain runway centerline. Use of tiller steering should be limited to speeds less than 60 KIAS.

END

Traffic Pattern

After Takeoff

1. Landing Gear . . . . UP
2. Flaps . . . . 0°
3. Climb Power . . . . SET
4. Yaw Damper . . . . AS DESIRED
5. Autopilot. . . . . AS DESIRED

Pattern

1. Landing Data . . . . CONFIRM
2. Approach Briefing . . . . COMPLETE
3. Avionics and Flight Instruments. . . . . CHECK/SET
4. Flaps . . . . 7° or 15°

Before Landing

1. Landing Gear. . . . . DOWN (3 GREEN)
2. Flaps . . . . 35°
3. Speedbrakes 0%
4. EICAS . . . . CHECK
5. Airspeed . . . . V_{REF}
6. Autopilot. . . . . DISENGAGE
7. Yaw Damper . . . . DISENGAGE

Taxi-Back

1. ANTI-ICE PITOT/STATIC Buttons (both). . . . . OFF
2. Exterior Lights . . . . AS REQUIRED
3. Transponder . . . . STANDBY
4. Flaps . . . . SET FOR TAKEOFF
5. Speedbrakes 0%
6. Trim (stabilizer/aileron/rudder). . . . . SET
7. Takeoff Briefing . . . . ACCOMPLISHED
8. FMS . . . . SET
9. Primary and Standby Displays . . . . SET
10. Radar. . . . . AS REQUIRED
11. Transponder/TCAS . . . . TA/RA

CLEARED FOR TAKEOFF

12. Gust Lock . . . . .RELEASED
13. ANTI-ICE PITOT/STATIC Buttons (both). . . . . .ON
14. Exterior Lights . . . . .ON
15. V-Speeds . . . . .CHECKED
16. EICAS . . . . .CHECKED

CAUTION
Flight crews must take precautions when conducting repetitive traffic circuits, including multiple landings and/or multiple rejected takeoffs, to prevent overheating the brakes, which could melt the fuse plugs and cause loss of all tire pressure and possible tire and wheel damage. During such operations, available runway permitting, minimize brake usage and consider cooling the brakes in flight with the landing gear extended. Maximizing use of reverse thrust and extending speed brakes will assist in bringing the airplane to a stop.

END

All Engine Go-Around

1. Go-Around Button (either throttle) . . . . PRESS

   The flight director go-around mode provides an initial climb pitch attitude reference. Pressing the throttle mounted go-around button disengages the autopilot, if on, and engages the flight director in go-around mode (wings level/LNAV armed, +7.5° pitch), and on airplanes incorporating Epic Phase 5 software, selects LNAV as the active navigation source. The autopilot disconnect aural tone will sound continuously until the AP/TRIM/NWS DISC button is pressed, which will disengage the yaw damper.

2. Throttles. . . . . TO DETENT
3. Aircraft Pitch Attitude . . . . 7.5° INITIALLY (FD GO-AROUND COMMAND), THEN AS REQUIRED
4. Flaps . . . . .15°
5. Landing Gear. . . . . UP

   If the landing gear is retracted before the flaps reach 15°, the landing gear aural warning will sound briefly.

6. Flaps . . . . 0° (V_{APP} +10 KIAS AND AT OR ABOVE 400 FT. AGL)
7. Airspeed . . . . AS REQUIRED
8. Throttle . . . . .MCT DETENT OR AS REQUIRED
9. Yaw Damper . . . . AS DESIRED
10. Autopilot. . . . . AS DESIRED

END

After Landing

1. Thrust Reversers . . . . STOW
2. Speedbrakes 0%
3. Flaps . . . . AS DESIRED
4. Anti-Ice Switches . . . . CONFIRM
   a. PITOT/STATIC Buttons (both) . . . . OFF
   b. ENGINE/STAB Buttons (both) . . . . AS REQUIRED
   c. WING Buttons (both) . . . . OFF
5. Exterior Lights . . . . AS REQUIRED
6. Stabilizer Position . . . . SET TO -6.9°
7. APU . . . . TEST/START

   Refer to APU GROUND OR IN-FLIGHT START (AT OR BELOW FL200) page 5-27.

WARNING

Operation with APU bleed air on with the cabin door closed will result in a slight positive pressure in the aircraft. To avoid potential injury to persons or damage to the cabin door, APU bleed air should be turned off or a cockpit side window opened prior to opening the cabin door.

8. BUS TIE Button (if only one generator) . . . . CLOSED

END

Shutdown

1. Throttles . . . . IDLE

CAUTION
It is recommended that the engines remain at idle for a minimum of 2 minutes prior to shutdown to allow the engine inter-turbine temperatures to stabilize. **For generator cooling during ground operations, the engine must be operated at idle with the generator load less than 75 amps for 4 minutes prior to engine shutdown. Otherwise, a 35-minute cooling period after engine shutdown is required prior to attempting a restart.**

2. Park Brake . . . . SET
   Ensure cyan **PARK BRAKE ON** message is displayed.

> ***NOTE:*** If the brakes are suspected to be hot, release the parking brake after wheel chocks are in place.

3. ANTI-ICE ENGINE/STAB Buttons (both) . . . . OFF
4. AVN Buttons (both) . . . . OFF
5. Throttles . . . . CUTOFF
6. SEAT BELTS and PAX SAFETY Buttons . . . . OFF
7. EMER LTS Switch . . . . OFF
8. STBY PWR Switch . . . . OFF
9. APU . . . . SHUT DOWN
   Refer to APU Shutdown, page 5-28.
10. Exterior Lights . . . . OFF
11. EICAS Button . . . . OFF
12. BATT Buttons (both)
    (30 seconds after throttles CUTOFF) . . . . OFF
13. Gust Lock . . . . AS REQUIRED
14. Engine Inlet and Exhaust Covers . . . . AS REQUIRED
    Engine inlet and exhaust covers should be installed to prevent long periods of engine rotation due to wind.
15. If the ambient temperature is below -10°C (+14°F), refer to Extreme Cold Weather Operations, page 5-29.

END

Shutdown (Quick Turn)

1. Throttles. . . . . IDLE

CAUTION
It is recommended that the engines remain at idle for a minimum of 2 minutes prior to shutdown to allow the engine inter-turbine temperatures to stabilize. **For generator cooling during ground operations, the engine must be operated at idle with the generator load less than 75 amps for 4 minutes prior to engine shutdown. Otherwise, a 35-minute cooling period after engine shutdown is required prior to attempting a restart.**

2. Park Brake. . . . . SET
3. Anti-Ice Systems (all). . . . . OFF
4. External Power or APU Generator
   a. External Power Connected
      1) AVAIL Light. . . . . .ILLUMINATED
      2) EXT PWR Button . . . . .ON
   b. APU Generator
      1) APU . . . . TEST/START,

      Refer to APU GROUND OR IN-FLIGHT START (AT OR BELOW FL200), page 5-27.

      2) APU SYSTEM GENERATOR Button. . . . . .ON
      3) APU SYSTEM BLEED AIR Button. . . . . AS DESIRED

WARNING
Operation with APU bleed air on with the cabin door closed will result in a slight positive pressure in the aircraft. To avoid potential injury to persons or damage to the cabin door, APU bleed air should be turned off or a cockpit side window opened prior to opening the cabin door.

CAUTION
The APU is not approved for unattended ground operation.

5. BUS TIE Button . . . . VERIFY PROPER INDICATION
   a. Battery Power Only . . . . OPEN
   b. APU Generator and External Power ON . . . . OPEN
   c. APU Generator or External Power ON . . . . CLOSED
6. Throttles. . . . . CUTOFF
7. SEAT BELTS and PAX SAFETY Buttons . . . . .OFF
8. Exterior Lights . . . . AS REQUIRED
9. Return to Normal Procedures, Before Start checklist.

END

APU Ground or In-Flight Start (At or Below FL200)

WARNING

The aircraft batteries must be installed and the battery switches on or the aircraft generator(s) must be operating and on prior to and during all APU operations to assure fire protection system power.

1. BATT Buttons (both) . . . . .ON
2. EICAS Button . . . . .ON
3. Battery Voltage . . . . CHECK (24V DC MIN)
4. INTERIOR Button (ground start only) . . . . .NORM
5. Altitude (in-flight start) . . . . FL200 MAXIMUM
6. Airspeed (in-flight start) . . . . .250 KIAS MAXIMUM
7. BUS TIE Button (in-flight start only). . . . . CLOSED
8. Exterior Lights . . . . AS REQUIRED
9. APU SYSTEM MASTER Button . . . . .ON
10. APU TEST Button . . . . PRESS
    a. Verify the following lights illuminate on the APU SYSTEM Panel: APU SYS FAIL, BLEED VALVE OPEN, READY TO LOAD, APU RELAY ENGAGED, BLEED AIR ON/OFF, GENERATOR ON/OFF, MASTER ON/OFF, TEST, START, and STOP.
    b. Verify the digital display has values of 45-55 for APU RPM, 480-520 for APU EGT, and 0.00 for DC VOLTAGE within 10 seconds of depressing the TEST button.
    c. Verify the APU FIRE button illuminates on the right instrument panel and the appropriate double chime or "APU FIRE" voice sounds.
11. APU SYSTEM START Button . . . . PUSH
12. APU RELAY ENGAGED Button . . . . .ON, THEN OFF BEFORE READY TO LOAD LIGHT ON
13. APU READY TO LOAD Light . . . . .ON
14. BUS TIE Button (in-flight start only). . . . . OPEN
15. INTERIOR Button . . . . .NORM

NOTE: Airplanes incorporating SB680-49-02 (Configuration AF) may operate the APU generator in flight.

16. APU SYSTEM GENERATOR Button. . . . . ON OR AS DESIRED

    The APU generator will not come on line if the left engine generator is on line.

17. APU Ammeter . . . . .CHECK (275 AMPS MAXIMUM)
18. APU SYSTEM BLEED AIR Button . . . . ON OR AS DESIRED
19. APU SYSTEM MAX COOL Button . . . . AS DESIRED

WARNING

Operation with APU bleed air on with the cabin door closed will result in a slight positive pressure in the aircraft. To avoid potential injury to persons or damage to the cabin door, APU bleed air should be turned off or a cockpit side window opened prior to opening the cabin door.

END

APU Shutdown

1. APU SYSTEM STOP Button . . . . PUSH
2. APU SYSTEM READY TO LOAD Button . . . . EXTINGUISHED
3. APU SYSTEM MASTER Button . . . . .OFF

NOTE: If BLEED AIR and GENERATOR switches are left ON when the APU STOP switch is pushed, they will automatically come back on when the READY TO LOAD light illuminates after the next APU start.

END

All-Weather Operations and Procedures

Extreme Cold Weather Operations

Cessna provides recommended procedures to assist in initial system operation, airplane heating, and engine starting, after prolonged cold-soak conditions. Operation of the aircraft has been demonstrated after prolonged exposure to ground ambient temperature of -40°C (-40°F). This was the minimum temperature achieved in cold weather testing. The following operational procedures are recommended for operations where prolonged exposure to temperatures below -10°C (+14°F) is anticipated or has occurred.

> ***NOTE:*** If the ground operating temperature is expected to drop more than +28°C (+50°F) or the arrival airport is expected to be more than +28°C (+50°F) colder than the departure airport, then increase the main and nose tire pressures by +1% of the placard inflation pressure for every +3°C (+5°F) expected below the current servicing temperature.

If the aircraft will be cold soaked at temperatures below -10°C (+14°F) it is recommended that the batteries, crew oxygen masks and known fluids in the cabin (i.e. chemical toilet, refreshment center, etc.) be removed and stored at a temperature above -10°C (+14°F). If the batteries have been cold soaked at temperatures below -10°C (+14°F) battery warmup to at least -10°C (+14°F) is required. This temperature may be checked with the battery temperature gauge. Proper battery warmup may require extended application of heat to the battery. Below -20°C (-4°F), NiCad batteries may be inert and will neither charge nor discharge.

The aircraft should be parked with flaps retracted and engine, APU, and pitot covers should be installed after shutdown. Do not set the parking brake or gust lock if the anticipated cold soak temperature is -10°C (+14°F) or less.

> ***NOTE:*** Unless visible leaks are present, the oil level should not be serviced after a prolonged cold soak, as overfilling may result.

Hydraulic accumulators, pneumatic storage bottles, and oxygen cylinders will indicate a lower pressure because of the temperature drop. Refer to the appropriate temperature change placards. It should be noted that hydraulic and pneumatic systems are more prone to leaks in extreme cold. A significantly lower charge may indicate a leak. Prior to preflight, the flaps should be extended to allow inspection of the wing trailing edge for hydraulic leaks. Nose strut extension should be at least 2.4 inches (6.1 cm), and main strut extension should be at least 1.3 inches (3.3 cm).

The APU should be started as soon as possible to provide cabin heat. Either the APU generator or external power should be connected to supply electrical and avionics power. The APU should start normally using external power or batteries provided that the aircraft has not been cold soaked below -40°C (-40°F). Preheating will be required if the cold soak was below -40°C (-40°F).

Some electrical systems and avionics may require warmup after cold soak. Extreme cold-soaking can cause spurious failure messages and indications on the Crew Alerting System (CAS) until the core temperatures of control units have reached normal operating temperatures. All avionics must be operating properly before flight. Proper warm-up of the avionics is indicated by normal illumination of all flight displays and MCDUs with pilot control of brightness and by radio reception on all applicable avionics. In the absence of a suitable station, background static is an acceptable demonstration of reception.

Fuel temperature limits for the type of fuel being used must be observed. Refer to Fuel Limitations.

CAUTION

Do not operate the auxiliary hydraulic pump if the aircraft has been cold soaked below -40°C (-40°F). Chock the aircraft prior to starting engines.

The use of engine preheat should not be required at temperatures down to -40°C (-40°F). Engine preheat is required if the engine oil temperature is below -40°C (-40°F). Engine oil temperature as displayed in EICAS, is a good indicator of cold soak. Normal engine starts using batteries, external power, or the APU should be normal except that the exhaust will smoke initially and engine oil pressure will be high. Engine oil pressure above 110 PSI is normal during cold starts. The engine may not be operated above idle until oil pressure is at or below 110 PSI. Once engine oil pressure is in normal limits, the engine may be operated above idle, but cannot exceed the CRU detent until the engine oil temperature is in normal limits, >16°C. This process should take only a few minutes. It should be verified after engine start and before flight that there are no visible oil leaks.

NOTE: During a battery start of the engines, flames may be present momentarily aft of the engine.

Following engine start, all flight controls and speed brakes should be cycled through full travel several times to verify that all controls reach full travel and operate normally. Flaps and all trims should be cycled through full travel to verify normal operation. Hydraulic quantity should be monitored (EICAS) prior to takeoff to verify that no system leaks have occurred.

Prior to flight, the aircraft must be cleared of snow and ice and if the wing, empennage or control surfaces are frosted, they must be deiced. Additionally, the flight crew should be alert during preflight preparation to inspect areas where surface snow or frost could change or affect normal system operations.

When the aircraft has been exposed to prolonged temperatures below 0°C (32°F), to provide proper deployment of passenger oxygen masks, the cabin must be warmed to at least +15°C (+60°F) as indicated on the cabin temperature indicator on the environmental control panel before flight above FL250.

Flight into Icing

Flight into known icing is the intentional flight into icing conditions that are known to exist by either visual observation or pilot weather report information. Icing conditions may exist when indicated RAT is +10°C or below, and visible moisture in any form is present (such as clouds, fog with visibility of one mile or less, rain, snow, sleet, or ice crystals). Icing conditions also may exist when the OAT (SAT) on the ground and for takeoff is +10°C or below when operating on ramps, taxiways, or runways where surface snow, ice, standing water, or slush may be ingested by the engines, or freeze on the engines, nacelles, or engine sensor probes. The Citation Sovereign, equipped with properly operating anti-ice equipment, is approved to operate in maximum intermittent and maximum continuous icing conditions as defined by 14 CFR Part 25, Appendix C, when that equipment is in operation. The equipment has not been designed, or certified, to provide protection against freezing rain or severe conditions of mixed or clear ice. During all operations, the pilot is expected to exercise good judgment and is to be prepared to alter the flight plan (i.e. exit icing) if conditions exceed the capability of the aircraft and equipment.

Ice accumulations will significantly alter the shape of the airfoils of any aerodynamic surface. The resulting change in shape of the airfoil and, to a lesser extent, the added weight of the ice, can affect the stall speed and possibly change the normal handling characteristics and performance of the aircraft. During periods of high angle-of-attack (low airspeed) flight conditions, an increase in drag may be experienced due to a build up of ice on the undersurface of the wing aft of those areas that are protected by the leading edge anti-ice system. To keep the angle-of-attack low, the minimum airspeed for sustained flight in icing conditions (except approach and landing) is 180 KIAS. Prolonged flight in icing conditions with the flaps and/or landing gear extended is prohibited. Trace or light amounts of icing on the horizontal stabilizer can alter airfoil characteristics that will affect stability and control of the aircraft.

The accumulation of ice on the upper surface of the wing aft of the protected area extending 12 inches to 18 inches aft of the heated leading edge is normal.

Freezing rain and clear ice will be deposited in layers over the entire surface of the aircraft and can “run back” over control surfaces before freezing. Rime ice is an opaque, granular and rough deposit of ice that usually forms on the leading edges of wings, tail surfaces, pylons, engine inlets, antennas, etc.

Flight crews are to ensure that the aircraft is free from ice prior to dispatch.

Engine icing can occur without wing icing. A jet engine operating in an air mass with an ambient temperature below +8°C (+46 ºF) may experience engine icing. This is caused by the temperature drop associated with the reduction in pressure between that of the air mass and the pressure at the first stages of the compressor. As air is drawn into the engine, moisture condenses into droplets. These droplets, due to their inertia, cannot follow the air around the fan blades and guide vanes. Instead, they strike the metal parts and freeze. This can happen in clear air if the temperature is near or below freezing and the relative humidity is near saturation. The APU is also affected.

WARNING

UNDER NO CIRCUMSTANCES WILL FLIGHTS BE PLANNED THROUGH FORECASE OR KNOWN SEVERE ICING CONDITIONS. IF FLIGHT THROUGH ICING CONDITIONS IS NECESSARY, THE ENGINE AND WING ANTI-ICING SYSTEMS SHOULD BE TURNED ON BEFORE ENTERING THE CONDITION. THESE ARE ANTI-ICING SYSTEMS, AND THEY MUST BE USED BEFORE ICE BUILDUP OCCURS. FLIGHT IN FREEZING RAIN OR FREEZING DRIZZLE SHOULD BE AVOIDED.

Anti-Ice Additives

NOTE: Anti-Ice additives are not required for fuel anti-ice protection of the Citation Sovereign; however, periodic use improves protection against bacterial growth in the fuel tanks.

Procedure for Adding Anti-Ice Fuel Additives

Use the following procedure for Diethylene Glycol Monomethyl Ether (DIEGME; MIL-1-85470) for blending the anti-icing additive as the aircraft is being refueled through the wing filler caps:

1. Attach the additive blender to refuel nozzle, making sure the blender tube discharges in the refueling stream.
2. Start refueling while simultaneously fully depressing the blender trigger and slipping the ring over the trigger.

WARNING

Anti-ice additives are combustible. Before using this material, refer to all safety information on the container.

CAUTION

Anti-icing additives containing DIEGME are slightly toxic if swallowed and may cause eye redness, swelling and irritation.

Assure the anti-icing additive is directed into the flowing fuel stream with the additive flow started after the fuel flow starts and stopped before fuel flow stops. Do not allow concentrated additive to contact the coated interior of the fuel tank or aircraft painted surface.

Use not less than 20 fluid ounces of anti-icing additive per 156 U.S. gallons of fuel or more than 20 fluid ounces of anti-icing additive per 104 U.S. gallons of fuel.

NOTE: Service experience has shown that DIEGME has provided acceptable protection from bacterial growth in fuel systems.

Procedure for Checking Fuel Additives

Prolonged storage of the aircraft will result in a water buildup in the fuel that "leaches out" the additive. An indication of this is when an excessive amount of water accumulates in the fuel tank sumps. The concentration can be checked using an anti-icing additive concentration test kit available from Cessna Aircraft Company. It is imperative that the instructions for the test kit be followed explicitly when checking the additive concentration. The concentrations by volume for DIEGME shall be 0.10% minimum and 0.15% maximum, either individually or mixed in a common tank. Fuel, when added to the tank, should have a minimum concentration of 0.10% by volume.

Cold Weather and Contaminated Runway Operations

Except where noted, all flight manual field length data assumes a dry, hard surface runway. Precipitation-covered runway conditions will degrade braking effectiveness and will require significantly greater actual takeoff, abort and landing field lengths. Aircraft Flight Manual, Section IV, Performance provides takeoff and landing performance data for contaminated surfaces and Section VII, Advisory Information provides deicing procedures.

Before Takeoff Considerations

To ensure safe operation, departure airport runway/taxiway condition and impact to preflight operation must be carefully considered prior to takeoff. Operation on contaminated surfaces will increase takeoff distances, introduce degraded ground handling characteristics during taxi, takeoff, and landing, and may interfere with proper landing gear extension or retraction.

Once a “go” decision is made based on field conditions and aircraft and crew limitations, the following additional procedures are recommended to ensure satisfactory aircraft operation.

CAUTION
If deicer solution is inadvertently sprayed into the engine/APU inlets or contacts the exhaust when the engine or APU is in operation, a potentially unsafe condition could develop in the cabin. Engine bleeds should be selected OFF and APU shut down during de-icing operations to minimize the risk of cabin environment contamination. For specific information regarding deicing and anti-icing procedures, refer to AFM Section VII, Advisory Information.

Preflight Inspection – Exterior

1. Main Landing Gear (MLG) Door/Wheels/Tires/Brakes/Strut/Wheel Well . . . CONDITION
   a. In addition to Normal Procedures, ensure the wheels are not frozen to the ground and verify ice has not accumulated on the landing gear brake stacks.

> ***NOTE:*** If the aircraft was stored in a hangar to defrost, water may have collected in the brake components and can freeze in flight. Frozen brakes may not allow the tires to rotate after landing and a blown tire may result.
>
> If the aircraft is to be left outside in cold climate with wet brakes, it is recommended to rinse the brake stack outer perimeter with denatured/anhydrous isopropyl alcohol with the parking brake off. Alcohol may be applied before or after flight when the brakes are cool enough to touch but not below freezing.

Figure 5-2: Brake Stack

Before Taxi

> ***NOTE:*** If the aircraft is to taxi through slush, ice, or water, it is recommended to leave the flaps up until completing the BEFORE TAKEOFF checklist. This practice will help prevent ice contamination on the flap surfaces.
>
> If anti-ice fluid is to be applied to the aircraft before takeoff, it is recommended the BEFORE TAKEOFF Anti-Ice Systems check be completed prior to anti-ice application.

Taxi

1. Nosewheel Steering . . . . CHECK
   a. Verify nosewheel controllability in both directions.
   b. Avoid tight turns with brake application and large steering changes on icy surfaces as loss of steering may be experienced.
2. Thrust Reversers . . . . CHECK/STOWED

CAUTION
Reverse thrust should be used only when absolutely necessary if the taxi surface is slippery or covered with slush or snow. Reverse thrust can cause surface contaminants to become airborne and freeze to the aircraft lifting surfaces. Nosewheel skidding may result, especially with single reverser operation.

3. Adequate Aircraft Separation. . . . . MAINTAIN
   (STOPPING DISTANCES WILL BE LONGER ON CONTAMINATED SURFACES)
4. Brake Stacks . . . . HEAT

   Within the last mile of taxi to remove excess water that may freeze after takeoff. This is important if the taxi was over wet or slushy surfaces. Warm the brakes by applying firm and even brake pressure during taxi to slow from approximately 20 to 5 Kts or 15 to 0 Kts as indicated on the Flight Management System (FMS) ground speed window. The following chart shows the recommended number of brake applications based on gross weight and deceleration technique.

Brake Applications	Gross Weight (lb) 20-5 Kts	Gross Weight (lb) 15-0 Kts
4	30,100 or higher	-
5	24,100 to 30,099	-
6	20,100 to 24,099	
7	20,099 or below	28,700 to 30,350
8	-	25,100 to 28,699
9	-	22,400 to 25,099
10		20,100 to 22,399
11		18,300 to 20,099
12		18,299 or below

If taxiway contamination is such that stopping distance is excessive or the above number of brake applications cannot be applied, consideration should be given to brake applications during a runway back-taxi or an alternate improved surface.

After Takeoff

If conditions permit, consider delaying gear retraction until 200 KIAS to aid in clearing moisture and slush from the gear assemblies.

Cold Weather Altimeter Setting Procedures

CAUTION
Extreme caution should be exercised when flying in proximity to obstructions or terrain in low temperatures.

This is especially true in extremely cold temperatures that cause a large differential between the Standard Day temperature and actual temperature. This circumstance can cause serious errors that result in the airplane being significantly lower than the indicated altitude.

Temperature has an effect on the accuracy of altimeters and your altitude. The crucial values to consider are standard temperature versus the ambient (at altitude) temperature. It is this “difference” that causes the error in indicated altitude. When the air is warmer than standard, you are higher than your altimeter indicates. Subsequently, when the air is colder than standard you are lower than indicated. It is the magnitude of this “difference” that determines the magnitude of the error. When flying into a cooler air mass while maintaining a constant indicated altitude, you are losing true altitude. However, flying into a cooler air mass does not necessarily mean you will be lower than indicated if the difference is still on the plus side. For example, while flying at 10,000 feet (where STANDARD temperature is -5°C), the outside temperature cools from +5°C to 0°C, and the temperature will nevertheless cause the airplane to be HIGHER than indicated. It is the extreme “cold” difference that normally would be of concern to the pilot. Also, when flying in cold conditions over mountainous country, the pilot should exercise caution in flight planning both in regard to route and altitude to ensure adequate enroute and terminal area terrain clearance.

The table below was derived from ICAO formulas and indicates how much error can exist when the temperature is extremely cold. To use the table, find the reported temperature (Temp (°C)) in the left column, then read across the top row to locate the height above the airport / reporting station (i.e., subtract the airport / reporting elevation from the intended flight altitude). The intersection of the column and row is how much lower the airplane may actually be as a result of the possible cold temperature induced error.

Temp	Height Above Airport (Feet)						
(°C)	**200**	**300**	**400**	**500**	**600**	**700**	**800**
+10	10	10	10	10	20	20	20
0	20	20	30	30	40	40	50
-10	20	30	40	50	60	70	80
-20	30	50	60	70	90	100	120
-30	40	60	80	100	120	130	150
-40	50	80	100	120	150	170	190
-50	60	90	120	150	180	210	240
Temp	**Height Above Airport (Feet)**						
°C	**900**	**1000**	**1500**	**2000**	**3000**	**4000**	**5000**
+10	20	20	30	40	60	80	90
0	50	60	90	120	170	230	280
-10	90	100	150	200	290	390	490
-20	130	140	210	280	420	570	710
-30	170	190	280	380	570	760	950
-40	220	240	360	480	720	970	1210
-50	270	300	450	590	890	1190	1500

The possible result of the previous example should be obvious, particularly if operating at the minimum altitude or when conducting an instrument approach. When operating in extreme cold temperature, pilots may wish to compensate for the reduction in terrain clearance by adding a cold temperature correction.

Landing Considerations

Landing on a precipitation-covered runway is similar to short field operations where speed is minimized and maximum rollout distance is made available. Runway composition, condition and construction, the amount of precipitation, and depth of MLG tire tread remaining affect the magnitude of braking degradation, so it is impossible to apply a fixed factor to cover all conditions. Refer to the FAA Approved Aircraft Flight Manual, Section IV, Performance for data that will permit estimation of the minimum runway required under various precipitation-covered runway conditions. A firm touchdown, maximizing rollout runway available, and touching down at a minimum safe speed will provide the greatest possible margin.

Since ground speed is the critical factor, landing on precipitation-covered runways with any tailwind component should be avoided. Tread depth tends to relieve hydrodynamic pressure under the tire on wet runways and proper inflation is important because a low tire pressure lowers the minimum hydroplaning speed. Anticipated operation on precipitation-covered runways dictates close monitoring of tire condition and pressure. Use of the thrust reversers on precipitation-covered runways is the same as that for a landing on a normal or dry runway. Cockpit visibility is not hampered by blowing rain, snow or ice thrown forward by the thrust reverser. Single-engine reversing during crosswind landings on precipitation-covered runways should be used with discretion. After landing on ice or slush, a complete check of the aircraft, including overboard vents, brakes, and control surfaces should be conducted.

Hot Weather Operations

General

Hot weather operation generally means operation in a hot, humid atmosphere. High ambient temperatures on the ground have important effects on performance, crew and operating efficiency. High temperatures, alone or coupled with high humidity or blowing sand and dust, will complicate normal operations. Proper protection and inspection of the airplane while it is on the ground, and observance of the precautions covered in this section, will assure the most successful operation. High humidity usually results in the condensation of moisture throughout the airplane, which can result in malfunctioning of electrical and electronic equipment, fogging of instruments, and growth of fungi in vital areas of the airplane. Further results may be pollution of lubricants, hydraulic fluid, and fuel. The procedures essential to operation under such conditions are given in the following paragraphs. These procedures are in addition to the normal operating procedures.

Preflight Inspection

Inspect the airplane for the presence of corrosion or fungus at joints, hinge points, and similar locations. If corrosion or fungus is found, ensure it is removed. Inspect the airplane for hydraulic leaks, as heat and moisture may cause seals and packings to swell. Inspect the landing gear struts for cleanliness. Use a clean, dry, soft cloth to wipe the shock strut chrome piston clean. Inspect the tires for proper inflation. Ensure all protective covers, plugs and shields are removed.

If instruments, equipment, and controls are coated with moisture, wipe them dry with a clean, soft cloth. Use mild ground heat if necessary to dry them. To achieve better cabin cooling during ground operation, it is recommended that APU be used as the air source for the air conditioning system. Complete as much of the checklist as possible before starting engines, to avoid prolonged ground operation. Ensure that the APU BLEED AIR button is selected to ON.

Taxi and Takeoff

Limit the use of brakes as much as possible during taxi, as cooling is reduced when outside air temperatures are high. Idle reverse thrust can be used to reduce brake usage on clean taxiways. Execute a normal takeoff.

> ***NOTE:*** Examine performance data thoroughly to determine the adverse effects of high temperature on airplane performance.

Landing and Parking

Adhere to normal landing procedures and avoid excessive use of brakes to prevent overheating. Before leaving the airplane, ensure protective covers are installed promptly on pitot tubes, intake ducts and exhaust ducts. Ensure windshield protective sun screens are installed on cockpit windows. Close cabin window shades. If unable to close shades, ensure there are no pillows or material items close to the window. If the life rafts are expected to be exposed to temperatures above 53.5°C (130°F), it is recommended that they be removed from the airplane. At temperatures above 53.5°C (130°F), the CO_2 cartridge may discharge. Close the main entrance door and external baggage compartment door.

High Elevation Airport Operations

This subsection presents the recommended procedures to assist in engine starting, taxi, takeoff and landing operations at high elevation airports.

The maximum altitude limit for takeoffs and landings is restricted to airport field elevations of 14,000 feet. On approach, landing and rollout, be aware of increases in True Airspeed (TAS) and Ground Speed (GS). Ground speed amplified by tailwind conditions could exceed maximum tire speed on landing.

The cabin altitude selector is marked with an amber arc from 8,000 ft. to 14,000 ft. designating that special procedures are required for operation to or from high elevation airports. When the aircraft is operated in this region, the pressurization controller deactivates the cabin altitude amber (8,500 ft.) **CABIN ALTITUDE CAS** message and will cause the red (10,000 ft.) **CABIN ALTITUDE CAS** message to be set to 14,500 ft. The following is a summary of operating procedures using the high altitude airport mode.

Conditions	Procedure	Pressurization System Will
Takeoff from field elevation <8,000 ft. to high elevation airport.	Select landing airport elevation. Set Normal Auto Schedule mode.	After takeoff, will maintain cabin per auto schedule. Will begin rating cabin to 8,000 ft. when aircraft has descended 1,000 ft. from cruise. Will rate cabin to selected altitude when the aircraft is below 24,500 ft. MSL.
Takeoff from field elevation ≥8,000 ft. to another high elevation airport, short distance flight below 24,500 ft. MSL.	Set Altitude Select mode. Select landing airport elevation. Consider oxygen requirements.	After takeoff, will rate cabin to landing field elevation.
Takeoff from field elevation ≥8,000 ft. to airport <8,000 ft. or to airport ≥8,000 ft., longer distance flight above 24,500 ft. MSL.	Set Normal Auto Schedule mode. Select landing airport elevation.	After takeoff, will rate to and maintain cabin at 8,000 ft. Will rate cabin to normal auto schedule after 10 minutes at level cruise or when aircraft descends 1,000 ft. If landing elevation is greater than 8,000 ft., will rate cabin to 8,000 ft. after aircraft has descended 1,000 ft. and will rate to selected elevation when aircraft has descended below 24,500 ft. MSL.
Go-Around and return to land at high elevation airport. Takeoff from and return to land at high elevation airport.	Set Altitude Select mode at Go-Around or when returning to land. Select landing airport elevation.	In auto schedule, cabin will begin rating down to 8,000 ft. when climb is started. Selecting Altitude Select mode will retain landing airport cabin altitude.

> ***NOTE:*** The cyan **CABIN ALTITUDE** CAS message will be displayed when the High Altitude Airfield mode is engaged and the cabin altitude is above 8,500 ft. for less than 30 minutes.
>
> The amber **CABIN ALTITUDE** CAS message will be displayed when the High Altitude Airfield mode is engaged and the cabin altitude has been above 8,500 ft. for more than 30 minutes. When displayed, both pilots must don oxygen masks and use oxygen.
>
> If the field elevation selected for the destination is greater than 8,000 ft., then the cabin will begin rating up to the selected altitude upon descent below 24,500 ft. MSL. If the aircraft subsequently returns to an altitude above 24,500 ft., the cabin will begin rating back down to 8,000 ft. If the aircraft reaches 24,500 ft. while the cabin altitude is high, the amber and red **CABIN ALTITUDE** CAS messages will illuminate.
>
> If the aircraft is to hold above 12,000 ft. MSL, cabin altitude must be selected at or below 12,000 ft. until holding is completed; otherwise one pilot must wear an oxygen mask and use oxygen.

Engine Start

During engine starts at high elevation airports (generally above 8,000 feet), ITT may reach a temperature where the FADEC will schedule fuel flow to prevent exceeding an ITT limit. This will appear to the pilot as a cycling in the ITT display and corresponding aural engine indications. This is normal and acceptable provided N_2 continues to increase. Once the engines are running, FADEC will compensate for altitude, keeping ground idle speeds within limits. Thus the left and right generators (L GEN/R GEN) will remain on line.

Takeoff

Certain high elevation airports have preferential runways for takeoff and landing, i.e., upslope for landing and downslope for takeoff. Slope, headwind and tailwind conditions should be given due consideration. Expect a slower-than-normal acceleration.

Approach and Landing

On approach, landing and rollout, be aware of True Airspeed (TAS) and Ground Speed (GS). A 145 KIAS approach speed can translate to 175 KTAS. Ground speed amplified by tailwind conditions could exceed maximum tire speed on landing. Expect slower than normal thrust reverser spool-up times.

Use of Supplemental Oxygen

Use of oxygen by the flight crew while performing high-workload tasks at high-elevation airports or at field elevations for which the flight crew is not acclimated is highly recommended. For operations at field elevations at or above 10,000 feet, the use of oxygen is recommended.Turbulent Air Penetration

Flight through severe turbulence should be avoided if possible. The following procedures are recommended for flight in severe turbulence.

1. Maximum Airspeed . . . . .225 KIAS OR MACH 0.80 WHICHEVER IS LESS (DO NOT CHASE AIRSPEED)
2. Maintain a constant attitude without chasing the altitude. Avoid sudden large control movements.
3. If Autopilot Is Engaged. . . . . DISENGAGE ALTITUDE HOLD
4. SEAT BELT Button . . . . .ON

END

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6

Standard Operating Procedures

Contents

General Information

CAE SimuFlite strongly supports the premise that the disciplined use of well-developed Standard Operating Procedures (SOP) is central to safe, professional aircraft operations, especially in multi-crew, complex, or high performance aircraft.

If your flight department has an FAA-accepted or approved SOP document, we encourage you to use it during your training. If your flight department does not already have one, we welcome your use of the CAE SimuFlite SOP.

Corporate pilots carefully developed this SOP. A product of their experience, it is the way CAE SimuFlite conducts its flight operations. In general, effective SOPs are the product of healthy collaboration among managers and flight operations people, including flight crews. A safety culture promoting continuous feedback from flight crews and other, and continuous revision by the collaborators distinguishes effective SOPs at flight departments of all sizes and ages.

The procedures described herein are specific to the Citation Sovereign and apply to specific phases of flight. The flight crew member designated for each step accomplishes it as intended.

Definitions

LH/RH: Pilot Station.

- Designation of seat position for accomplishing a given task because of proximity to the respective control/indicator. Regardless of PF or PM role, the pilot in that seat performs tasks and responds to checklist challenges accordingly.

PF: Pilot Flying.

- The pilot responsible for controlling the flight of the aircraft, either manually or through automation monitoring.

PIC: Pilot-in-Command.

- The pilot responsible for the operation and safety of an aircraft during flight time.

PM: Pilot Monitoring.

- The pilot who is monitoring the flight of the aircraft and actions of the PF.

Flow Patterns

Flow patterns are an integral part of the SOP. Accomplish the cockpit setup for each phase of flight with a flow pattern, then refer to the checklist to verify the setup. Use normal checklists as “done lists” rather than “do lists.”

Flow patterns are disciplined procedures; they require pilots who understand the aircraft systems/controls and who methodically accomplish the flow pattern.

Checklists

Use a challenge-response method to execute any checklist. After the PF initiates the checklist, the PM challenges by reading the checklist item aloud. The PF is responsible for verifying that the items designated as PF or his seat position (i.e., LH or RH) are accomplished and for responding orally to the challenge.

Items designated on the checklist as PM or by his seat position are the PM's responsibility. The PM accomplishes the item, then responds orally to his own challenge. In all cases, the response by either pilot is confirmed by the other and any disagreement is resolved prior to continuing the checklist.

After the completion of any checklist, the PM states "_______ checklist is complete." This allows the PF to maintain situational awareness during checklist phases and prompts the PF to continue to the next checklist, if required.

Effective checklists are pertinent and concise. Use them the way they are written: verbatim, smartly, and professionally.

At the captain's discretion or as dictated by individual company SOP, some phases of flight (such as after takeoff and during climb) may be better suited for silent completion of the checklist by the PM, upon command of the PF. The PM will generally accomplish a flow pattern and then verify that the items have been completed using the checklist. The PM then acknowledges completion of the checklist to the PF, stating "_____ checklist complete".

Omission of Checklists

While the PF is responsible for initiating checklists, the PM should ask the PF whether a checklist should be started if, in his opinion, a checklist is overlooked. As an expression of good crew resource management, such prompting is appropriate for any flight situation: training, operations, or check rides.

Challenge/No Response

If the PM observes and challenges a flight deviation or critical situation, the PF should respond immediately. If the PF does not respond by oral communication or action, the PM must issue a second challenge that is loud and clear. If the PF does not respond after the second challenge, the PM must ensure the safety of the aircraft. The PM must announce that he is assuming control, and then take the necessary actions to return the aircraft to a safe operating envelope.

> ***NOTE:*** "Control" means responsible for flight control of the aircraft, whether manual or automatic.

Normal Procedures

The normal procedures checklist should be thought of as routine in day-to-day flying. It should be accomplished using the following procedures:

One Pilot in Cockpit

The Preflight Inspection, Cockpit Preparation, Before Starting, Starting Engine and Shutdown checklists may be accomplished by one pilot alone. The checklist items should be verified as listed in the checklist or as required by the SOPs. A pilot that completes one of these checklists alone must make known to the other pilot which checklist(s) is/are completed.

Both Pilots in Cockpit

Checklist items should be accomplished as listed or as required by the SOPs. Any response different from the listed response should indicate something is abnormal and should be challenged by the other crewmember before continuing. When a response on a checklist is "as required" the appropriate crewmember should respond according to the actual switch position.

On the Ground

It is the LH pilot's responsibility to call for the checklist at the appropriate time. The RH pilot will be responsible for verifying checklist items.

In Flight

It is the PF's responsibility to call for the checklist at the appropriate time to ensure the aircraft is in correct configuration for that portion of flight. The PM will be responsible for verifying checklists items as appropriate.

Abnormal/Emergency Procedures

When any crewmember recognizes an abnormal or emergency condition, the PIC designates who controls the aircraft, who performs the tasks, and any items to be monitored. Following these designations, the PIC calls for the appropriate checklist. The crewmember designated on the checklist accomplishes the checklist items with the appropriate challenge/response.

The pilot designated to fly the aircraft (i.e., PF) does not perform tasks that compromise this primary responsibility, regardless of whether he uses the autopilot or flies manually.

Both pilots must be able to respond to an emergency situation that requires immediate corrective action without reference to a checklist. The elements of an emergency procedure that must be performed without reference to the appropriate checklist are called memory or recall items. Accomplish all abnormal and emergency procedures, including previously accomplished memory items, while referring to the printed checklist.

Accomplishing abnormal and emergency checklists differs from accomplishing normal procedural checklists in that the pilot reading the checklist states both the challenge and the response when challenging each item.

When a checklist procedure calls for the movement or manipulation of controls or switches critical to safety of flight (e.g., throttles, engine fire switches, fire bottle discharge switches), the pilot performing the action obtains verification from the other pilot that he is moving the correct control or switch prior to initiating the action.

Any checklist action pertaining to a specific control, switch, or piece of equipment that is duplicated in the cockpit is read to include its relative position and the action required (e.g., “Left Throttle – IDLE; Left Boost Pump – OFF”).

Time Critical Situations

When the aircraft, passengers, and/or crew are in jeopardy, remember three things:

- FLY THE AIRCRAFT – Maintain aircraft control.
- RECOGNIZE CHALLENGE – Analyze the situation.
- RESPOND – Take appropriate action.

Rejected Takeoffs

The aborted takeoff procedure is a preplanned maneuver; both crewmembers must be aware of and briefed on the types of malfunctions that mandate an abort. Assuming that the crew trains to a firmly established SOP, either crewmember may call for an abort.

The PF normally commands and executes the takeoff abort for directional control problems or catastrophic malfunctions. The PF usually executes an abort prior to 80 KIAS for any abnormality observed. Additionally, any indication of one of the following malfunctions above 80 KIAS but prior to V_1 is cause for an abort:

- Engine failure
- Fire
- Loss of directional control
- Red master warning

Critical Malfunctions in Flight

In flight, the observing crewmember positively announces a malfunction. As time permits, the other crewmember makes every effort to confirm/identify the malfunction before initiating any emergency action.

If the PM is the first to observe any indication of a critical failure, he announces it and simultaneously identifies the malfunction to the PF by pointing to the indicator/annunciator.

After verifying the malfunction, the PF announces his decision and commands accomplishment of any checklist memory items. The PF monitors the PM during the accomplishment of those tasks assigned to him.

Non-Critical Malfunctions in Flight

Procedures for recognizing and verifying a noncritical malfunction or impending malfunction are the same as those used for time-critical situations: use positive oral and graphic communication to identify and direct the proper response. Time, however, is not as critical and allows a more deliberate response to the malfunction. Always use the appropriate checklist to accomplish the corrective action.

Radio Tuning and Communication

The PM accomplishes navigation and communication radio tuning, identification, and ground communication.

For navigation radios, the PM tunes and identifies all navigation aids. Before tuning the PF's radios, he announces the NAVAID to be set. In tuning the primary NAVAID, in particular, the PM coordinates with the PF to ensure proper selection sequencing with the autopilot mode. After tuning and identifying the PF's NAVAID, the PM announces “(Facility) tuned and identified.”

Monitor NDB audio output at any time that the NDB is in use as the NAVAID. Use the marker beacon audio as backup to visual annunciation for marker passage confirmation.

In tuning the VHF radios for ATC communication, the PM places the newly assigned frequency in the COM Tune window at the time of receipt. Pressing the appropriate line select key transfers the preselect frequency to the active frequency. After contact on the new frequency, the PM retains the previously assigned frequency for a reasonable time period. Any confusion in the flight deck related to ATC communication is immediately cleared up by requesting ATC confirmation.

Flight Management System

The crew should review the programmed FMS flight plan prior to starting engines. Normally, the pilot conducting the cockpit setup has programmed the FMS flight plan through either MCDU. The flight plan is then displayed for review by both pilots against the dispatch release or ATC clearance routing. Any flight plan errors are corrected at this time. Once the briefing is complete and both pilots agree with the FMS flight plan, it is cross-filled to the other FMS if operating in the Initiated Transfer mode.

During FMS operations, both crewmembers should have the FMS mode selected on their display controller. Any underlay information required should be displayed with the bearing pointers. The PFD command mode of the FGP should always be selected to the flying pilot’s side. When transitioning from VHF NAV mode to FMS mode or vice versa, the crewmember making the change will state the mode selected.

In the event of a discrepancy between a charted airway or procedure and the FMS database, the chart/map is the final authority. It is the responsibility of the crew to ensure that the FMS guidance conforms to the chart.

With the autopilot engaged, either pilot (one at a time) may conduct FMS programming above 10,000 feet. Below 10,000 feet, the PF should request the PM to make all the FMS entries. With the autopilot OFF, the PM will conduct all FMS programming confirmed by PF.

For arrival and approaches, the appropriate charts should be out of the flight kit, opened and available. Full LNAV/VNAV guidance using the FMS during terminal operations must be limited to situations permitting advance preparations, review of FMS programming and complete crew briefings. This level of automation is not appropriate when significant changes to route or landing runway have been issued by ATC. In such situations, pilots should revert, at least temporally, to a lower level of automation. All approaches, both enabled (coupled to the FMS) and advisory (FMS data used for situational awareness), should be programmed in the FMS. Enabled approaches should be flown by using the FMS. Editing the flight plan after the approach label is permitted on advisory approaches only. Editing on an enabled approach cannot be done without consequences such as loss of the approach vertical guidance and canceling approach scaling if available.

WARNING

EXTREME CAUTION MUST BE EXERCISED BY MONITORING APPROPRIATE ANNUCIATORS TO INSURE THAT THE PROPER NAVIGATION INFORMATION IS SELECTED AND UTILIZED ON EACH APPROACH.

NOTE: The PF will monitor/control the aircraft, regardless of the level of automation employed. The PM will monitor the aircraft and actions of the PF.

Altitude Assignment

The PM sets the assigned altitude in the PFD altitude preselect display and points to the ALT knob on the Flight Guidance Panel while orally repeating the altitude. The PM continues to point to the ALT knob until the PF confirms the altitude assignment and PFD altitude window setting.

Pre-Departure Briefings

The PF should conduct a pre-departure briefing prior to each flight to address potential problems, weather delays, safety considerations, and operational issues.

Pre-departure briefings should include all crewmembers to enhance team-building and set the tone for the flight. The briefing may be formal or informal, but should include some standard items. This is also an opportunity to brief the crew on any takeoff or departure deviations from the SOP that are due to weather or runway conditions.

> ***NOTE:*** The following are suggested items to include in the pre-departure briefing:
>
> Brief the following:
>
> - Assigned runway for takeoff
> - Initial heading, course and altitude
> - Airspeed limit (if applicable)
> - Clearance limit
> - Emergency return plan
> - SOP deviations
>
> Consider the following:
>
> - Runway and weather conditions
> - Obstacle clearance or noise abatement
> - Use of FMS for charted departure

Advising of Aircraft Configuration Change

If the PF is about to make a change to aircraft control or configuration, he alerts the PM to the forthcoming change (e.g., gear, speed brake, and flap selections). If time permits, he also announces any abrupt flight path changes so there is always mutual understanding of the intended flight path.

Time permitting, a PA announcement to the passengers precedes maneuvers involving unusual deck or roll angles.

Transitioning from Instrument to Visual Meteorological Conditions

If Visual Meteorological Conditions (VMC) are encountered during an instrument approach, the PM normally continues to make callouts for the instrument approach being conducted. However, the PF may request a changeover to visual traffic pattern callouts.

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Phase of Flight SOP

Holding Short

PF	PM
CALL "Before Takeoff checklist."	
	ACTION Complete the Before Takeoff checklist.
	CALL "Before takeoff checklist complete."

Takeoff Briefing

ACTION Brief the following:
- Assigned runway for takeoff
- Initial heading, course and altitude
- Airspeed limit (if applicable)
- Clearance limit
- Emergency return plan
- SOP deviations

Consider the following:
- Runway and weather conditions
- Obstacle clearance or noise abatement
- Use of FMS for charted departure

Cleared for Takeoff

PF	PM
	ACTION Confirm assigned runway for takeoff and check heading indicator agreement.
	CALL "Assigned runway confirmed, heading checked."
ACTION Confirm assigned runway for takeoff and check heading indicator agreement.	
CALL "Assigned runway confirmed, heading checked."	
CALL "Line-up checklist."	
	ACTION Complete the line-up (Cleared for Takeoff) items on the Before Takeoff checklist.
	CALL "Line-up checklist Complete."

Takeoff Roll

PF	PM
Setting Takeoff Power	
ACTION Set takeoff power.	
CALL "Check power."	
	ACTION Confirm power setting.
	CALL "Power checked."
Initial Airspeed Indication	
	ACTION Check airspeed alive.
	CALL "Airspeeds alive."
ACTION Visually confirm positive IAS indication.	
At 80 KIAS	
	ACTION Cross-check 80 KIAS.
	CALL "80 knots."
CALL "80 knots."	
At V_1	
	CALL "V_1."
ACTION Move hand from throttles to yoke.	
At V_R	
	CALL "Rotate."
ACTION Rotate to approximately 10° pitch attitude for takeoff.	

Climb

PF		PM	
At Positive Rate of Climb on VSI			
Only after PM's call,		**CALL**	"Positive rate."
CALL	"Gear up."	**ACTION**	Select gear UP and verify gear indicates UP.
At V_2 +10 KIAS and 400 Feet Above Airport Surface (Minimum)			
CALL	"Flaps up."		
		CALL	"Flaps up."
		ACTION	Verify flap indicator and synoptic show flaps UP.
At 1,000 Feet AGL (Minimum)			
CALL	"Select Flight Level Change (or Vertical Speed)."		
ACTION	Move throttles to MCT detent.	**ACTION**	Select FLC or VS on the Guidance Panel. Confirm that power is set to the MCT detent.
		CALL	"Flight Level Change (or Vertical Speed) selected."
At 1,500 Feet (Minimum) Above Airport Surface and Workload Permitting or climbing through 10,000 Feet whichever is higher			
CALL	"After Takeoff/Climb checklist."		
		ACTION	Complete After Takeoff/Climb checklist silently.
		CALL	"After Takeoff/Climb checklist complete."
At Transition Altitude			
CALL	"29.92 or 1013 set."	**CALL**	"29.92 or 1013 set."

Cruise

PF	PM
At 1,000 Feet Below Assigned Altitude	
	CALL "_____ (altitude) for _____ (altitude)." (e.g., "9,000 for 10,000.")
CALL "_____ (altitude) for _____ (altitude)." (e.g., "9,000 for 10,000.")	
At Cruise Altitude	
CALL "Cruise checklist."	
	ACTION Complete Cruise checklist.
	CALL "Cruise checklist complete."
Altitude Deviation in Excess of 100 Feet	
	CALL "Altitude."
CALL "Correcting."	
Course Deviation in Excess of One Half Dot	
	CALL "Course."
CALL "Correcting."	

Descent

PF	PM
Upon Initial Descent from Cruise	
CALL "Descent checklist."	
	ACTION Complete Descent checklist.
	ACTION Program FMS for approach and landing data.
	CALL "Descent checklist complete."
At 1,000 Feet Above Assigned Altitude	
	CALL "_____ (altitude) for _____ (altitude)." (e.g., "10,000 for 9,000.")
CALL "_____ (altitude) for _____ (altitude)." (e.g., "10,000 for 9,000.")	
At FL 180	
CALL "Approach checklist."	
	ACTION Initiate Approach Checklist. RECOG lights on. APU - verify operating (if desired).
	CALL "RECOG on; APU on."
At Transition Level	
CALL "Altimeter set ___, three times."	**CALL** "Altimeter set ____ ."
	ACTION Verify altimeters set correctly.
At 10,000 Feet	
	CALL "10,000 feet"

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PF	PM

CALL "Check."
"Speed 250 Knots."

Maintain sterile cockpit below 10,000 feet above airport surface.

At Appropriate Workload Time

REVIEW | **REVIEW**

Review the following:
- Weather
- Field conditions

At appropriate workload time:
- Approach to be executed
- Field elevation
- Appropriate minimum sector altitude(s)
- Inbound leg to FAF, procedure turn direction and altitude
- Final approach course heading and intercept altitude
- Timing required
- DA/MDA
- MAP (non-precision)
- VDP
- Special procedures (VNAV, glide path, DME step-down, arc, etc.,)
- Type of approach lights in use (and radio keying procedures, if required)
- Missed approach procedures
- Runway information conditions

ACTION Brief the following:
- Configuration
- Approach speed
- Minimum safe altitude (MSA)
- Approach course
- FAF altitude
- FMS Flight Plan
- VNAV plan (non-precision)
- DA/MDA altitude
- Field elevation
- VDP
- Missed approach
  - Heading
  - Altitude
  - Intentions
- Abnormal implications

Accomplish as many checklist items as possible. The Approach checklist must be completed prior to the initial approach fix.

Precision Approach

PF	PM
Prior to Initial Approach Fix	
CALL "Flaps 7."	
	CALL "Flaps selected 7." When flaps indicate 7 degrees, "Flaps indicate 7."
CALL “Approach checklist.”	
	ACTION Complete Approach checklist.
	CALL “Approach checklist complete.”
After Initial Convergence of Course Deflection Bar	
CALL “Localizer/course alive.”	**CALL** “Localizer/course alive.”
At initial Downward Movement of Glideslope Raw Data Indicator	
CALL “Glideslope alive.”	**CALL** “Glideslope alive.”
CALL “Flaps 15.”	
	CALL “Flaps selected 15.”
Glideslope One Dot Above	
CALL “Gear down. Before Landing Checklist.”	
	CALL When gear indicates down, “Gear indicates down.”
Glideslope Centered	
CALL “Flaps FULL.”	
	CALL When flaps indicate FULL, “Flaps indicate FULL.”

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PF	PM
	ACTION Complete Before Landing checklist.
	CALL "Before Landing checklist complete."

When Annunciator Indicates Glideslope Capture

PF	PM
CALL "Glideslope captured."	**CALL** "Glideslope captured."

If the VOR on the PM's side is used for crosschecks on the intermediate segment, the PM's localizer and glideslope status calls are accomplished at the time when the PM changes to the ILS frequency. This should be no later than at completion of the FAF crosscheck, if required. The PM should tune and identify his NAV radios to the specific approach and monitor. The approach should be loaded into the FMS and correctly sequenced to provide situational awareness and missed approach guidance.

At FAF

PF	PM
CALL "Outer marker." or "Final fix."	
	ACTION ▪ Start timing. ▪ Visually crosscheck that both altimeters agree with crossing altitude. ▪ Set missed approach altitude in altitude alerter. ▪ Check PF and PM instruments. ▪ Call FAF inbound. ▪ Verify correct FMS waypoint sequencing.
	CALL "Outer marker." or "Final fix." "Altitude checks."

At 1,000 Feet Above DA(H)

PF	PM
	CALL "1,000 feet to minimums."

At 500 Feet Above DA(H)

PF	PM
	CALL "500 feet to minimums."

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PF	PM

NOTE: An approach window has the following parameters:

- Within one dot deflection, both LOC and GS
- IVSI less than 1,000 FPM
- IAS within V_{REF} + 10 knots (no less than V_{REF}).
- No flight instrument flags with the landing runway or visual references not in sight
- Landing configuration

When within 500 feet above touchdown, the aircraft must be within the approach window. If the aircraft is not within this window, a missed approach must be executed.

At 100 Feet Above DA(H)

PF	PM
	CALL "100 feet to minimums."

At point where PM Sights Runway or Visual References

PF	PM
	CALL "Runway (or visual reference) ____ o'clock."
CALL "Going visual. Land." or "Missed approach."	
	ACTION As PF goes visual, PM transitions to instruments.

At DA(H)

PF	PM
CALL "Minimums."	
	CALL "Runway (or visual reference) ____ o'clock."
ACTION Announce intentions.	
CALL "Going visual. Land." or "Missed approach."	
	ACTION As PF goes visual, PM transitions to instruments.

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PF	PM
100 Feet Above Touchdown on ILS Approach	
CALL "Minimums."	
	CALL "Approach lights in sight, continue."
CALL "Continue."	
ACTION Set new minimums at 100 feet above touchdown.	
CALL "Minimums."	
	CALL "Runway in sight."
CALL "Going visual. Land." or "Missed approach."	
	ACTION As PF goes visual, PM transitions to instruments.

Precision Missed Approach

PF	PM
At DA(H)	
CALL "MInimums."	
	CALL "Runway not in sight."
CALL "Missed Approach."	
ACTION Activate GA. Set power to TAKEOFF detent. Rotate to the flight director Go-Around command.	**ACTION** Monitor power setting.

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PF	PM
CALL "Flaps 15 or 7."	
	CALL "Flaps selected 15 or 7." When flaps indicate 15 or 7°, "Flaps indicate 15 or 7."
At Positive Rate of Climb on VSI	
	CALL "Positive rate."
CALL "Gear up."	
	CALL "Gear selected up." When gear indicates up, "Gear indicates up."
	ACTION Announce heading and altitude for missed approach.
At V_{REF} +10 and 400 Feet Above Airport Surface (Minimum)	
	CALL "V_{REF} +10."
CALL "Flaps up."	
	CALL "Flaps up." When flaps indicate UP, "Flaps indicating UP."
At 1,500 Feet (Minimum) Above Airport Surface and Workload Permitting	
CALL "Go-Around checklist."	
	ACTION Complete Go-Around checklist.
	CALL "Go-Around checklist complete."

Precision Approach Deviations

PF	PM
± One Half Dot – Glideslope	
	CALL "One half dot (high, low) and (increasing, holding, decreasing)."
CALL "Correcting."	
± One Half Dot – Localizer	
	CALL "One half dot (right, left) and (increasing, holding, decreasing)."
CALL "Correcting."	
V_{REF} >10 Knots	
	CALL "V_{REF} plus _____ (knots) and (increasing, holding, decreasing)."
CALL "Correcting."	
At or Below V_{REF}	
	CALL "V_{REF}." or "V_{REF} minus _____ (knots below V_{REF})."
CALL "Correcting."	
Rate of Descent Exceeds 1,000 FPM	
	CALL "Sink _____ (amount) hundred and (increasing, holding, decreasing)."
CALL "Correcting."	

Non-Precision Approach

PF	PM
Prior to Initial Approach Fix	
CALL "Flaps 7."	
	CALL "Flaps selected 7." When flaps indicate 7 degrees, "Flaps indicate 7."
CALL "Approach checklist."	
	ACTION Complete Approach checklist.
	CALL "Approach checklist complete."
At Initial Convergence of Course Deviation Bar	
CALL "Localizer/course alive."	**CALL** "Localizer/course alive."holding, decreasing)."
CALL "Flaps 15."	
	CALL "Flaps 15." When Flaps indicate 15 degrees "Flaps 15."
When Annunciators Indicate Course Capture	
CALL "Localizer/course captured."	**CALL** "Localizer/course captured."
Prior to FAF	
	CALL "_____ (number) miles/minutes from FAF."
CALL "Gear down. Before Landing checklist."	

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PF	PM
	CALL When annunciator illuminates, "Gear indicates down."
At FAF	
CALL "Flaps FULL."	
	CALL When flaps indicate FULL, "Flaps indicate FULL."
	ACTION Complete before Landing Checklist.
CALL "Outer marker." or "Final fix."	**CALL** "Outer marker." or "Final fix."
	ACTION ▪ Start timing. ▪ Visually crosscheck that both altimeters agree. ▪ Set MDA (or nearest 10 feet above) in altitude alerter. ▪ Check PF and PM instruments. ▪ Call FAF inbound. ▪ Verify correct FMS waypoint sequencing.
	CALL "Altimeters check."
At 1,000 Feet Above MDA	
	CALL "1,000 feet to minimums."
At 500 Feet Above MDA	
	CALL "500 feet to minimums."

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PF	PM

NOTE: An approach window has the following parameters:
- Within one dot CDI deflection or 5 degrees bearing
- IVSI less than 1,000 FPM
- IAS within V_{REF} +10 knots (no less than V_{REF} or 0.6 AOA, whichever is less)
- No flight instrument flags with the landing runway or visual references not in sight
- Landing configuration

When within 500 feet above touchdown, the aircraft must be within the approach window. If the aircraft is not within this window, a missed approach must be executed.

At 100 Feet Above MDA

PF	PM
	CALL "100 feet to minimums."

At MDA

PF	PM
CALL "Minimums."	
	CALL "Minimums. _____ (time) to go." or "Minimums. _____ (distance) to go."
CALL "Maintaining MDA."	

At Point Where PM Sights Runway or Visual References

PF	PM
	CALL "Runway (or visual reference) _____ o'clock."
CALL Going Visual. Land." or "Missed Approach."	
	ACTION As PF goes visual, PM transitions to instruments.

Non-Precision Missed Approach

PF		PM	
At MAP			
CALL	"Missed approach point. Missed approach."		
ACTION	Activate GA. Set power to TAKEOFF detent. Rotate to the Flight Director Go-Around command.	**ACTION**	Monitor power setting.
CALL	"Flaps 15 or 7."		
		CALL	"Flaps selected 15 or 7." When flaps indicate 15 or 7 degrees, "Flaps indicate 15 or 7."
At Positive Rate of Climb			
		CALL	"Positive rate."
CALL	"Gear Up."		
		CALL	When annunciator illuminates, "Gear indicates up."
		ACTION	Announce heading and altitude for missed approach.
At V_{REF} +10 and 400 Feet Above Airport Surface (Minimum)			
		CALL	"V_{REF} +10."
CALL	"Flaps up."		
		CALL	When flaps indicate UP, "Flaps indicating UP."

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PF	PM
At 1,500 Feet (Minimum) Above Airport Surface and Workload Permitting	
CALL "Go-Around checklist."	
	ACTION Complete Go-Around checklist.
	CALL "Go-Around checklist complete."

Non-Precision Approach Deviations

PF	PM
± One Dot – Localizer/VOR	
	CALL "One dot (right, left) and (increasing, holding, decreasing)."
CALL "Correcting."	
± 5 Degrees At or Beyond Midpoint for NDB Approach	
	CALL "_____ (degrees off course) (right, left) and (increasing, holding, decreasing)."holding, decreasing)."
CALL "Correcting."	
V_{REF} >10 Knots	
	CALL "V_{REF} plus _____ and (increasing, holding, decreasing)."
CALL "Correcting."	
At or Below V_{REF}	
	CALL "V_{REF}." or V_{REF} minus _____ (knots below V_{REF}.)."
CALL "Correcting."	

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PF	PM
Descent is ±200 FPM of Briefed Rate	
	CALL "Sink _____ (amount) hundred and (increasing, holding, decreasing)."
CALL "Correcting."	

Visual Traffic Patterns

PF	PM
Before Pattern Entry/Downwind (1,500 Feet Above Airport Surface)	
CALL "Approach checklist." approach."	
	ACTION Complete Approach checklist.
	CALL "Approach checklist complete."
CALL "Flaps 15."	
	CALL When flaps indicate 15 degrees, "Flaps indicate 15."
Abeam Threshold	
CALL "Gear down." "Before Landing checklist."	
	CALL When annunciator illuminates, "Gear indicates down."
	ACTION Complete Before Landing checklist.

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PF	PM
Base Leg	
CALL "Flaps FULL."	
	CALL When flaps indicate FULL degrees, "Flaps indicate FULL. Before Landing checklist complete."
At 1,000 Feet Above Airport Surface	
	CALL "1,000 feet AGL."
CALL "Check."	
At 500 Feet Above Airport Surface	
	CALL "500 feet AGL."
CALL "Check."	

Landing

PF	PM

Landing Assured (At Point on Approach When PF Sights Runway and Normal Landing Can be Made)

PF	PM
CALL "Going visual. Land."	
ACTION Push autopilot disconnect button.	**ACTION** At 100 feet AGL: ▪ Speed check ▪ Vertical speed check ▪ Callouts ▪ Gear down verification ▪ Flap verification
CALL "Autopilot off."	
	CALL "Final gear and flaps recheck Cleared to land."

At Touchdown

PF	PM
ACTION Extend speed brakes immediately upon main gear touchdown. Move hand from control yoke to nosewheel steering.	
	ACTION Take control yoke from PF. Apply forward pressure to the control column.

At Thrust Reverser Deployment

CAUTION: Nosewheel should be firmly on the ground before attempting to deploy the thrust reversers.

PF	PM
	CALL "Two deployed."

Prior to Thrust Reverser Idle Speed (65 KIAS, maximum)

PF	PM
	CALL "70 knots".
CALL "Idle."	

NOTE: Thrust reversers should be stowed by taxi speed.

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Maneuvers

Contents

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Maneuvers

General

This chapter contains the procedures and techniques for operating the Citation Sovereign aircraft on the ground and for various flight maneuvers. There is always more than one way to fly an aircraft; however, these procedures have evolved from many thousands of Citation Sovereign flying hours and have proven to be safe and functional.

Should any conflict exist between this information and the procedures in the Airplane Flight Manual, the Flight Manual shall take priority. Any implied techniques presented assume that proper pilot skill and judgement are exercised.

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Two Engine Operation

Taxiing

General

Taxi procedures for the Citation Sovereign aircraft are basically the same as previous models of Cessna Citation aircraft. Some special care is required, however, because of the CE-680 additional engine thrust and the nose wheel steering system. Particular attention to correct taxi speed and adequate wing clearance is also required.

Use of Thrust

To break away at the ramp, release the brakes and smoothly advance the throttles to let the aircraft roll forward. Because of the residual thrust created at idle power, very little throttle movement is needed to move the aircraft. When adding power, wait for the aircraft to respond before adding additional power. As the engines spool up, the aircraft will begin moving smoothly at a comfortable speed. If obstructions are behind the aircraft, use the minimum thrust necessary for taxi to avoid damage caused by engine exhaust. Both engines should be used together to reduce the amount of thrust required from any one engine.

Braking

Do not ride the brakes. Overheated brakes reduce braking efficiency and could seriously affect the stopping distance in a rejected takeoff. Use of idle reverse is permissible on clean taxiways to reduce brake usage; however, deployment of the thrust reversers for more than 30 seconds with the APU operating is prohibited.

Maneuvering

Beginning to move while at the same time attempting to turn requires a considerable higher thrust level. When a turn is required immediately following brake release, advance power to obtain sufficient speed to carry the aircraft throughout the turn. If braking is required, use brakes symmetrically.

Whenever space is available, turns should be made with less than full nosewheel steering travel. For small changes of direction, rudder pedal steering alone can be used to provide up to 7° of travel. The combined use of rudder pedal steering and nosewheel steering is additive. Force should be applied to the nosewheel steering with a constant and smooth application and returned to center gently, while keeping firm control of the nosewheel steering. Any quick movement of the nosewheel steering will result in jerky movements of the aircraft, which may be uncomfortable for the passengers.

Taxi speed should be monitored closely in tight turns. The best reference is the ground speed indication on the copilot's Multi-Function Display (MFD). Excessive speed in tight turns or on wet or slippery surfaces may cause the nose wheel to skid or scrub the side walls.

Be cautious when maneuvering in tight spaces when turning. Always use wing walkers when taxiing in tight spots. When turning into narrow taxiways from a wider surface, it is better to oversteer than understeer, i.e., go past the extended centerline of the narrow taxiway until it intersects the main door before initiating the turn.

Takeoff

Before Takeoff

Prior to takeoff, consider the following:

- Correct runway alignment for takeoff
- Initial heading, course and altitude
- Airspeed limit (if applicable)
- Clearance limit
- Emergency return plan
- SOP deviations
- Runway and weather conditions
- Obstacle clearance or noise abatement
- Use of FMS for charted departure

Normal Takeoff

The PF's takeoff briefing, in accordance with SOP, should be clear, concise, and pertinent to the specific takeoff. Navigation aids should be tuned and identified; the specific courses should be set. The altitude alerter should be set to the proper altitude. When cleared for takeoff, complete all items on the "Cleared for Takeoff" portion of the Before Takeoff checklist.

Tiller steering should be used to align the airplane on centerline. Once takeoff roll has commenced, use of rudder pedals is recommended to maintain directional control. Both pilots should confirm the correct departure runway alignment.

Takeoff (General)

All takeoff data contained in the AFM assumes that takeoff N_1 is set before the brakes are released, unless otherwise specified. The primary instruments for verifying takeoff thrust are the N_1 gauges. The required takeoff power settings are determined by each FADEC. The takeoff N_1 setting (as computed by the FADEC) is displayed on the N_1 scale by cyan target bugs.

Normal Standing Takeoff

Refer to the profile on page 7-37. Hold the brakes firmly and advance the throttles to the TO detent. When power is set, check engine instruments and release the brakes smoothly. The PM should monitor the engine instruments and verify that the N_1 and tapes are in the takeoff bugs and that the FADEC mode is indicating T/O. The PF should control direction with the rudder pedals while maintaining power lever control with the hand that is free of the control yoke.

Directional control is normally accomplished with the rudder pedals. At V_1, the PF's hand moves from the throttles to the yoke in preparation for takeoff rotation.

CAUTION
Tiller steering should be used to align the airplane on centerline. Once takeoff roll has commenced, use of tiller steering above 60 KIAS is not recommended.

Rolling Takeoff

A rolling takeoff may be accomplished when actual runway length adequately exceeds required field length and obstacle clearance is not a factor. Once the aircraft is aligned with the runway, the brakes are applied and throttles advanced toward TO. The brakes are then released as throttles are advanced to the takeoff detent.

Remember that AFM takeoff field length data and takeoff N_1 settings assume a standing start, if a rolling takeoff is performed, at least 500 feet of required runway distance must be added to the takeoff field length.

Crosswind Takeoff

The crosswind technique for takeoff requires that the pilot hold aileron into the wind with slight forward pressure on the yoke to maintain nosewheel contact with the runway throughout the takeoff roll. Do not over control in aileron since it can result in unwanted steering due to the differential in spoiler drag between the upwind and downwind wing. The recommended pilot technique is to use tiller steering to align with the runway and then to rely on pedal steering for the takeoff.

For high crosswinds, the pilot may use tiller nosewheel steering to maintain runway alignment until the combination of pedal nosewheel steering and aerodynamic rudder control becomes effective enough to provide steering. The rate of transfer from tiller nosewheel steering to rudder steering is a function of runway condition (wet, icy, etc.) and the magnitude of the crosswind. The nosewheel steering available through the pedals is 7° either side of center. This is sufficient to handle most crosswind situations but may require the pilot to use full rudder pedal deflection. The important point to remember is that nosewheel steering is very effective in providing directional control and that to be effective, the nose wheel has to maintain contact with the runway.

If the tiller nosewheel steering is used during the takeoff roll, the transfer of yoke control during crosswind takeoffs may be delayed due to the necessity of maintaining control through the tiller. Once the pilot is assured that there is sufficient aerodynamic rudder control, then the transfer of control of the yoke to the pilot can proceed. The pilot should still maintain forward pressure on the yoke sufficient to maintain nose wheel contact with the runway and aileron deflected into the wind. For takeoffs on wet or icy runways, consideration must be given to reducing the amount of crosswind acceptable for the takeoff.

Takeoff Rotation

Precisely at V_R, smoothly rotate to approximately 10° nose-up attitude (flight director takeoff pitch). Smooth rotation prevents a decrease in airspeed. Early or late rotation (as well as over-rotation or under-rotation) degrades takeoff performance.

Takeoff Speed

Minimum Control Speed – Ground (V_{MCG})

To continue a takeoff when engine failure occurs on the ground, the minimum control speed (V_{MCG}) is 96 KIAS, flaps 7° and 97 KIAS, flaps 15°. This speed assumes use of aerodynamic controls only (no nosewheel steering) and maximum available takeoff thrust on the operating engine. The aircraft is rotated at the normal rotation speed (V_R).

Minimum Control Speed – Air (V_{MCA})

The minimum control speed away from ground effect (V_{MCA}) is 92 KIAS, flaps 7° and 90 KIAS, flaps 15°. This speed assumes maximum available takeoff thrust on the operating engine.

Rotation Speed (V_R)

The rotation speeds (V_R) identified in the AFM give margins above the minimum demonstrated unstick speed (V_{MU}) and above V_{MCA}. If an engine failure occurs during takeoff, the aircraft should pass through 35 feet at V_2 speed when rotated at V_R.

Takeoff Safety Speed (V_2)

V_2 is the takeoff safety speed, or the target speed of the aircraft to be attained by 35 feet above the runway surface. It is the minimum speed that ensures the aircraft will achieve the charted climb gradient. It is reached by rotation to the charted takeoff pitch altitude.

Rejected Takeoff

Because of the diversity of Sovereign operators, the decision as to who may directly call for a rejected takeoff is left to the individual operators.

Refer to the profile on page 7-39. For abort prior to V_1, maintain directional control, then immediately and simultaneously apply maximum effort wheel braking and retard throttles to idle. Extend speedbrake handle to 100%. Deploy thrust reversers as necessary. When the thrust reversers are deployed, increase reverse thrust to aid in slowing the aircraft.

During a rejected takeoff, reverse thrust may be used to bring the airplane to a stop (zero ground speed). If reverse thrust is used during a rejected takeoff down to zero ground speed, record the event and report the occurrence for maintenance action.

Use reverse thrust cautiously on wet or slippery runways to prevent the airplane from being forced to the runway edge. Also use caution during strong crosswind conditions, since reverse thrust will aggravate any weather vaning tendency. Maintain directional control with differential braking and nosewheel steering to remain on the runway centerline.

The PM should verify that the PF has deployed the speed brakes. Monitor engine instruments and apply slight forward pressure on the control column. Notify the tower of rejected takeoff as soon as conditions permit.

When clear of the runway, perform the appropriate Emergency, Abnormal or Normal checklist, to include evacuating the aircraft, if desired.

Initial Climbout

After a positive rate of climb is established, and at the PF's command, the PM will retract the landing gear. Confirm that the gear is retracted and monitor the annunciators and engine instruments.

When reaching a minimum altitude of 400 feet AGL and a minimum airspeed of V_2+10 KIAS at the PF's command the PM retracts the flaps. At a minimum altitude of 1,000 feet AGL, the PF sets climb power by moving the throttles to the MCT detent and accelerates to normal climb speed. The PM confirms that power is set to the MCT detent and selects a desired vertical mode on the Guidance Panel as commanded by the PF. The engines have a normal limitation of 5 minutes at takeoff thrust.

Noise Abatement

In Section IV of the AFM, the manufacturer indicates compliance with FAR and ICAO Stage 4 noise level requirements with the following procedures:

Takeoff Configuration. . . . . FLAPS 7°

Weight . . . . 30,300 POUNDS

Procedure

Climb at 133 KIAS to a height of 3,300 feet AGL, then reduce N_1 to 79.2% and retract the flaps. When clear of noise sensitive areas, return to normal climb power.

Climb

After setting the climb power, and when clear of the airport traffic area, complete the After Takeoff/Climb checklist. The PM may complete the checklist silently using a flow pattern, verifying completion and indications with the After Takeoff/Climb checklist. With the throttles in the MCT detent, the FADECs automatically control the engines to maximum climb N_1. It will not be necessary to manipulate the throttles. Observe the differential pressure/cabin altitude and cabin vertical speed gauges for normal operation.

Cruise

Thrust Setting

Climb power (MCT) is normally maintained upon level off until acceleration to the desired cruise speed. Then, adjust power to the CRU detent or below. It is recommended that the throttles be reduced to the CRU detent or below within 10 minutes after reaching an intermediate or the final cruise altitude. The use of MCT during normal operations beyond 10 minutes after reaching cruise altitude may decrease engine life and increase operator costs.

CAUTION
Prolonged flight in icing conditions with the flaps and/or landing gear extended is prohibited.

Turbulent Air Penetration

> ***NOTE:*** During turbulent air penetration, use of the autopilot is permitted.

Turbulence penetration procedures apply to flying at altitude and should not be confused with the low altitude wind shear precautions recommended for the traffic pattern and landing approach phase of the mission. If possible, flight through turbulence should be avoided. Flying the recommended speeds at reduced altitudes produces greater buffet margins for the same intensity of turbulence.

Continued use of the autopilot will reduce pilot workload. However, use of the Flight Director (FD) vertical modes is not advised in severe turbulence. The basic pitch attitude and heading hold autopilot modes will reduce excessive control surface motion and attitude changes in severe turbulence. Airplane pitch motions and ride qualities are aggravated when FD vertical modes are engaged during these flight conditions.

Although the aircraft is not operationally restricted in rough air, do not fly into known severe turbulence. Carefully plan a turbulence avoidance strategy with an understanding of mountain wave dynamics, thunderstorm characteristics, and weight versus altitude buffet margins.

When turbulence is encountered, the following are recommended:

1. Maintain 225 KIAS or Mach 0.80 maximum, whichever is less.
2. Set thrust to maintain target airspeed. Change thrust only for extreme airspeed variation.
3. Activate the SEAT BELTS sign.
4. With the autopilot not engaged,
   a. Fly altitude.
   b. Avoid using the stabilizer trim.
   c. Do not chase altitude and speed.

Keep control movements moderate and smooth. Maintain wings level and the desired pitch attitude. Use attitude indicator as the primary instrument. In extreme drafts, large attitude changes may occur. Do not make sudden large control movements. After establishing the trim setting for turbulence penetration speed, do not change the trim.

5. Large altitude changes are possible in severe turbulence. Do not chase altitude or airspeed.
6. Ensure yaw damper is engaged to reduce yaw/roll oscillations.

Windshear/Microbursts

A low-level wind shear, microburst, or downburst may develop within an unstable air mass, during frontal passage, and in the vicinity of thunderstorms. These conditions can create rapidly changing wind directions and velocities. An even more dangerous condition can result from high velocity down flows that can force the airplane into ground impact unless very prompt and drastic actions are taken. Severe microbursts may occur with greater frequency than originally believed. However, they are of short duration, two (2) to five (5) minutes, about two (2) miles in diameter, and can have a down-flow in center of as much as 6,000 to 7,000 feet per minute. When conditions exist where low-level wind shear, microbursts, or downbursts may be present, the pilot should consider diversion to an alternate airport or delay takeoff or landing until the risk of an encounter is minimized. If the condition is unavoidable or unexpectedly encountered, you may expect a rapid decay in airspeed and/or an increase in sink rate.

Takeoff

When the amber WINDSHEAR annunciation illuminates on the Primary Flight Display (PFD) during takeoff, or the crew recognizes the signs of increasing performance conditions, the following procedures should be followed:

1. The alert occurs during increasing performance conditions (i.e. increasing head wind/decreasing tail wind and/or updraft). The flight crew should be alerted to the possibility of subsequent decreasing performance (i.e., significant airspeed loss and down draft conditions).
2. Throttles should be advanced to achieve maximum rated thrust and takeoff/go-around target pitch attitude should be maintained until safe climb-out is assured.

Final Approach

When the amber WINDSHEAR annunciation illuminates on the PFD during final approach, or the crew recognizes the signs of increasing performance conditions, the following procedures should be followed:

1. The alert occurs during increasing performance conditions (i.e. increasing head wind/decreasing tail wind and/or updraft). The flight crew should be alerted to the possibility of subsequent significant airspeed loss and down draft conditions.
2. Wind and gust allowances should be added to the approach speed, increasing thrust if necessary. It may be necessary to disengage the autopilot.
3. Avoid sinking below the approach glide path or letting the throttles remain at flight idle for extended periods of time.
4. Coupled with other weather factors, the alert should be considered in determining the advisability of performing a go-around.

At any time

When the siren and "WIND SHEAR--WIND SHEAR--WIND SHEAR" WARNING occurs, and the red WINDSHEAR annunciation illuminates on the PFD, or an obvious wind shear condition is encountered, the following procedures should be followed:

1. Disconnect the autopilot and apply power to the mechanical forward limit.
2. Rotate at 3 to 4 degrees per second to increase pitch attitude to the highest possible value.
3. When stick shaker is encountered, or as V_{REF} is approached, reduce pitch rate/angle of attack to intercept V_{REF} -20 KIAS.
4. DO NOT retract flaps or landing gear until safe climb-out is assured.

EGPWS Alerts

Pilots are authorized to deviate from their current air traffic control clearance (ATC) to the extent necessary to comply with an EGPWS warning.

EGPWS Caution

Airplane Flight Path . . . . ADJUST UNTIL CAUTION ALERT CEASES

EGPWS Warning

Vertical Escape Maneuver. . . . . .FOLLOW UNTIL ALL ALERTS CEASE

Unless operating in Visual Meteorological Conditions (VMC), and/or the pilot determines based on all available information that turning, in addition to the vertical escape maneuver, is the safest course of action, only the vertical escape maneuver is recommended.

CAUTION
THE TERRAIN DISPLAY IS INTENDED TO SERVE AS A SITUATIONAL AWARENESS TOOL ONLY, AND MAY NOT PROVIDE THE ACCURACY AND/OR FIDELITY ON WHICH TO SOLELY BASE TERRAIN AVOIDANCE MANEUVERING DECISIONS.

Vertical Escape Maneuver

Autopilot. . . . . DISCONNECT

Throttles. . . . . .MECHANICAL FORWARD LIMIT

Speed Brakes . . . . ENSURE RETRACTED

Pitch Attitude . . . . ROTATE AT 3° TO 4° PER SECOND TO INCREASE PITCH ATTITUDE TO HIGHEST POSSIBLE VALUE

When stick shaker is encountered or as V_2/V_{REF} is approached:

Pitch Rate / Angle Of Attack . . . . REDUCE TO INTERCEPT V_2/V_{REF} -20 KIAS

Flaps / Landing Gear. . . . . .DO NOT RETRACT UNTIL SAFE CLIMB-OUT IS ASSURED

TCAS II Flight Procedures

1. Upon initiation of a Resolution Advisory (RA), the pilot flying should focus attention on flying the commanded maneuver. The airplane should be smoothly maneuvered to comply with the TCAS command and to promptly return to ATC clearance when the “CLEAR OF CONFLICT” message is received.
2. During a Resolution Advisory (RA), the PFD will present a wide box and vertical pitch boresight symbol. Maneuver the pitch boresight symbol (single cue or cross pointer) into this wider box.
3. Compliance with a TCAS II RA is necessary unless the pilot considers it unsafe to do so, or unless the pilot has better information about the cause of the RA and can maintain safe separation (e.g., visual acquisition of and safe separation from a nearby airplane, obvious TCAS system failure, etc.).

WARNING
NON-COMPLIANCE WITH A CROSSING RA BY ONE AIRPLANE MAY RESULT IN REDUCED VERTICAL SEPARATION; THEREFORE, SAFE HORIZONTAL SEPARATION MUST ALSO BE ASSURED BY VISUAL MEANS.

CAUTION
ONCE A NON-CROSSING RA HAS BEEN ISSUED, SAFE OPERATION COULD BE COMPROMISED IF CURRENT VERTICAL SPEED IS CHANGED, EXCEPT AS NECESSARY TO COMPLY WITH THE RA. THIS IS BECAUSE TCAS II-TO-TCAS II COORDINATION MAY BE IN PROGRESS WITH THE INTRUDER AIRPLANE, AND ANY CHANGE IN VERTICAL SPEED THAT DOES NOT COMPLY WITH THE RA MAY NEGATE THE EFFECTIVENESS OF THE OTHER AIRPLANE'S COMPLIANCE WITH ITS RA.

NOTE: The consequences of not following an RA may result in additional RAs in which aural alert and visual annunciations may not agree with each other.

Operation in Icing Conditions

CAUTION
The equipment has not be designed, or certified to provide protection against freezing rain or severe conditions of mixed or clear ice.

Ice protection equipment on the Citation Sovereign is designed to prevent the accumulation of ice. All anti-ice systems should be turned on prior to encountering icing conditions.

Anti-ice equipment should be used for taxi and takeoff when the ambient temperature is 10°C or below, and visible moisture, precipitation, or a wet runway exists. Anti-ice is used in flight when the ram air temperature (RAT) is 10°C or below with visible moisture, precipitation, or icing. Flap deployment should be delayed until necessary for approach and landing. Minimum speed in icing conditions is 180 KIAS until ready to configure for approach and landing.

Additional information pertaining to operations in icing conditions can be found in the Expanded Normals section of this manual.

Inflight Procedures

Speedbrake Deployment

Speedbrakes may be used to expedite a descent or to reduce airspeed, and are variable from 0 to 100%. Speedbrakes may be used at any speed and, if necessary, with the landing gear and/or wing flaps extended. If V_{MO}/M_{MO} is unintentionally exceeded, do not hesitate to use the speedbrakes. During approach, speedbrakes must be retracted by 500 feet AGL unless otherwise specified by AFM procedures.

Change of Airspeed

Speedbrakes may be used in conjunction with thrust reduction when reducing airspeed quickly. Reduce thrust to the appropriate setting for the desired airspeed, and then extend the speedbrakes. Upon reaching the desired airspeed, retract speedbrakes. Smoothly coordinate all power and flight control inputs to maintain the desired heading, airspeed, and altitude. Speedbrakes may also be used to control airspeed during in-flight operation of the engine and airframe anti-icing systems when higher-than-normal engine power settings are required.

Use of the Rudder in Flight

Flight crews should use caution when operating the rudder in flight. The rudder design protects the vertical fin for prolonged maximum rudder inputs in a single direction only. If the rudder is deflected to maximum deflection then suddenly reversed to the maximum deflection in the opposite direction, the vertical fin can be overstressed. Additionally, the vertical fin can be overstressed by a pilot "walking" the rudder either abruptly or in small increments in tune with the yaw response. The issue is magnified at high speed.

Three rules to follow when using the rudder in flight:

1. Maximum deflection of the rudder in a single direction may be used to control the airplane when needed such as in the case of an engine failure at takeoff. Do not return the rudder past neutral when completing the maneuver.
2. Do not walk the rudder in tune with the yaw response either with abrupt or smooth inputs.
3. If you follow the above two rules and continue to fly the airplane within the published envelope using normal airmanship, you will not overstress the airplane.

Steep Turns

This maneuver familiarizes the pilot with aircraft handling characteristics and helps to improve the instrument cross check. Refer to the profile on page 7-43. Stabilize the aircraft in trim at the desired speed, heading and altitude. Remove the flight director command bars from view.

Maintaining a steady pitch attitude is essential for a level steep turn. As bank angle is increased, apply back pressure as required to maintain altitude and increase power as required to maintain airspeed. Maintain a rapid scan so that deviations will be detected early enough to require only small corrections. When the turn is complete, reducing pitch and power will also be necessary to transition back to straight and level flight. For training purposes, the following values are recommended:

- Suggested altitude: 10,500 to 17,500 feet (3,000 AGL minimum)
- Angle of bank: 45°
- Airspeed: 200 KIAS
- Turns should be at least 180° in each direction.

NOTE:	Power settings during steep turns are the responsibility of the PF. The PF has the option to use the PM to set power. However, it is essential that very precise calls be made, e.g.: "increase power 10%".

Stall Recognition and Recovery

Stall training should always emphasize reduction of AOA as the most important response when confronted with any stall event. Therefore, the FAA recommends the stall recovery template for use as a reference. Airplane manufacturers have created this guide to provide commonality among various airplanes.

Stall Recovery Template

1.	**Autopilot and Autothrottle (if applicable)**	**Disconnect**
Note:	*While maintaining the attitude of the airplane, disconnect the autopilot and autothrottle. Ensure the pitch attitude does not increase when disconnecting the autopilot. This may be very important in out-of-trim situations. Manual control is essential to recovery in all situations. Leaving the autopilot or autothrottle connected may result in inadvertent changes or adjustments that may not be easily recognized or appropriate, especially during high workload.*	
2a.	**Nose down pitch control**	**Apply until stall warning is eliminated**
Note:	*Reducing the AOA is crucial for recovery. This will also address autopilot induced excessive nose up trim.*	
2b.	**Nose down pitch trim**	**As Needed**
Note:	*If the control column does not provide sufficient response, pitch trim may be necessary. However, excessive use of pitch trim may aggravate the condition, or may result in loss of control or high structural loads.*	
3.	**Bank**	**Wings Level**
Note:	*This orients the lift vector for recovery.*	
4.	**Thrust**	**As Needed**
Note:	*During a stall recovery, maximum thrust is not always needed. A stall can occur at high thrust or at idle thrust. Therefore, the thrust is to be adjusted accordingly during the recovery. For airplanes with engines installed below the wing, applying maximum thrust may create a strong nose-up pitching moment if airspeed is low. For airplanes with engines mounted above the wings, thrust application creates a helpful pitch-down tendency. For propeller-driven airplanes, thrust application increases the airflow around the wing, assisting in stall recovery.*	
5.	**Speed brakes/Spoilers**	**Retract**
Note:	*This will improve lift and stall margin.*	
6.	**Return to desired Flight Path**	
Note:	*Apply gentle action for recovery to avoid secondary stalls, and then return to desired flightpath.*	

CAUTION
The Stall Recognition and Recovery discussion is presented only in the context of recovery training. Stalls in high performance aircraft should not be deliberately executed unless they are part of a supervised pilot training program. Safety of flight considerations dictate that the utmost caution be employed during such exercises.

Objective

These maneuvers are performed to familiarize the pilot with the indications of an approaching stall and correct recovery technique.

Maneuver Based Approach to Stalls

Approach to Stall

The approach to stall should be continued only to the first warning indication of a stall. At the first warning indication (stick shaker, airspeed indication turns red, angle-of-attack (AOA) approaches indication approaches 0.85), initiate an immediate recovery. Do not allow the aircraft to go into a full stall. Refer to the profile on page 7-45.

Perform the approach to stall in clean, takeoff, and landing configurations. Practice altitude should be no higher than 18,000 feet MSL, and no lower than 5,000 feet above terrain.

> ***NOTE:*** The indications of a stall are:
> - Airspeed index approaching red
> - AOA index approaching 0.85
> - Stick shaker
> - Loss of elevator effectiveness
> - Aerodynamic buffet

For training purposes, accomplish approach to stall series in the following manner:

1. Visually clear the area.
2. Reduce power and continue to trim for hands-off flight until 0.6 AOA. Do not trim past 0.6 AOA.
3. Initiate recovery at the first indication of a stall (normally, stick shaker) by slightly reducing pitch attitude to break the stall and advancing power to the TO detent. Use smooth, deliberate power application (not slam).
4. Adjust power and attitude to recover to desired airspeed and altitude.

Clean/Cruise Configuration – Flaps and Gear Up

While maintaining altitude and heading (wings level), retard throttles to idle. As the aircraft slows, maintain altitude with back pressure. Use trim to maintain elevator effectiveness. Observe the angle-of-attack indicator information; stall warning occurs when the indicator approaches the red band.

At the first indication of a stall (aerodynamic buffet or stick shaker), simultaneously accomplish the following:

1. Throttles – To detent
2. Pitch – Reduce angle of attack (trim as necessary)
3. Bank – Maintain heading and wings level
4. Speedbrakes – Verify retracted
5. Accelerate to V_{REF} minimum and initiate climb
6. Altitude and airspeed – Return/maintain start altitude and 170 KIAS minimum
7. Do not exceed any limitations

Takeoff/Approach Configuration – Flaps 15° and Gear Up

Establish a level turn using 20° bank; retard throttles to IDLE. As the aircraft slows, maintain altitude with back pressure. Use trim to maintain elevator effectiveness.

Observe the angle-of-attack indicator information; stall warning occurs when the indicator approaches the red band. At the first indication of a stall (aerodynamic buffet or stick shaker), simultaneously accomplish the following:

1. Throttles – To detent
2. Pitch – Reduce angle of attack (trim as necessary)
3. Bank – Level the wings (if using flight director have PM center heading bug and deselect 1/2 bank)
4. Speedbrakes – Verify retracted
5. Accelerate to V_{REF} minimum and initiate climb
6. Altitude and airspeed – Return/maintain start altitude and 170 KIAS minimum
7. Do not exceed any limitations

Landing Configuration – Flaps 35° and Gear Down

Engage the autopilot. While maintaining heading (wings level), retard throttles to 50% N_1. When the autopilot disconnects at the first indication of a stall (stick shaker), simultaneously accomplish the following:

1. Throttles – To detent
2. Pitch – Reduce angle of attack (trim as necessary)
3. Wings – Keep level
4. Flap – 15°
5. Accelerate to V_{REF} minimum and initiate climb
6. Positive rate of climb – Gear up
7. At V_{APP} +10 Kts – Flaps up
8. Altitude and airspeed – Return/maintain start altitude and 170 KIAS minimum
9. Do not exceed any limitations

Scenario Based Approach to Stalls

The goal of scenario based demonstration approach to stall events is to provide the best practices and guidance for pilots, within existing regulations, to ensure correct and consistent responses to unexpected stall warnings activation. Emphasis will be on reducing the angle of attack at the first indication of a stall as the primary means of approach to stall recovery. Refer to profile on **Page 7-47**.

Clean Configuration Approach to Stall (High Altitude)

The pilot will recognize the stall warning and immediately perform the stall recovery procedure. The pilot should also demonstrate willingness to trade altitude for airspeed to accomplish an expeditious recovery from a stall event. Altitude – FL 360 Minimum

10. Level Flight
11. Flaps – Up
12. Landing Gear – Up
13. Autopilot – Engage
14. Thrust – Reduce to less than adequate for maneuvering flight
15. First Indication of Stall – Recovery procedure

The maneuver is considered complete once a safe speed is achieved and the airplane stabilized.

Positive recovery from the aerodynamic stall or approach to stall takes precedence over minimizing altitude loss.

Takeoff Approach to Stall with Partial Flaps

The pilot will recognize the stall warning and immediately perform the stall recovery procedure, then resume the assigned departure.

1. Altitude – During Takeoff, at an altitude that will allow for a recovery
2. Flaps – Takeoff
3. Landing Gear – Up
4. Thrust – Reduce to less than adequate to maintain airspeed and climb rate.
5. First Indication of Stall – Recovery Procedure
6. Climb – Assigned Departure and Altitude

The maneuver is considered complete once the flight reaches and stabilizes at the assigned altitude.

Positive recovery from the aerodynamic stall or approach to stall takes precedence over minimizing altitude loss.

Landing Configuration Stall

The pilot will recognize the stall warning and immediately perform the stall recovery procedure, then commence the missed approach.

1. Altitude – 1,000 ft AGL
2. Approach – Precision
3. Flaps – Landing Configuration
4. Landing Gear – Down
5. Thrust – Reduce to be inadequate to maintain a safe speed or descent angle, and results in an increase in AOA to maintain glidepath
6. First Indication of Stall – Recovery Procedure
7. Missed Approach – Commence

The maneuver is considered complete when safe speed has been achieved and the pilot initiates the missed approach.

Positive recovery from the aerodynamic stall or approach to stall takes precedence over minimizing altitude loss.

Unusual Attitudes

Refer to the flight profile on page 7-49.

CAUTION
A suspected unusual attitude may actually be a failed attitude source. First indications may be dramatically increasing or decreasing airspeed and attitude. Confirm attitude source by cross checking other attitude sources. **Upon detecting an unusual attitude, the Pilot Flying (PF) assisted by the Pilot Monitoring (PM) will immediately initiate a recovery to straight and level flight by performing the appropriate actions described below.**

Nose High Unusual Attitude Recovery

Increase power and angle of bank, not to exceed 90° in the same direction as the turn. As the nose of the aircraft falls below the horizon, decrease bank to wings level and nose on the horizon. This type of recovery will avoid negative G-forces.

Nose Low Unusual Attitude Recovery

Smoothly reduce power, leveling the wings, easing the nose up to the horizon. Use the speed brakes to assist in reducing the speed if required.

CAUTION
In extreme nose low attitude, smoothly increase pitch with minimum wing loading.

Instrument Procedures

Holding

Determine the recommended holding speed for the existing aircraft weight from the FMS MCDU holding page. 200 KIAS is recommended unless optimum performance is required. Slow to holding speed within three minutes prior to reaching holding fix. Holding pattern recommended entries are parallel, teardrop, and direct.

Outbound timing begins over or abeam the holding fix, whichever occurs later. Initial outbound leg should be flown to accomplish the proper holding pattern using the calculated airspeed and assigned altitude. Timing of subsequent outbound legs should be adjusted as necessary to achieve proper inbound leg time. For a crosswind correction, double the inbound drift correction on the outbound leg.

Flight Director

The flight director is effective for making an accurate approach in adverse weather conditions. If command bars are followed precisely, the flight director computes drift corrections based on track results. These computations command slow and deliberate corrections toward interception of course and glideslope.

While following the flight director commands, remember to cross-check the raw data presentations. The flight director is extremely reliable, but should not be relied upon solely. Monitor the CAS messages or PFD warning flags for indication of malfunction. If the flight guidance system is not working properly, erroneous information may be presented. For airplanes not incorporating EPIC Phase 4.2 or Phase 5 Software Upgrade, use of the single cue flight director for flight guidance is prohibited when operating without the autopilot engaged.

Instrument Approach Considerations

Several factors should be considered prior to commencing an approach in a high performance jet aircraft. The pilot must have a thorough knowledge of the destination and alternate weather conditions before descending out of the high altitude structure. Many weather and traffic advisory sources are available, including:

- AFIS or ACARS
- Flight Service Stations that may be used enroute any time to obtain the latest destination and alternate weather conditions
- ARTCC where controllers can obtain information (if requested) pertaining to traffic delays and whether aircraft are successfully completing approaches
- ATIS
- The destination Tower and/or Approach Control.

If weather is at or near minimums for the approaches available, review how much time and fuel are needed to go to the alternate airport. FAR 91.175 contains the requirements to continue an approach to landing after arrival at minimums.

Additional Instrument Systems

The following additional equipment is available on the Citation Sovereign and should be set according to company SOP:

- Radar altimeters
- Standby flight displays
- Vertical navigation guidance
- Flight Management Systems
- Traffic Collision Avoidance System (TCAS)
- Enhanced Ground Proximity Warning System (EGPWS)

Normal Descent

Select a new altitude using the flight guidance panel. Begin descent by setting a vertical speed, depressing FLC on the guidance panel or using VNAV. Speed brakes may be used at the discretion of the pilot.

As descent is initiated, ensure that the pressurization control is set for landing. Set the field altitude, and monitor the rate of descent on the cabin altitude gauge. Continue to monitor the differential pressure, cabin altitude, and cabin vertical speed throughout the descent to ensure the auto schedule is operating properly.

The engine and wing anti-ice systems should be on when operating in visible moisture if the ram air temperature (RAT) is 10°C or below. The minimums value on the PFD may be bugged to the decision altitude, the decision height, the minimum descent altitude, or as desired in VFR operation for terrain proximity warning.

Double check landing field information and estimated arrival gross weight; check runway requirements and V_{REF} and V_{APP}. When descending through the transition altitude, set the altimeters to field pressure and check for agreement.

The approach profiles are designed to provide suggested reference points or "gates" to assist in analyzing the descent to arrive at 500' AFE in a stabilized condition. As you progress through these "gates", it is important that any deviations be corrected immediately to arrive at the next "gate" within the parameters. The longer the delay in making a correction, the greater the chance of arriving at 500' AFE in an unstabilized condition.

During the early stages of the descent, corrections to altitude and/or airspeed can usually be done using speedbrakes. If in the latter stages of the descent/ approach, or if speedbrakes are not effective in correcting to the desired airspeed/altitude, consider extending the landing gear to assist in increasing rate of descent and/or deceleration. Extending flaps to increase deceleration or descent rate is not as effective as the use of speedbrakes and gear extension.

Emergency Descent

An emergency descent moves the aircraft rapidly from a high altitude to a lower altitude; it is most often used in conjunction with a loss of pressurization.

Put on oxygen masks, establish communications, disconnect autopilot, retard throttles to IDLE, extend speedbrakes, and roll into a moderate bank while lowering the nose (initially 15°) below the horizon.

Refer to the profile on page 7-69. Adjust pitch as necessary to approach, but not exceed, V_{MO}/M_{MO}. If flying in turbulent air, or if structural integrity is questionable, make the descent at a lesser and more prudent speed. The PM should set the transponder to 7700. When conditions permit, activate the PAX SAFETY signs, check the condition of the passengers, and contact ATC for assistance and instructions.

The PM should monitor the descent progress, and complete the appropriate checklists on command.

An Emergency Descent Mode (EDM) is incorporated into the flight guidance system. It is intended to return the aircraft to a safe cabin altitude in the event the flight crew becomes temporarily incapacitated. This is accomplished by automatic entry into FLC/HDG HOLD modes if the following conditions are satisfied:

1. The autopilot is engaged.
2. The cabin altitude reaches 14,500 feet.
3. The aircraft flight altitude is at or above FL310.

Activation of the EDM will result in the aircraft turning 90° left (with a 30° bank limit in HDG hold mode) and descending to 15,000 feet at V_{MO}-10 KIAS. The crew must retard the throttles for descent. EDM can be disabled at any time by selecting the autopilot off, resetting the guidance panel, then re-engaging the autopilot.

VFR Traffic Pattern

The traffic pattern altitude is normally 1,500 feet AGL. At non-towered airports, comply with the prescribed traffic flow for that airport. Refer to the Visual Approach profile on page 7-63. Before entering downwind leg, complete the Approach checklist. Set 7° flaps and slow to 150 KIAS. Abeam the end of the runway, select gear down and 15° flaps. On the base leg, slow to 130 KIAS and establish a descent rate of 500-600 FPM. At 1,000 feet select landing flaps and set power to cross the threshold at V_{REF}.

Approaches

General

Using aircraft automation for arrivals and approaches reduces crew workload and increases situational awareness. The CE-680 FMS has a database for arrivals and approaches, and should be used to the maximum extent possible. See the Honeywell Primus EPIC FMS Pilot's Guide for procedures on selecting arrivals and approaches.

Utilizing the FMS to reference the landing runway is an excellent technique for a visual approach. This will easily establish a DME reference to the landing runway for the targeted "gates". The key to a successful visual approach is to plan and make corrections early.

A stabilized approach is one of the key features of safe approaches and landings in flight operations, especially those involving transport category airplanes. A stabilized approach is characterized by a constant-angle, constant-rate of descent approach profile ending near the touchdown point, where the landing maneuver begins. A stabilized approach is the safest possible profile in all but special cases, in which another profile may be required by unusual conditions.

All appropriate briefings and checklists should be accomplished before 1000' height above touchdown (HAT) in instrument meterological conditions (IMC), and before 500' HAT in visual meterological conditions (VMC). Flight should be stabilized by 1000' HAT in IMC, and by 500' HAT in VMC.

Checklist and Configuration

For instrument approaches where a procedure turn is flown, complete the Approach checklist and set 7° flaps. The aircraft is slowed to 140 KIAS when passing the IAF outbound.

If the aircraft is receiving radar vectors for an approach, complete the Approach checklist and aircraft configuration changes when abeam the FAF, or 3-5 miles before the FAF for a straight-in approach.

Typical Precision ILS Approach and Landing

> ***NOTE:*** Because the decision height on a normal ILS is referenced to altitude above MSL, the DA is set rather than the DH. DH references a radar altitude and is used only for Category II and III approaches. Use the BARO SET knob to select the appropriate value on the PFD minimums display.

Refer to the profile on page 7-51.

When established on the localizer inbound to the FAF, ensure that the 15° flaps are set.

- Maintain airspeed at 140 KIAS.
- Upon approaching the glideslope (one dot above center), extend the landing gear.
- At glideslope intercept, select flaps 35°. Complete the Before Landing checklist. Begin descent. At the outer marker, cross check all instruments and note altitude at the marker.
- Maintain airspeed at 130 KIAS or V_{APP} minimum.
- The PM monitors altitudes, airspeed and sink rate, and notifies the PF of any abnormal readings. He also makes callouts as specified in the company Operations Manual.
- At or before DA, establish visual contact with the runway.
- At DA with landing assured, reduce airspeed to cross the threshold at V_{REF}. If not visual at the DA, the PM calls, "Minimums, go around. If visual at DA, the PM calls, "Land."

> ***NOTE:*** Consider abandoning the approach if there is confusion about configuration, procedures, or clearances.

Typical Non-Precision Approach and Landing

NOTE:	A non-precision approach using FMS VNAV guidance is flown like a typical precision ILS approach. Substitute “glidepath” for “glideslope."

When established on the inbound course to the FAF:

- Set 15° flaps and complete the Approach checklist.
- Adjust airspeed to 140 KIAS.
- Extend landing gear at 3-5 miles from FAF. Full flaps should be selected at 1-3 miles from FAF. Complete the Before Landing checklist. Maintain 130 KIAS.
- Upon crossing the FAF, start timing, notify ATC, and descend to the MDA while maintaining 130 KIAS. Vertical speed in descent should normally be 800 to 1,000 FPM.
- After leveling off at MDA, increase power to hold airspeed at 130 KIAS (or V_{APP} minimum) while proceeding to the VDP or the MAP.
- With the runway landing environment in sight, slow to V_{REF} while intercepting the proper visual glidepath for landing.

NOTE:	Consider abandoning the approach if there is confusion about configuration, procedures, or clearances.

RNAV Approach Procedures

NOTE:	Prior to conducting RNAV (RNP) approaches requiring Special Aircraft and Aircrew Authorization Required (SAAAR), appropriate operational approval (i.e., Operations Specifications (OpsSpecs), Letter of Authorization (LOA) or Management Specifications (Mspecs)) must be obtained. Requirements and operational guidance can be found in FAA Advisory Circular AC 90-101.

Review the published approach, then select approach from the FMS database and activate. For airplanes with EPIC Phase V software installed, if the RNAV approach has LPV minima, the FMS defaults to load LPV minima approach guidance. The pilot can select LNAV/VNAV minima approach guidance using the FMS if use of the guidance is not authorized or desired.

For airplanes with EPIC Phase V software and when performing an approach to LPV minima, the LPV icon on the PFD will display in white text, indicating an armed status when the approach has been loaded into the FMS and the airplane is within approximately 30 nm of the destination airport. When within approximately 2 nm of the FAF, the LPV icon will transition to green text, indicating captured status. The approach may be continued to LPV minima.

NOTE:	LPV or GP approach mode will be unavailable if Preview mode is active.

Prior to commencing an RNAV approach, the crew should set the published MDA or DA display on the PFD using the BARO SET knob on the PFD Controller. When cleared for the approach:

NAV Mode . . . . ARM

Altitude Preselector . . . . SET TO APPROPRIATE ALTITUDE

Vertical Glidepath (GP) Mode . . . . ARM BY PRESSING APPROACH (APPR) BUTTON

Altitude Preselector . . . . SET TO MISSED APPROACH ALTITUDE (WHEN APPROPRIATE)

When within 2 miles of the Final Approach Fix (FAF):

APPROACH Icon. . . . . VERIFY ILLUMINATED ON PFD

This is clearance to continue the approach to the published DA. If the APPR icon does not illuminate, the approach shall be abandoned.

When runway is in sight:

Autopilot. . . . . .DISCONNECT AND LAND AIRPLANE

If runway is not in sight at the DA or MDA (as appropriate), execute the published missed approach.

CAUTION

If ATC issues approach clearance when the airplane is in position downwind from the IAF and there is no intention to fly a course reversal at the IAF, the crew should use the “VECTORS” approach transition to final (ACT VECTORS) to avoid a premature descent prior to the FAF. The flight crew is responsible for complying with all published altitudes during the approach.

NOTE: Consider abandoning the approach if there is confusion about configuration, procedures or clearances.

Zero Flap Approach and Landing

Practice no flap approaches and landings are normally limited to simulator training or, in the aircraft, to a go-around executed at the runway threshold. Landing with flaps at 0° is not recommended due to the unnecessarily high stress imposed on the tires and the landing gear. If a full stop no flap landing is accomplished, it is recommended that landings at field elevations above 5,000 feet MSL be avoided.

Refer to profile on page 7-71.

CAUTION

V_{REF} at maximum landing weight (27,100 pounds) with no flaps is 130 KIAS. Use additional margin when maneuvering.

Maintain a minimum airspeed of V_{REF} +10 KIAS while maneuvering. Plan for a long final approach. Complete the Flaps Not in Landing Position (35°) checklist. Once established on final, reduce to V_{REF}.

The aircraft has a tendency to float because of increased airspeed and low drag configuration; this can be countered by flying the aircraft onto the runway and using minimal flare to break the descent rate.

Expect landing field length to be up to 1.5 times longer than normal. Use reverse thrust and braking as required. Refer to the CAE SimuFlite Operating Handbook for distance corrections.

Avoid landing with a tailwind or downhill runway gradient.

Go-Around/Missed Approach/Balked Landing

Accomplish the go-around/missed approach/balked landing at the DA/DH or MDA with time expired (if applicable) and runway visual reference either not in sight or not in a position from which a normal visual landing approach can be accomplished.

Go-Around Procedure

Refer to the profile on page 7-65.

Accomplish the following:

- Push the GA button.
- Set power to the TO detent.
- Rotate to the flight director go-around attitude (approximately 7.5° nose up). Ensure the speedbrakes are retracted.
- Select flaps 15° and maintain a minimum airspeed of V_{APP}.
- When a minimum rate of climb is indicated on the VSI, retract the landing gear.
- Set the Flight Guidance Panel as necessary.
- When clear of obstacles (400 feet AGL minimum) and at a minimum airspeed of V_{APP},retract the flaps and accelerate to 170 KIAS minimum. Adjust pitch attitude and power as necessary.
- Confirm the level-off altitude and heading/course needed for the missed approach, and set the guidance panel.
- Comply with the published missed approach instructions unless other directions are received from ATC.

> ***NOTE:*** If MISSED APP is selected on the FMS, the FGC will initiate the published missed approach at the Missed Approach Point. If the TO/GA button is depressed, then go-around will initiate immediately. Pitch bars will command a climb.

After Missed Approach – Proceeding for Another Approach

Accomplish the following:

- After level off, complete the All Engines Go-Around checklist and maintain 170 KIAS minimum.
- Return to the Approach checklist.

After Missed Approach – Departing Area

Accomplish the following:

- Accelerate to normal climb speed.
- Complete the All Engines Go-Around checklist.
- Follow normal climb out procedures.

Circling Approach/Circling Pattern

Refer to the profile on page 7-73.

The circling maneuver may be initiated from either a precision or non-precision instrument approach procedure and must be conducted entirely by external visual references. A normal instrument approach is flown until visual contact with the runway environment or to the Minimum Descent Altitude (MDA). As the circling maneuver is not an instrument maneuver, sufficient visual references to maneuver the aircraft to a landing must be maintained at all times.

Leave the final approach fix with flaps at 35°. Maintain a minimum of V_{APP} with landing gear extended. If operating on one engine, approach with flaps 15° and lower the landing gear not later than when descending from MDA.

Initiate descent using vertical speed on the guidance panel, VNAV, or available ILS glide path. If using vertical speed, establish at 1,000 to 1,500 feet per minute rate of descent maximum, then reduce the rate of descent when approaching the MDA to ensure leveling off not lower than the MDA.

Maintain a minimum speed of V_{APP} during the circling maneuver. With the runway in sight, maneuver to establish a downwind or base leg. As the turn to base leg is initiated, ensure the landing gear is extended and complete the Before Landing checklist. On final approach, maintain a minimum speed of V_{REF} until crossing the threshold.

If visual contact with the airport (or the landing runway, when below MDA) is lost during the circling maneuver, a missed approach must be initiated. The initial turn should be made, or continued, toward the runway until established on the published missed approach course, or as directed by approach control.

CAUTION

Pilots must exercise sound judgement in determining the circling approach category before attempting the approach. Although the Citation Sovereign is certified as Category B, the captain should operate the aircraft as Category C if maneuvering speed exceeds 120 knots. Factors affecting this determination may include gross weight for landing, landing configuration, the captain's desire to maintain extra speed during the circling maneuver due to turbulence, or larger turn radius at high altitude airports due to increased true airspeed.

Landing

When landing with flaps 35°, cross the threshold at V_{REF} + the gust factor. Reduce the power to idle and adjust the pitch attitude to decrease the rate of descent.

For approach and landing with flaps 15°, cross the threshold at V_{REF} + the gust factor. The pitch attitude will be slightly higher. On touchdown, extend the speedbrakes immediately, lower the nose wheel smoothly to the runway, and apply brakes as required. Deploy the thrust reversers and apply reverse thrust as necessary.

Use of Thrust Reversers

NOTE: Before using the thrust reversers, ensure the airplane is firmly on the ground on all 3 landing gears, and speedbrakes (if available) are extended.

Reverse thrust may be used to shorten the landing roll between touchdown and 65 KIAS. Idle reverse thrust can be used down to normal taxi speed. When the nose gear is on the ground, move the reverser levers up to the detent. When both DEPLOY lights are illuminated, smoothly move the levers further aft to increase reverse thrust.

Crosswind

On the final approach in a crosswind, the crab approach should be used. Do not allow the aircraft to float with power off prior to touchdown. Fly to touchdown with little flare. Deploy speedbrakes on touchdown. At nosewheel touchdown, turn the ailerons into the wind as needed for roll control. Use rudder steering, and differential braking for directional control. Nosewheel steering may be used cautiously as speed reduces. The PM should apply forward pressure to the control column to ensure positive reaction of the nose wheel steering.

Touch-and-Go Landings

If practicing touch-and-go landings, they should be pre-planned and briefed. The thrust reverser and speedbrakes should not be used on landing. The PM resets the flaps to 15°, sets the stabilizer trim to the takeoff range, and confirms these settings to the PF before the throttles are advanced to the TO detent.

One Engine Inoperative Operation

General Guidance

If an engine failure is experienced, the following actions are recommended:

Failed Engine. . . . . SECURE

Operating Engine Power . . . . ADJUST AS NECESSARY

Shut the engine down when the following occurs:

- Engine fire
- Extreme engine vibration is felt in the airplane

> ***NOTE:*** In icing conditions, vibrations may be felt without other abnormal indications and is considered normal. If vibration is accompanied by other failure indication, shut down engine.

- Excessive or uncontrollable power loss
- Sudden increase or decrease in oil pressure beyond limits
- Sustained high oil temperature above limits
- Sustained uncontrollable increase in TGT beyond limits
- Any other condition that indicates the advisability of engine shut down

Engine Failure at or Above V_1 - Takeoff Continued

Refer to the profile on page 7-41.

With an engine failure indication after reaching V_1, continue the takeoff and maintain directional control using the rudder. At V_R, rotate the aircraft smoothly to 10° nose-up attitude and accelerate to V_2. Adjust the pitch attitude as necessary to maintain V_2. If the engine failure occurs after exceeding V_2, maintain the existing airspeed (or V_2 if required for obstacle clearance). Retract the landing gear after establishing a positive rate of climb on the VSI. When clear of the obstacles, or at 1,500 feet AGL, accelerate to V_2+10 knots and retract the flaps. Continue the acceleration to V_{ENR} (180 KIAS), reduce power to the MCT detent and continue the climb to the required altitude.

When time and conditions permit, complete the appropriate Emergency or Abnormal Procedure.

> ***NOTE:*** For an obstacle above 1,500 feet AGL or a SID that requires a climb to more than 1,500 feet AGL, continue climbing at V_2 speed with flaps in the takeoff position until the obstacle is cleared or the SID requirement has been satisfied. Takeoff power may be maintained for 10 minutes during single-engine operations as needed. Power should then be reduced to the MCT detent.

One Engine Inoperative ILS Approach and Landing

Refer to the profile on page 7-59.

A single-engine approach does not deviate from normal procedures with respect to airspeed control, altitude, and configuration management. The only deviation is final flap setting.

Configure the aircraft in accordance with the Single-Engine Approach and Landing checklist. The engine inoperative power setting is approximately 10% N_1 greater than for the normal two engine N_1 setting. If using rudder trim during an approach to counter asymmetric thrust, zero the rudder trim prior to or during the landing power reduction to prevent unwanted yaw. Power reduction and flare are similar to a normal landing. Power reduction should be slower than normal to counter roll due to yaw effect. Consequently, slightly less flare than normal is necessary to prevent floating.

NOTE: Maximum flap extension for landing with one engine inoperative is 15°. The landing distance will be increased by a factor of 1.20 with the flaps set at 15°.

On touchdown, extend the speedbrakes, lower the nose wheel smoothly to the runway, and apply brakes as required. Use the rudder and nose wheel steering as required. The PM should apply forward pressure to the control column to ensure positive reaction of the nose wheel steering.

Reverse thrust on the remaining engine may be used. Add reverse thrust carefully, especially on runways that are contaminated. Reverse thrust may need to be decreased during crosswind landings on icy runways to prevent the airplane from being forced to the runway edge.

One Engine Inoperative Go-Around/Missed Approach

Refer to the profile on page 7-67.

Accomplish the following:

- Push the GA button on either throttle.
- Set power on the operating engine to the TO detent.
- Rotate to an airplane pitch attitude of 7.5° initially, then as required. Ensure the speedbrakes are retracted.
- Select flaps to 15° (multi-engine approach) or 7° (single-engine approach).
- Climb speed V_{REF}+3 KIAS minimum.
- When a minimum rate of climb is indicated on the VSI, retract the landing gear.
- Set the Flight Guidance Panel as necessary.
- At a minimum altitude of 1,000 feet above the airport, accelerate in level flight to V_{APP}+10 KIAS and retract the flaps.
- Continue the acceleration to V_{ENR}, reduce the power to the MCT detent or as required and continue the climb.

When time permits, accomplish the Single-Engine Go-Around checklist and advise ATC of the missed approach. Request further clearance (another approach or diversion to the alternate airport).

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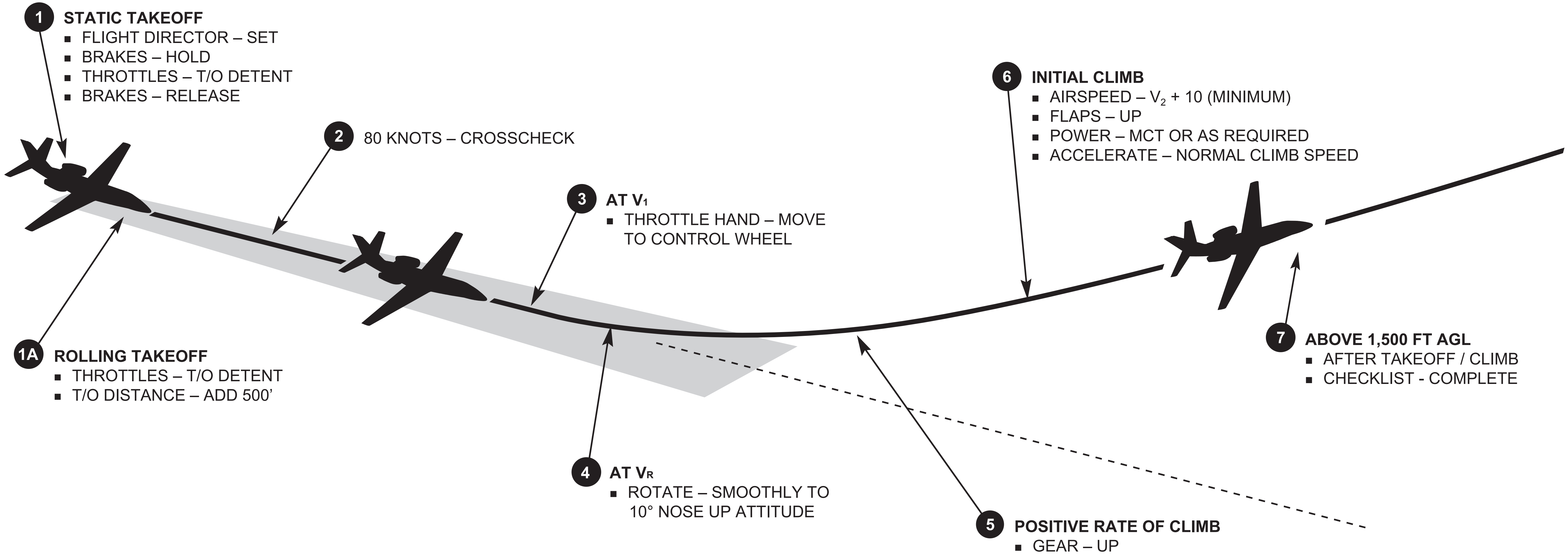
Normal Takeoff



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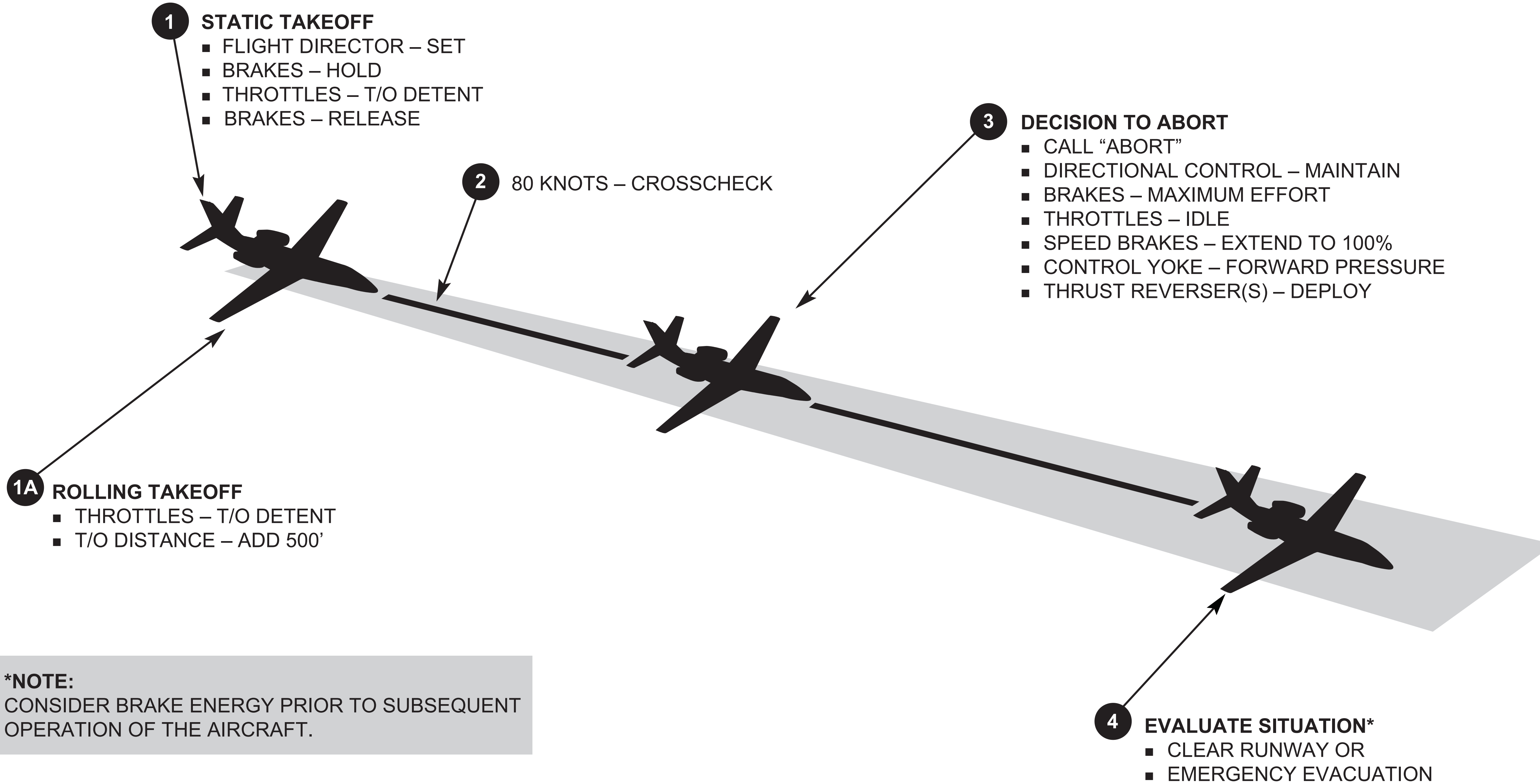
Rejected Takeoff



***NOTE:**
CONSIDER BRAKE ENERGY PRIOR TO SUBSEQUENT OPERATION OF THE AIRCRAFT.

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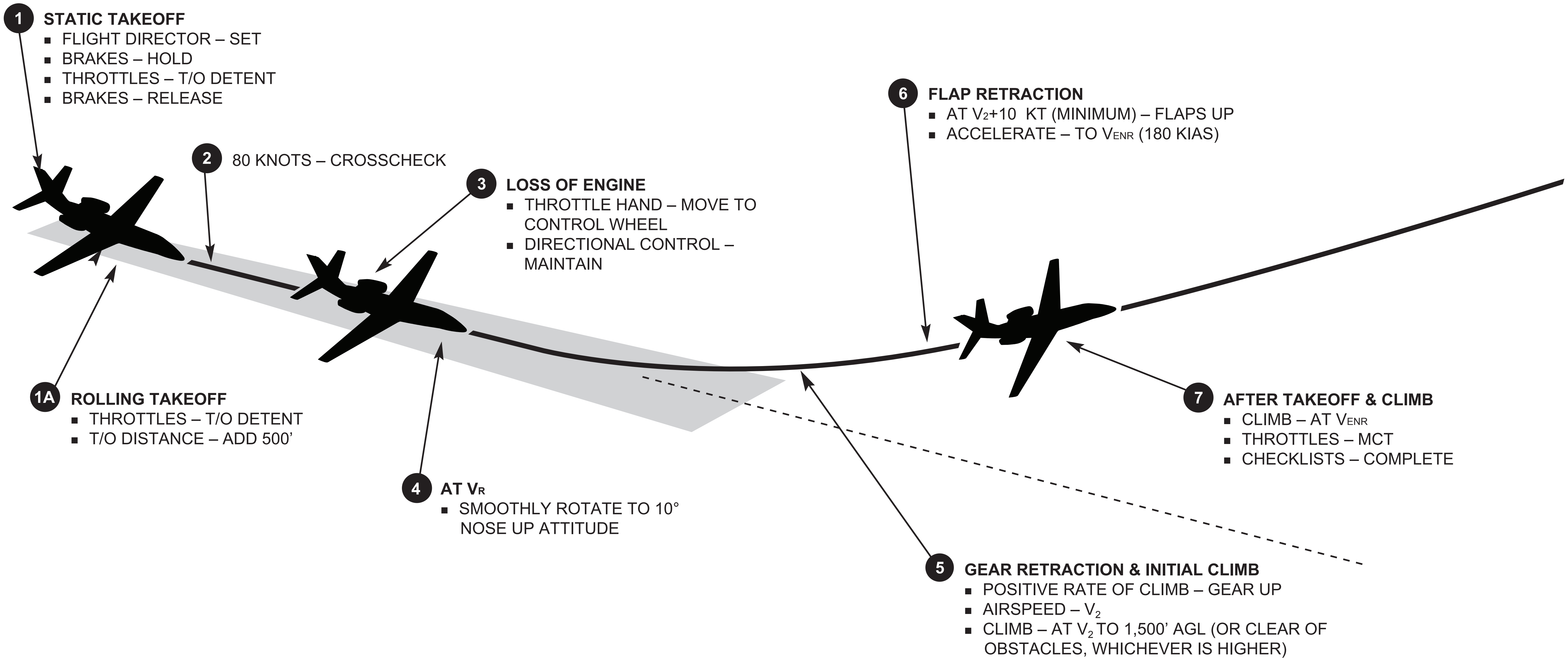
Engine Failure Above V_1



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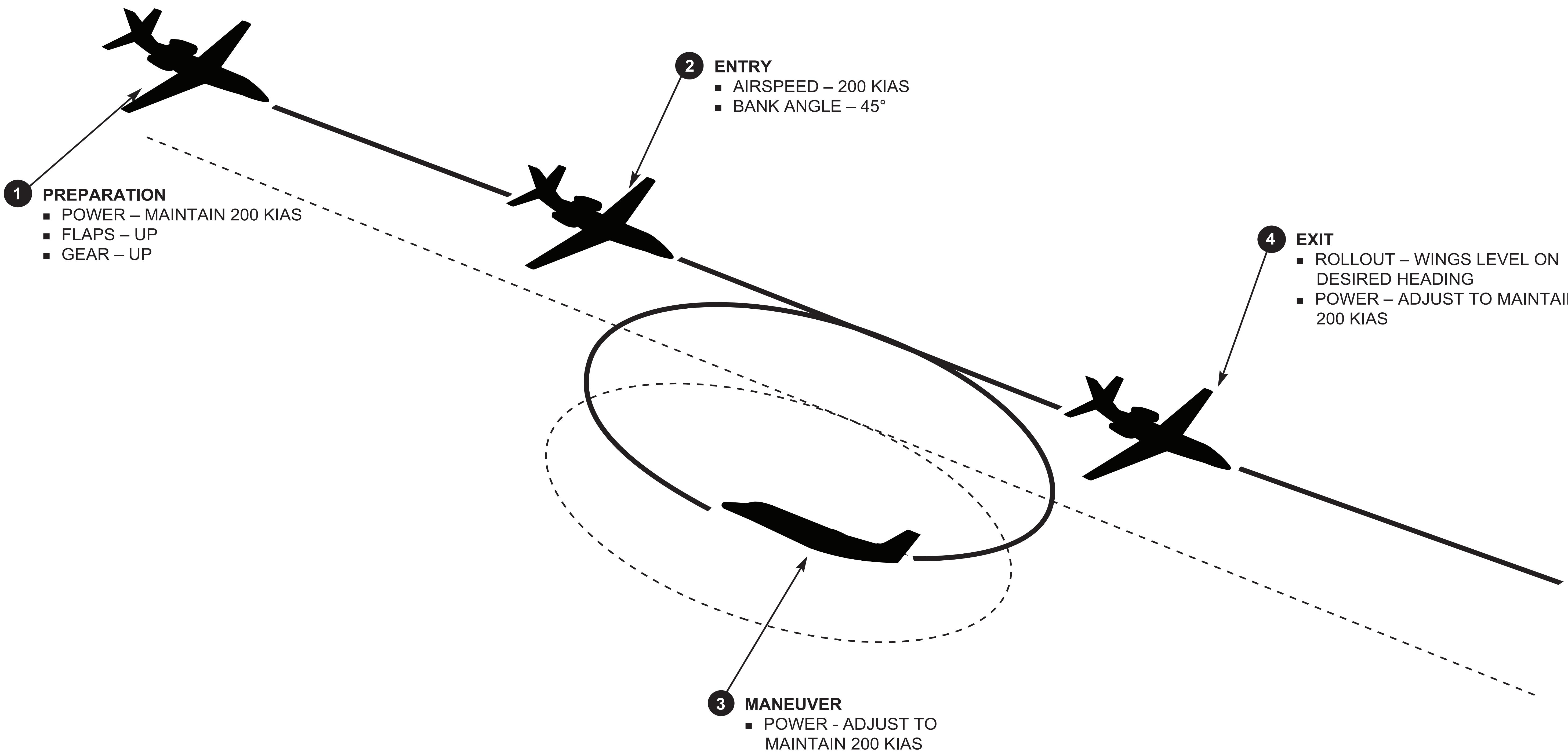
Steep Turns



2 ENTRY
■ AIRSPEED – 200 KIAS
■ BANK ANGLE – 45°
1 PREPARATION
■ POWER – MAINTAIN 200 KIAS
■ FLAPS – UP
■ GEAR – UP
4 EXIT
■ ROLLOUT – WINGS LEVEL ON DESIRED HEADING
■ POWER – ADJUST TO MAINTAIN 200 KIAS
3 MANEUVER
■ POWER - ADJUST TO MAINTAIN 200 KIAS

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Maneuver Based Approach to Stalls

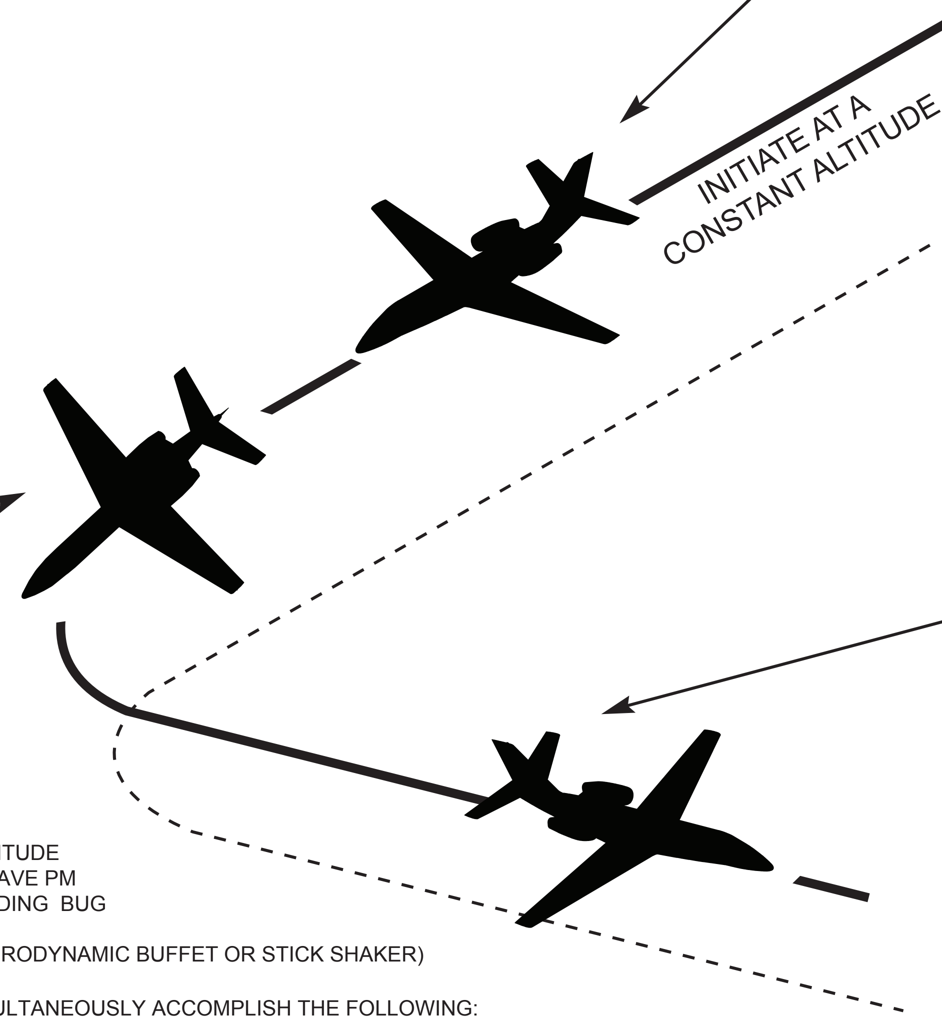
BEFORE BEGINNING STALL PRACTICE

- V_{REF}/V_{APP} – SET MANUALLY
- AOA INDICATORS – DISPLAY ON BOTH PFDs
- FLIGHT DIRECTORS – CAN BE ON OR OFF AT PILOT DISCRETION

1

CLEAN/CRUISE CONFIGURATION

- GEAR – UP
- FLAPS – UP
- AUTOPILOT – OFF
- THROTTLES – IDLE
- PITCH – MAINTAIN LEVEL FLIGHT AND ALTITUDE
- BANK – WINGS LEVEL AND MAINTAIN HEADING
- SLOW TO FIRST INDICATION OF STALL (AERODYNAMIC BUFFET OR STICK SHAKER)
- RECOVERY
  AT THE FIRST INDICATION OF STALL, SIMULTANEOUSLY ACCOMPLISH THE FOLLOWING:
  - THROTTLES – TO DETENT
  - PITCH – REDUCE ANGLE OF ATTACK (TRIM AS NECESSARY)
  - BANK – MAINTAIN HEADING AND WINGS LEVEL
  - SPEEDBRAKES – VERIFY RETRACTED
  - ACCELERATE TO V_{REF} MINIMUM AND INITIATE CLIMB
  - ALTITUDE AND AIRSPEED – RETURN/MAINTAIN START ALTITUDE AND 170 KIAS MINIMUM
  - DO NOT EXCEED ANY LIMITATIONS



2

TAKEOFF/APPROACH CONFIGURATION

- GEAR – UP
- FLAPS – 15°
- AUTOPILOT – OFF
- THROTTLES – IDLE
- PITCH – MAINTAIN LEVEL FLIGHT AND ALTITUDE
- BANK – 20° (IF USING FLIGHT DIRECTOR HAVE PM ENGAGE 1/2 BANK AND TURN HEADING BUG IN THE DESIRED DIRECTION)
- SLOW TO FIRST INDICATION OF STALL (AERODYNAMIC BUFFET OR STICK SHAKER)
- RECOVERY
  AT THE FIRST INDICATION OF STALL, SIMULTANEOUSLY ACCOMPLISH THE FOLLOWING:
  - THROTTLES – TO DETENT
  - PITCH – REDUCE ANGLE OF ATTACK (TRIM AS NECESSARY)
  - BANK – LEVEL THE WINGS (IF USING FLIGHT DIRECTOR HAVE PM CENTER HEADING BUG AND DESELECT 1/2 BANK)
  - SPEEDBRAKES – VERIFY RETRACTED
  - ACCELERATE TO V_{REF} MINIMUM AND INITIATE CLIMB
  - ALTITUDE AND AIRSPEED – RETURN/MAINTAIN START ALTITUDE AND 170 KIAS MINIMUM
  - DO NOT EXCEED ANY LIMITATIONS

3

LANDING CONFIGURATION

- AUTOPILOT – ON
- GEAR – DOWN
- FLAPS – 35°
- THROTTLES – 50% N_1
- ALTITUDE AND HEADING – MAINTAIN
- AUTOPILOT WILL DISCONNECT (AT STICK SHAKER ACTIVATION)
- RECOVERY
  AT THE FIRST INDICATION OF STALL, SIMULTANEOUSLY ACCOMPLISH THE FOLLOWING:
  - THROTTLES – TO DETENT
  - PITCH – REDUCE ANGLE OF ATTACK (TRIM AS NECESSARY)
  - WINGS – KEEP LEVEL
  - FLAP – 15°
  - ACCELERATE to V_{REF} MINIMUM AND INITIATE CLIMB
  - POSITIVE RATE OF CLIMB – GEAR UP
  - AT V_{APP} +10 KTS – FLAPS UP
  - ALTITUDE AND AIRSPEED – RETURN/MAINTAIN START ALTITUDE AND 170 KIAS MINIMUM
  - DO NOT EXCEED ANY LIMITATIONS

NOTE:
EVALUATION CRITERIA FOR A RECOVERY FROM AN APPROACH TO STALL SHOULD NOT MANDATE A PREDETERMINED VALUE FOR ALTITUDE LOSS AND SHOULD NOT MANDATE MAINTAINING ALTITUDE DURING RECOVERY.

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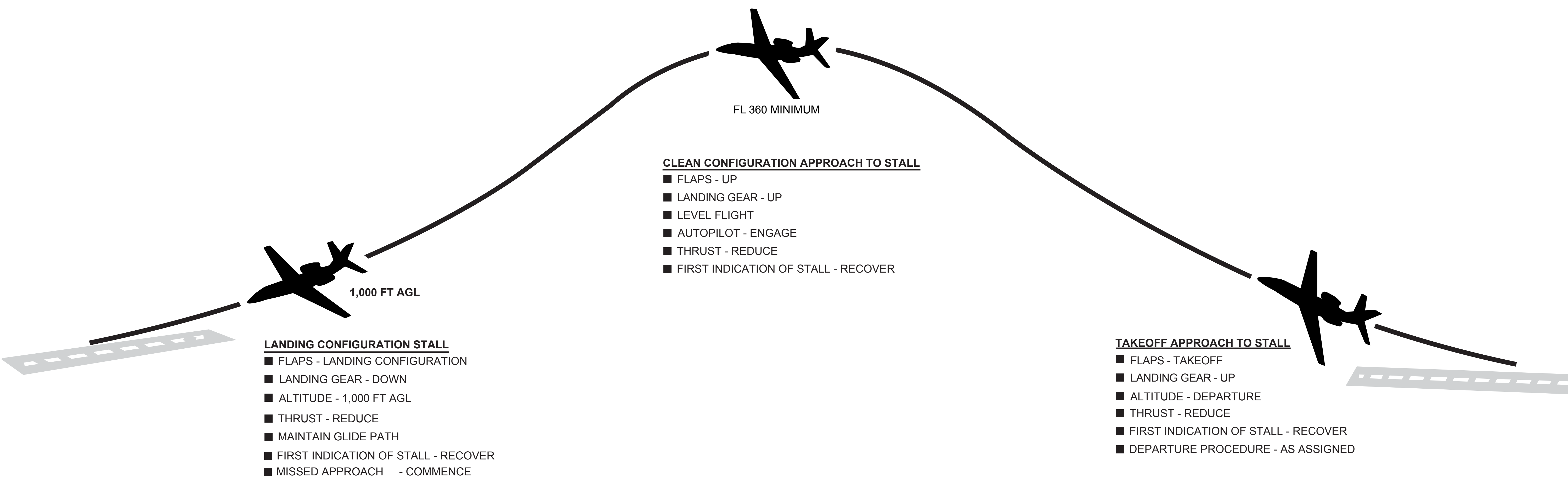
Scenario Based Approach to Stalls



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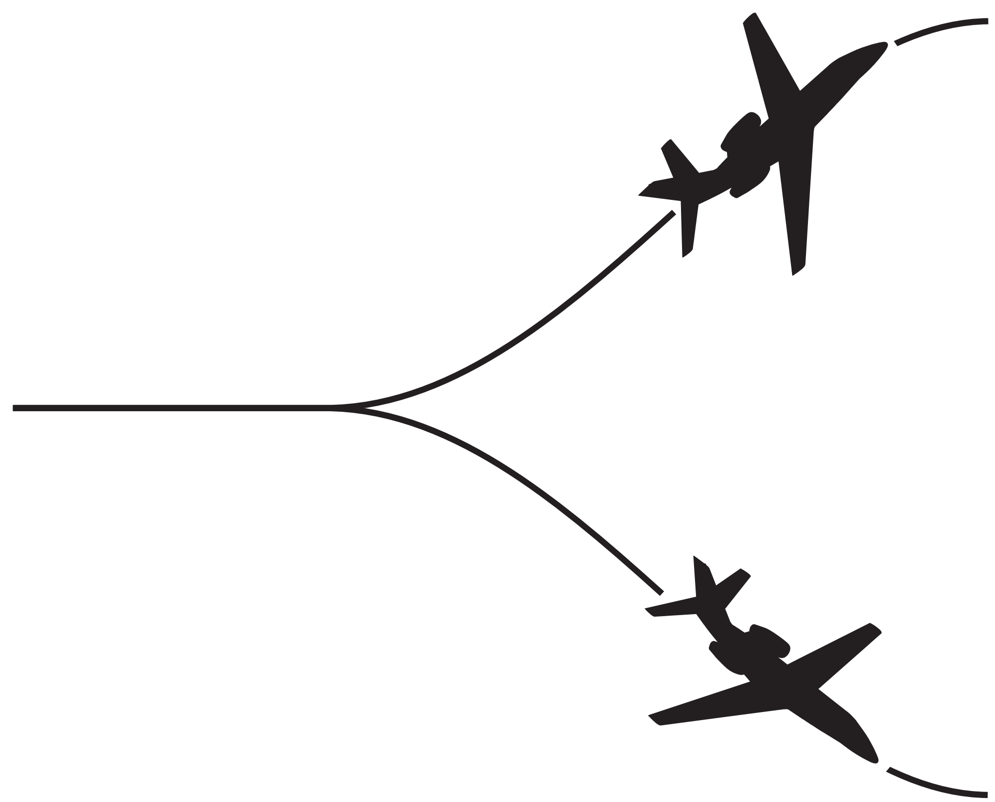
Unusual Attitudes



1 NOSE HIGH – SPEED DECAYING

- MAX THRUST – APPLY
- ROLL TO NEAREST HORIZON (45 TO 90° DEPENDING ON SEVERITY OF NOSE HIGH ATTITUDE & SPEED DECAY)
- ALLOW NOSE TO FALL THROUGH THE HORIZON – 5° NOSE DOWN PITCH ATTITUDE
- WINGS – LEVEL
- THRUST AND ATTITUDE – ADJUST

2 NOSE LOW – SPEED INCREASING

- THRUST – REDUCE
- WINGS – LEVEL
- APPLY BACK PRESSURE AND TRIM TO REDUCE AIRSPEED AS NECESSARY
- IF AIRSPEED EXCEEDS V_{MO}/M_{MO} – EXTEND SPEEDBRAKES
- RETURN TO STRAIGHT AND LEVEL FLIGHT
- THRUST AND ATTITUDE – ADJUST
- GEAR – DO NOT RETRACT

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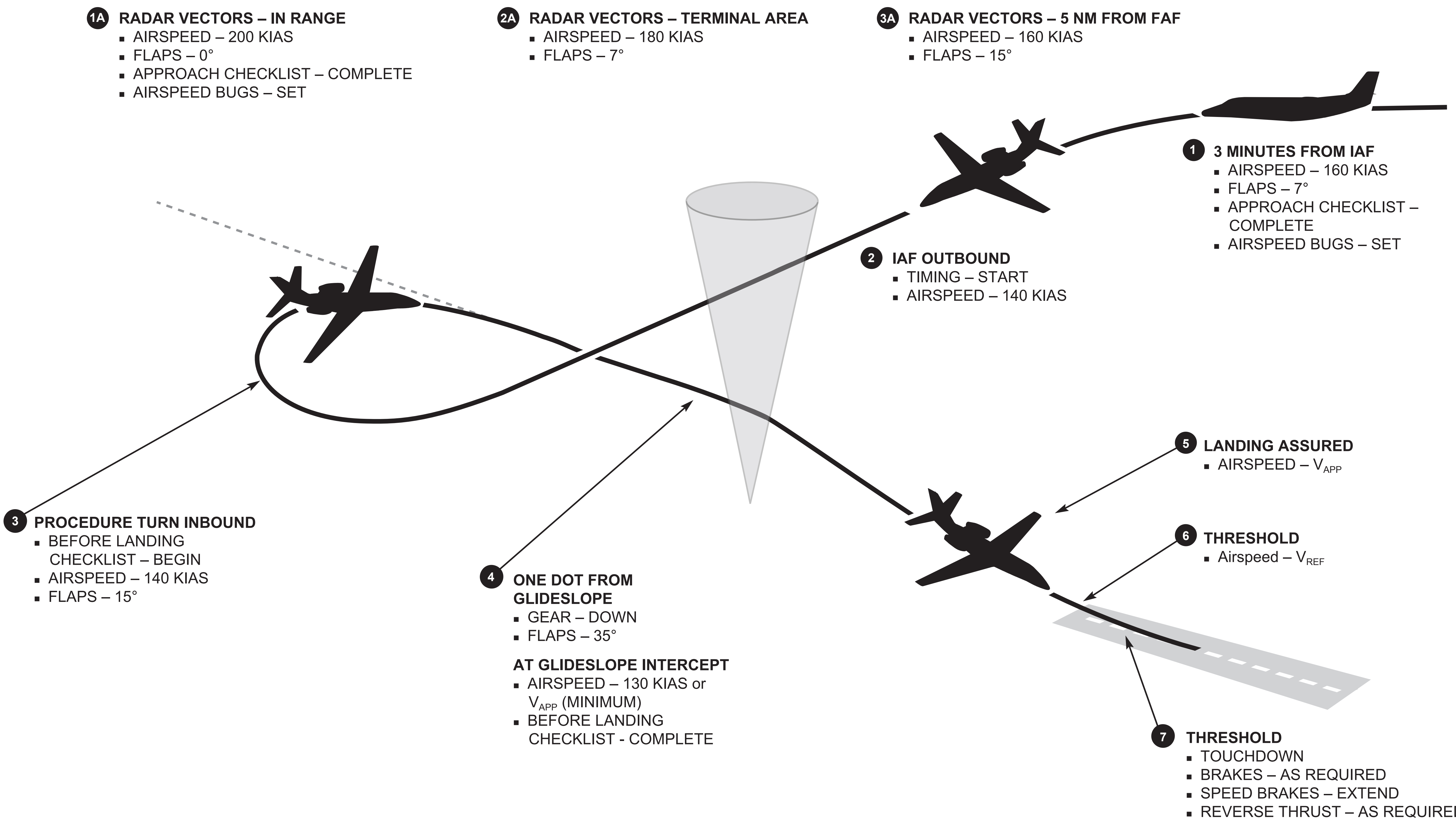
Precision Approach/Landing



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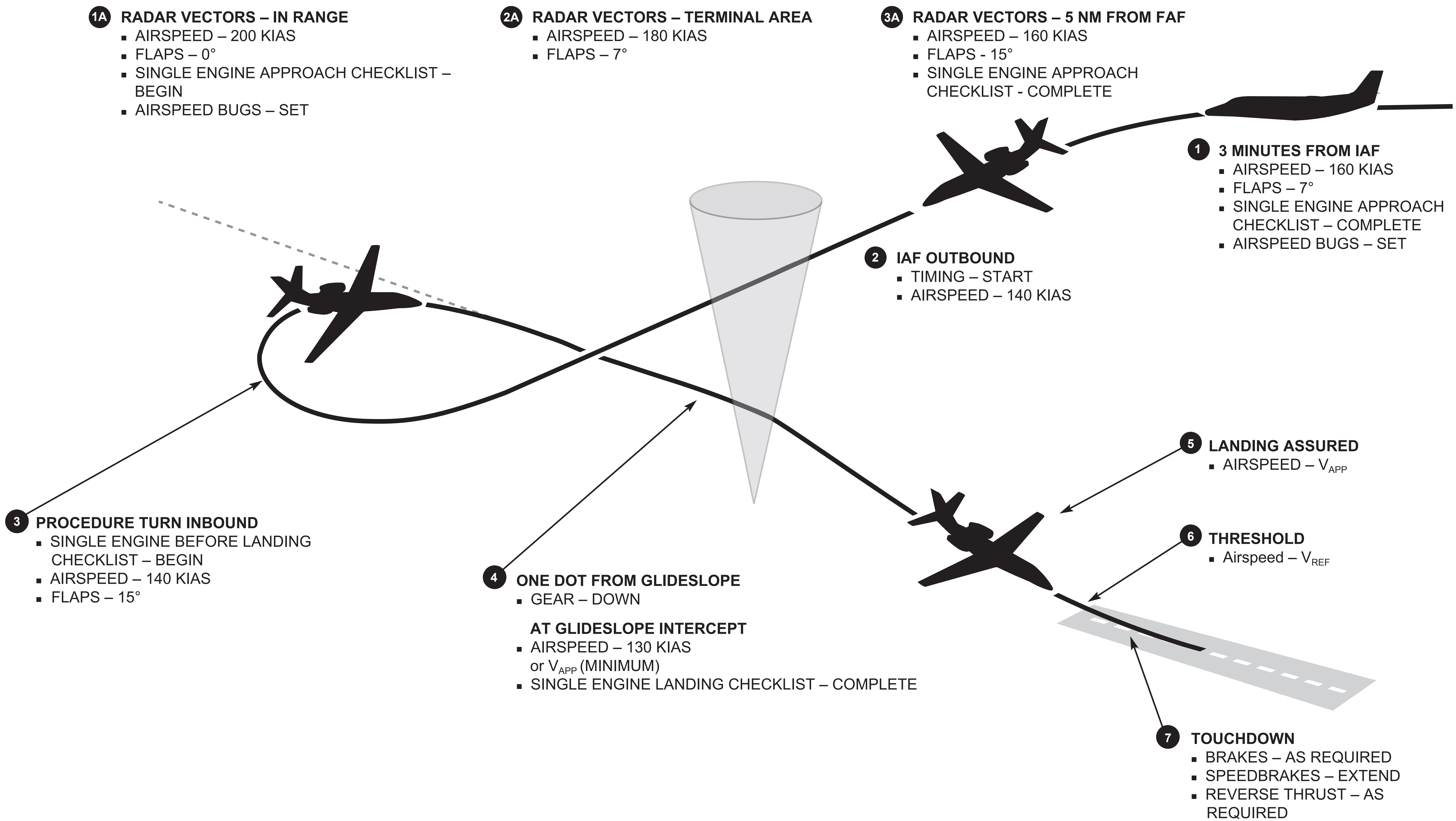
Single Engine Precision Approach/Landing



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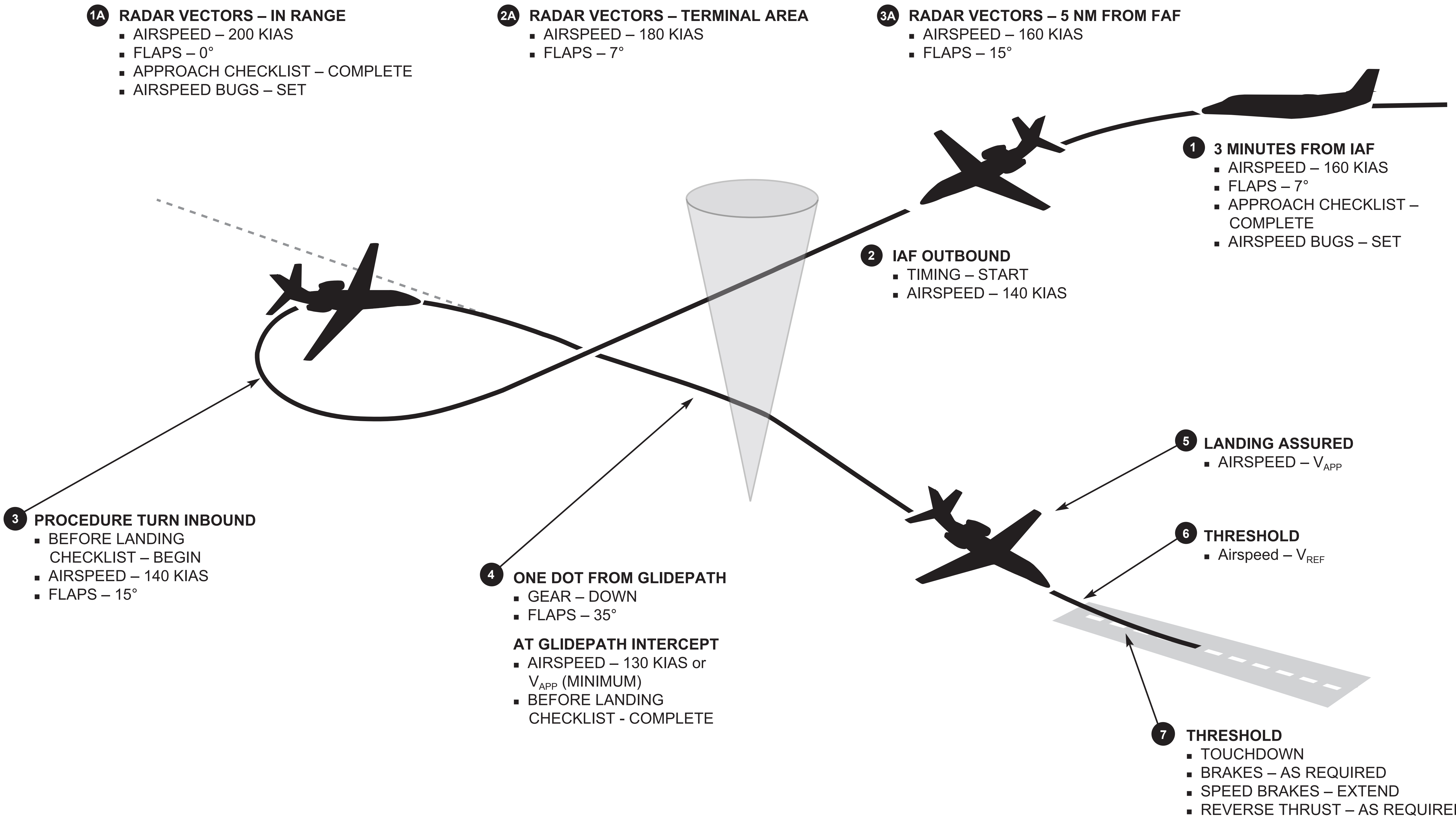
Two Engine Non-Precision Approach/Landing with VNAV Guidance



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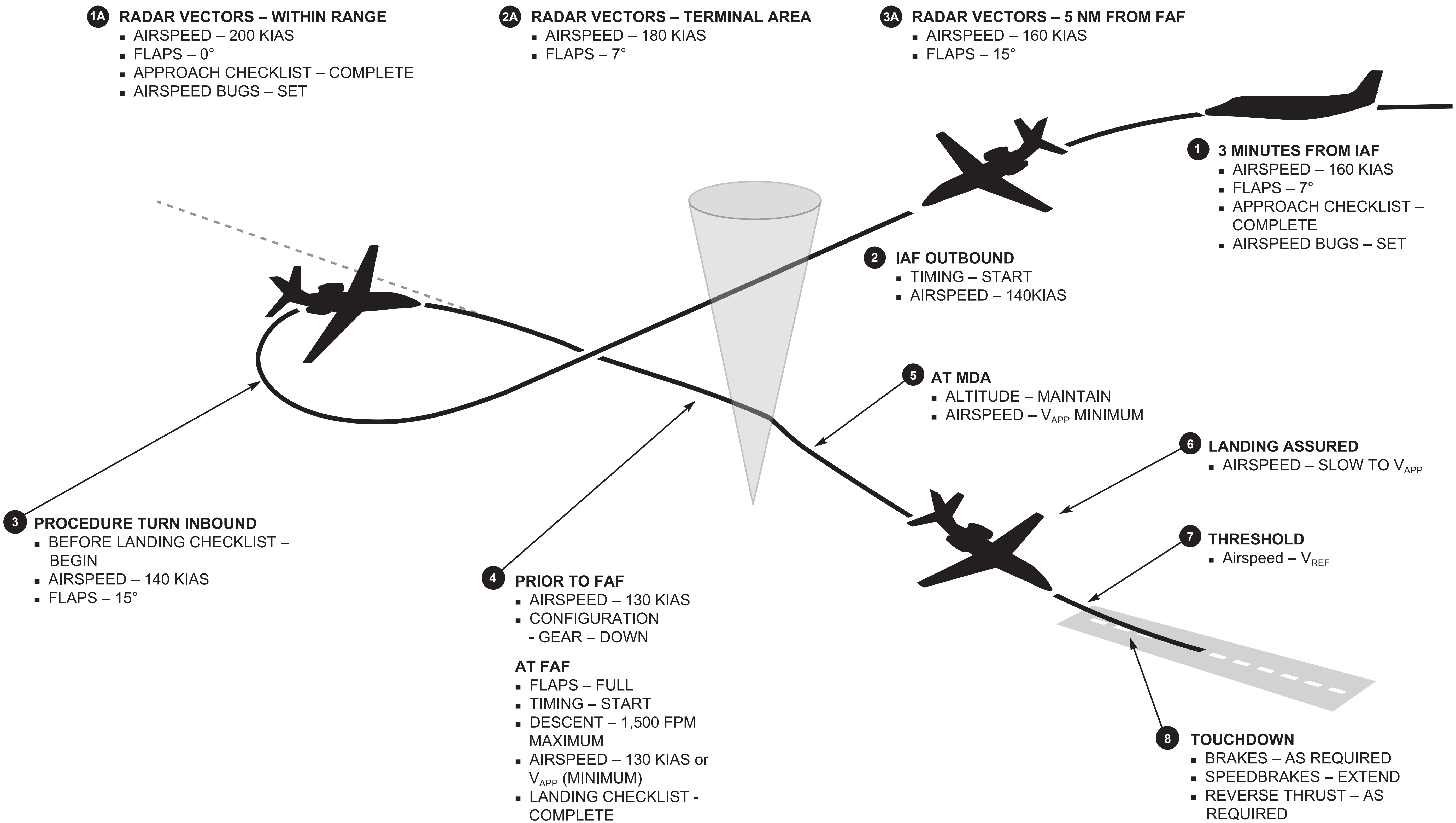
Two Engine Non-Precision Approach/Landing without VNAV Guidance



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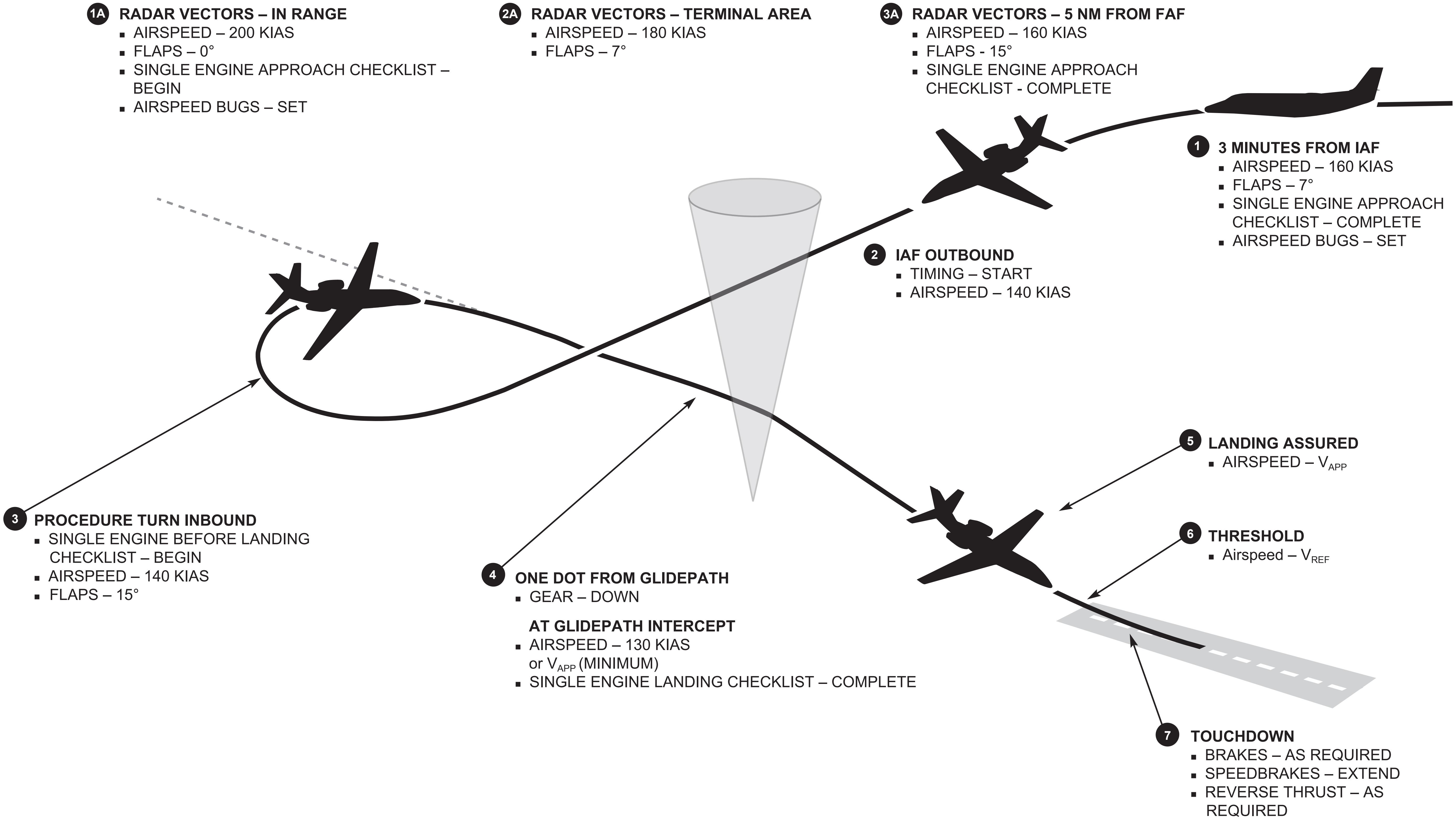
One Engine Inoperative Non-Precision Approach/Landing with VNAV Guidance



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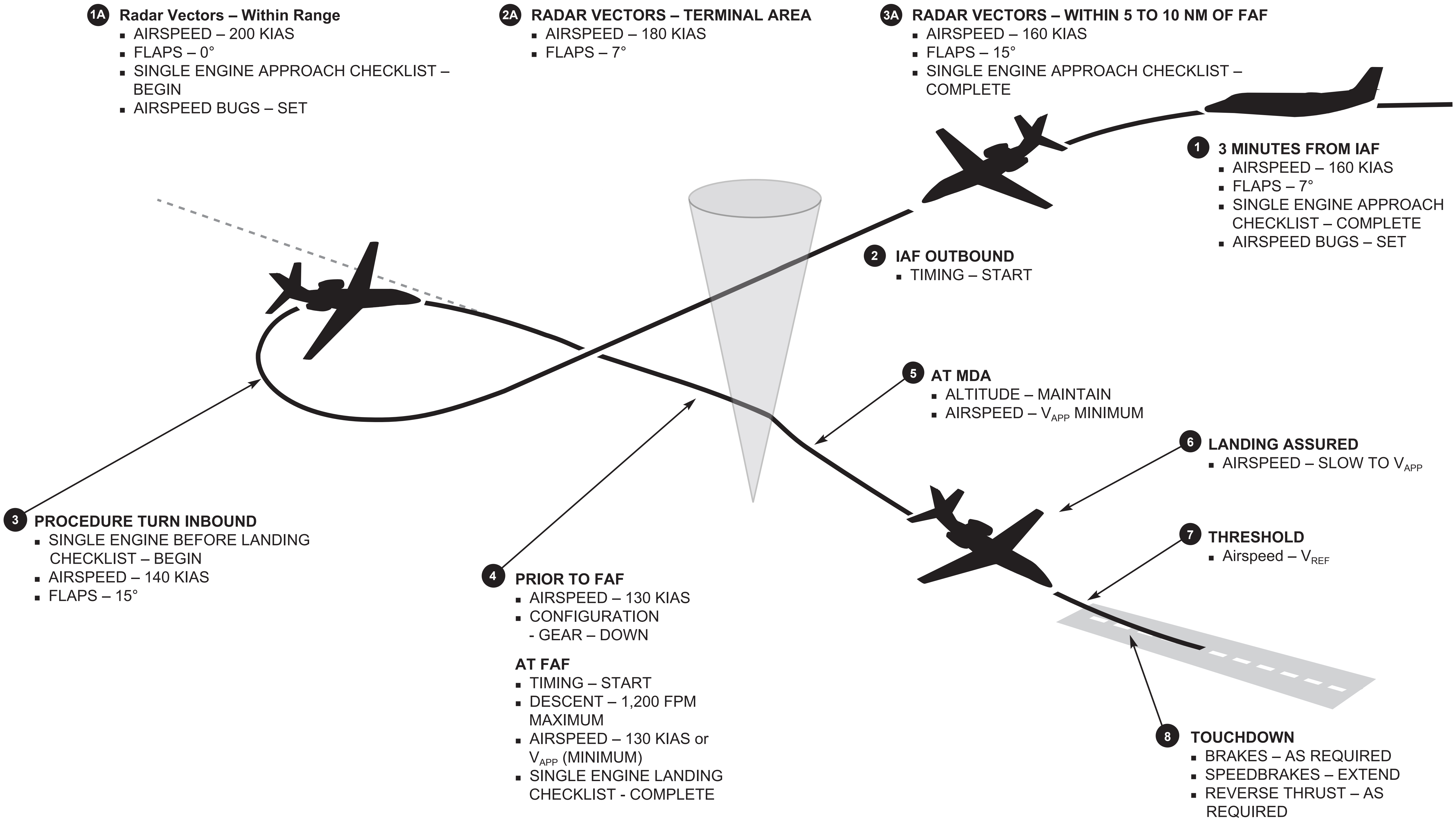
One Engine Inoperative Non-Precision Approach/Landing without VNAV Guidance



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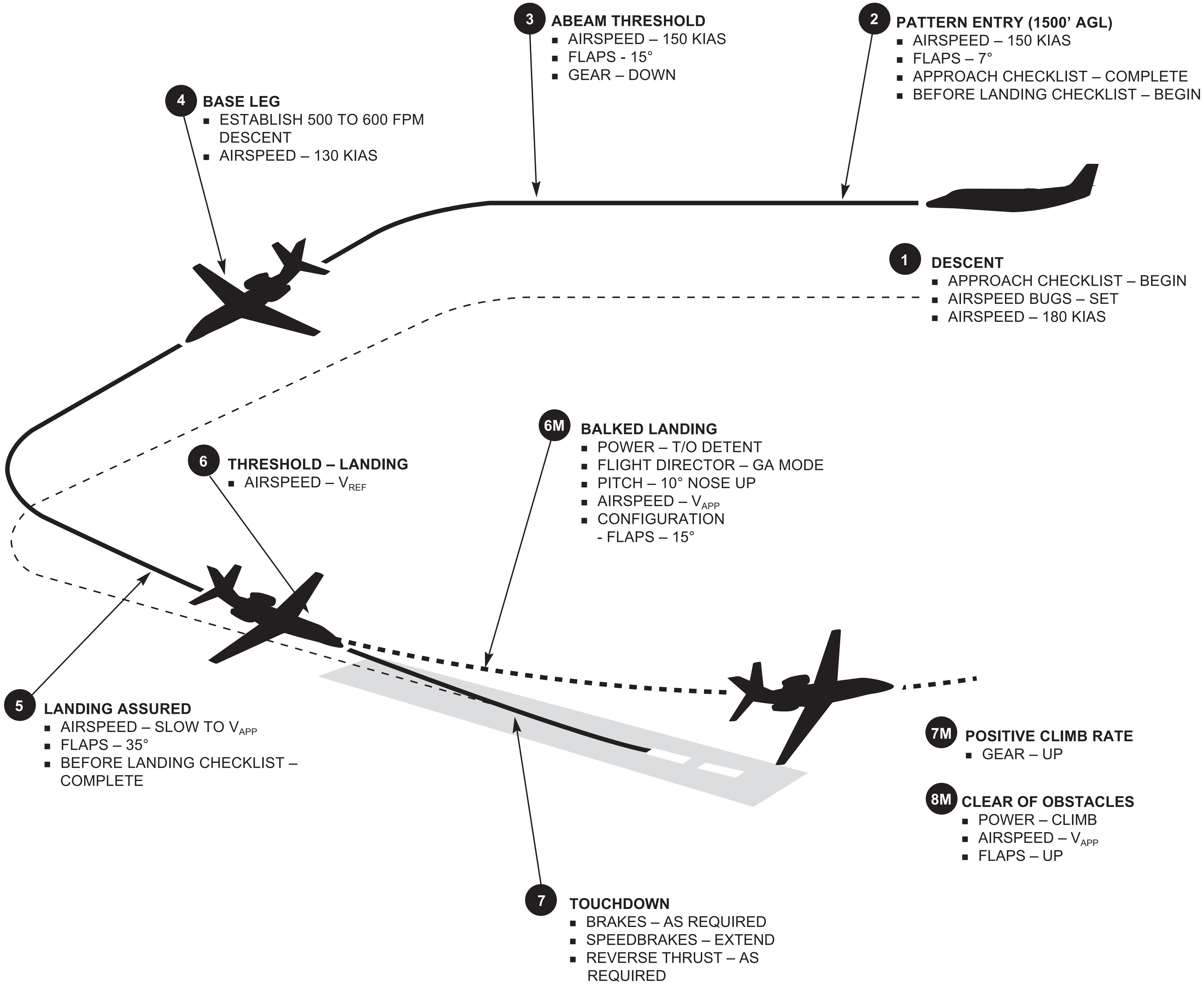
Visual Approach/Balked Landing



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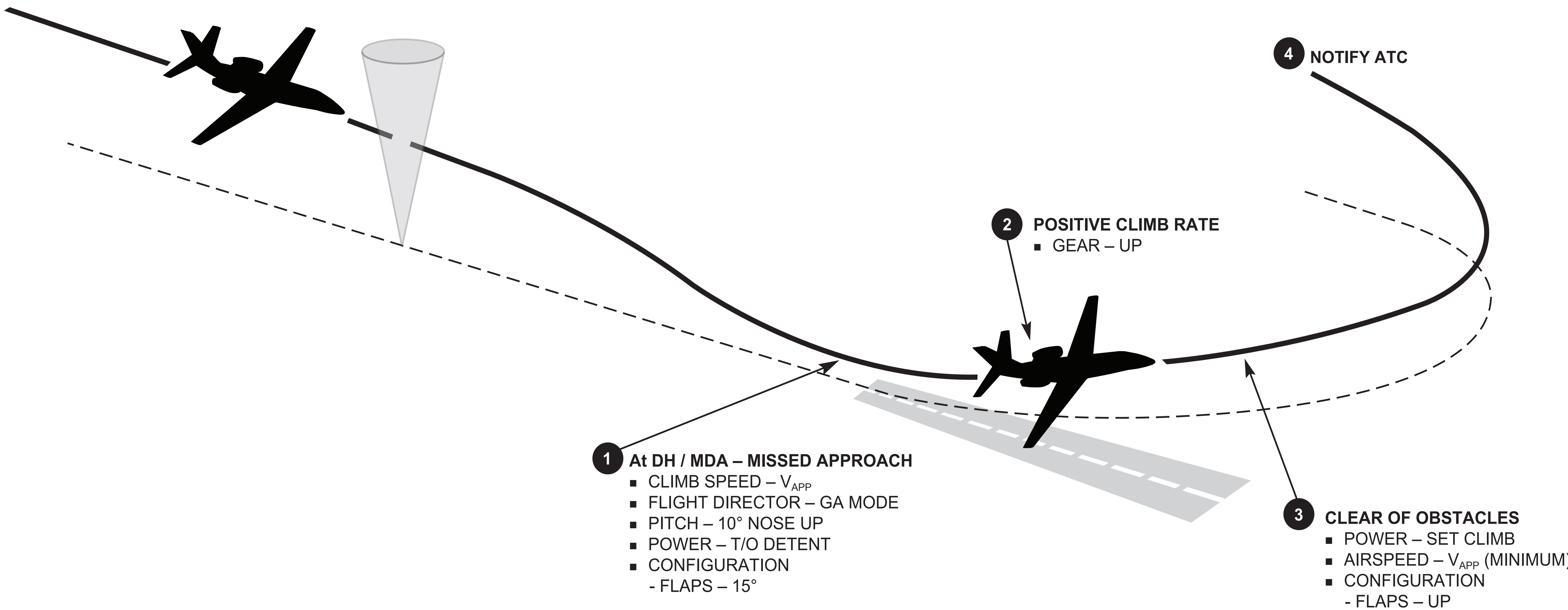
Go-Around/Missed Approach



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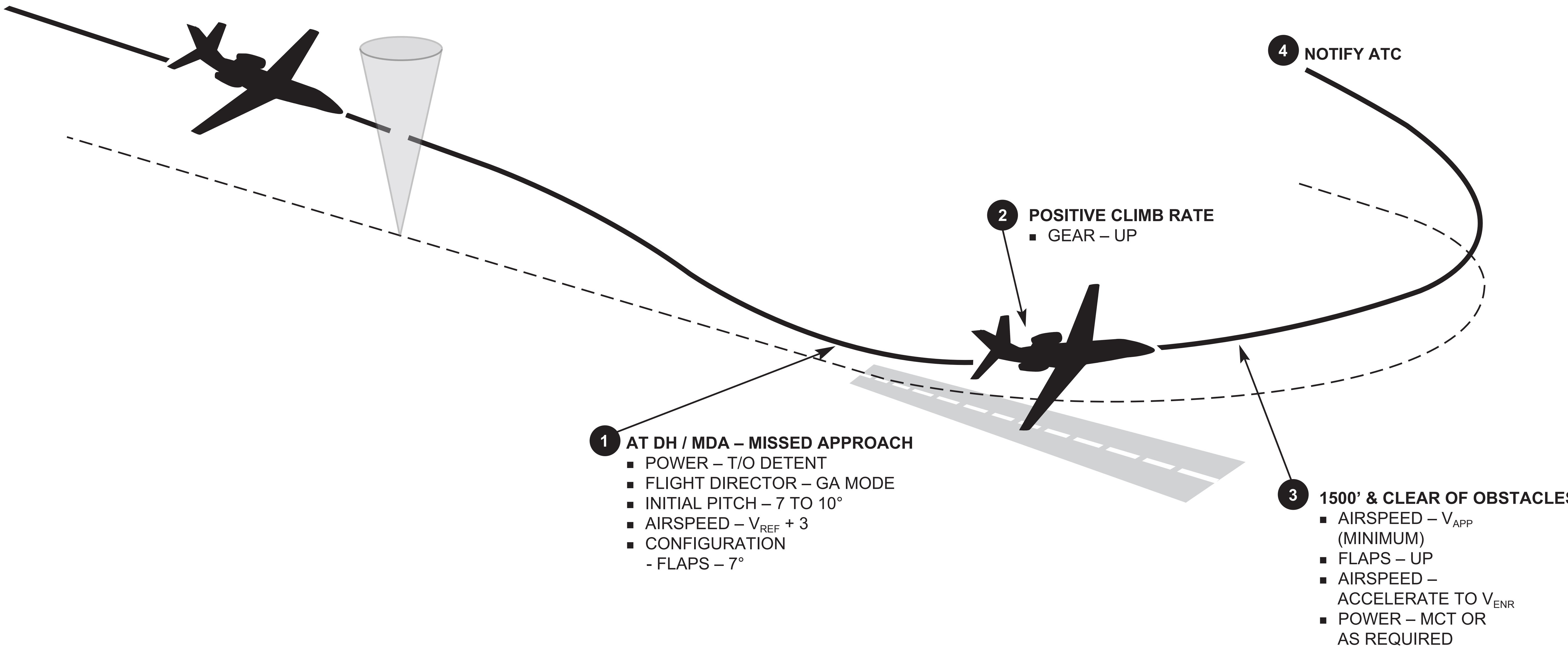
Single Engine Go-Around/Missed Approach



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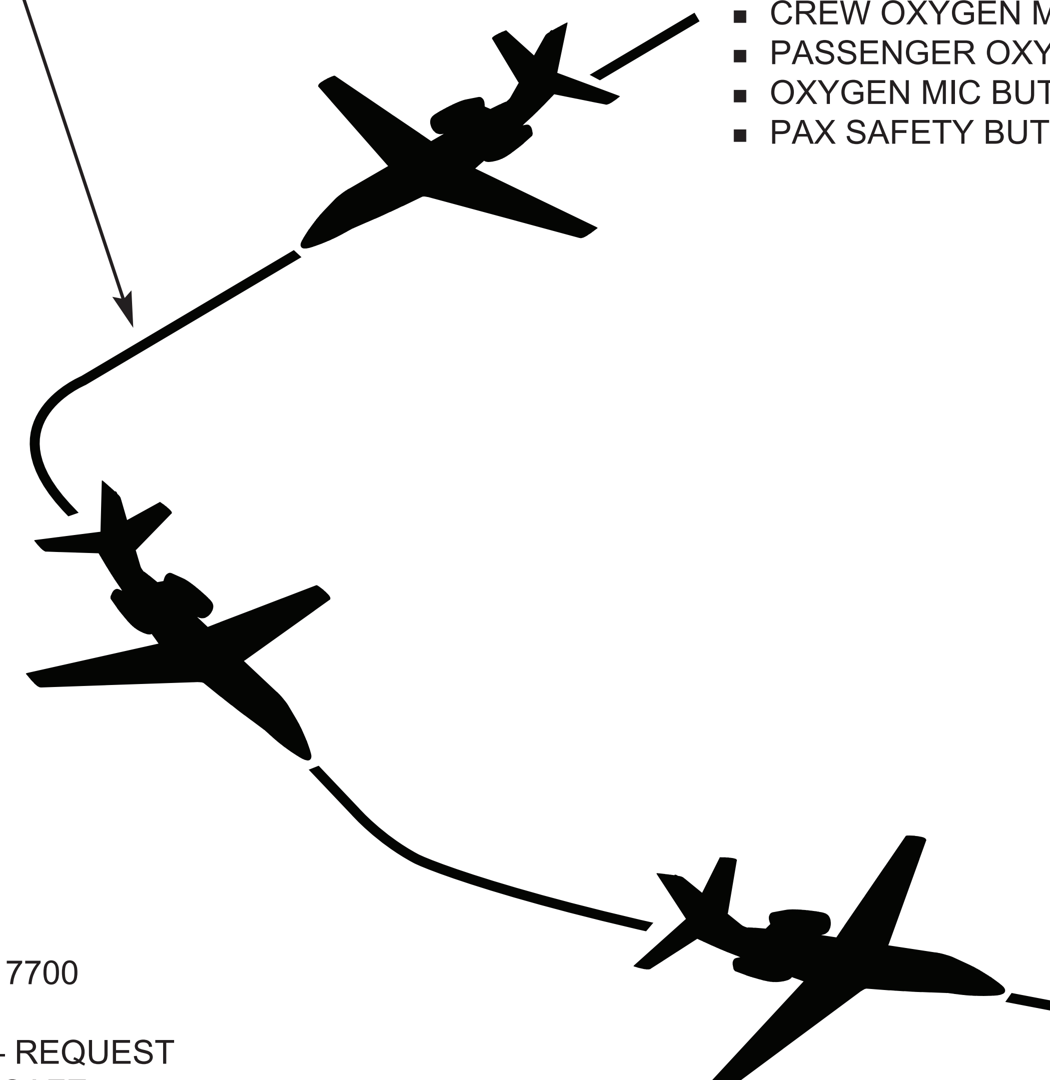
Emergency Descent



1 DECISION TO MAKE EMERGENCY DESCENT
- CREW OXYGEN MASKS – DON & 100%
- PASSENGER OXYGEN – ON
- OXYGEN MIC BUTTON – OXY MASK
- PAX SAFETY BUTTON – ON

2 INITIATE DESCENT
- AUTOPILOT – DISCONNECT
- THROTTLES – IDLE
- SPEED BRAKES – EXTEND
- ALLOW NOSE TO DROP TO 15°, AVOIDING NEGATIVE GS

3
- SPEED – M_{MO}/V_{MO} (USE REDUCED SPEED IF STRUCTURAL DAMAGE)

4 DURING DESCENT
- ATC – NOTIFY
- ATC TRANSPONDER – 7700 (IF NECESSARY)
- ALTIMETER SETTING – REQUEST
- DETERMINE MINIMUM SAFE ALTITUDE
- PRESSURIZATION – RESET IF ABLE

5 APPROACHING DESIRED ALTITUDE
- LEVEL OFF – INITIATE 1000’ PRIOR TO DESIRED ALTITUDE
- SPEED BRAKES – RETRACT
- CREW OXYGEN – NORMAL
- DETERMINE WELL BEING

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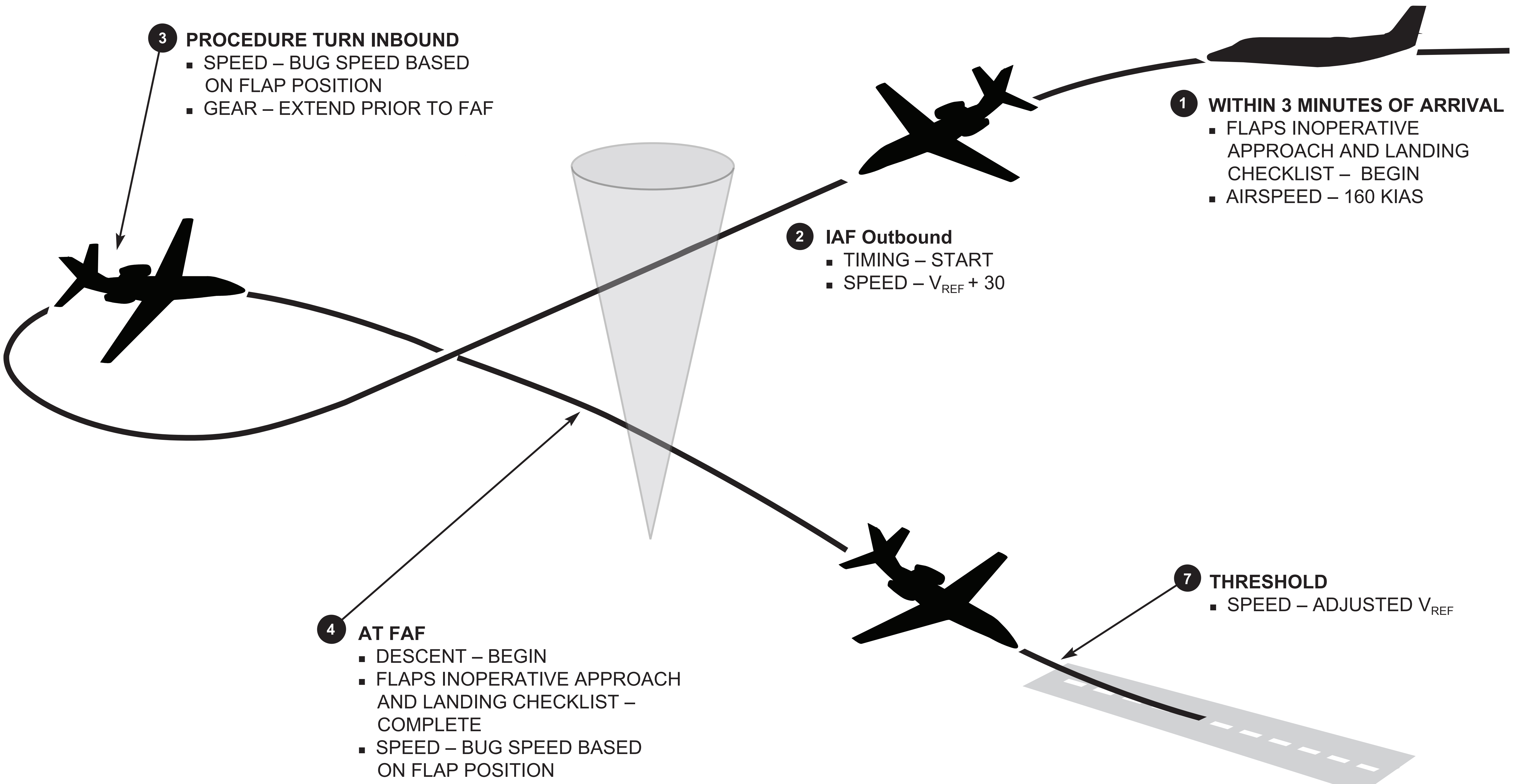
Flaps Inoperative Approach/Landing



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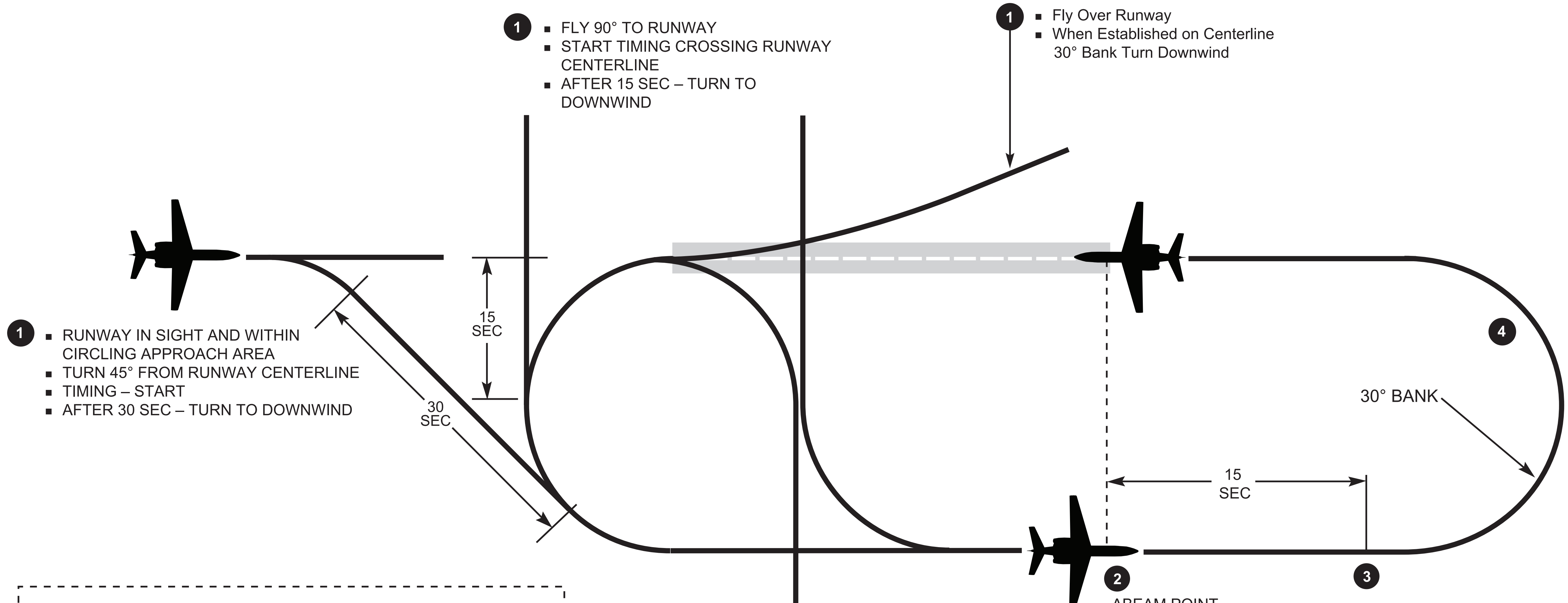
Circling Approach



NOTES:
- ADJUSTMENTS TO TIME OR HEADING MAY BE USED TO ADJUST FOR WIND
- BASED ON 30° BANK TURNS
- USE CATEGORY C MINIMA
- A MINIMUM OF 300 FT OBSTACLE CLEARANCE PROVIDED AT CATEGORY C CIRCLING MINIMA WITHIN 1.7 NM FROM ANY RUNWAY

RECOMMENDATIONS:
- FLAPS – 35°
- GEAR – DOWN
- AIRSPEED – 130 KIAS WITH FLAPS 35° (MAINTAIN CONSTANT SPEED FOR TIMING)
- POWER – AS REQUIRED
- F/D ALTITUDE HOLD – SELECT
- F/D HEADING – SELECT
- USE OF AUTOPILOT IS OPTIONAL

BASIC CIRCLING PATTERN

1. ENTER BASIC PATTERN AS APPROPRIATE FOR AIRCRAFT POSITION
2. START TIMING A BEAM APPROACH END OF RUNWAY
3. START TURN TO FINAL, MAXIMUM 30° BANK
4. WITH RUNWAY IN SIGHT AND IN POSITION TO MAKE A NORMAL DESCENT TO LANDING
   - BEFORE LANDING CHECKLIST – COMPLETE
   - DESCENT FROM MDA – BEGIN
   - AIRSPEED – APPROPRIATE FOR FLAP SETTING
   - IF NOT IN A POSITION TO MAKE A NORMAL LANDING – GO-AROUND – EXECUTE
   - AT THRESHOLD
     - AIRSPEED – V_{REF}

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8

Flight Planning

Contents

Flight Planning

Flight planning involves the gathering of data and accurately applying charts provided by the manufacturer to determine the optimum utilization of the aircraft. Flight planning data can be found in the following manuals:

- Aircraft Operating Manual
  - Weight and Balance
  - Flight Planning Charts
  - Performance Charts
    - Climb
    - Cruise
    - Drift down
    - Descent
    - Holding
- Aircraft Flight Manual
  - Takeoff performance
  - Obstacle clearance
  - Landing performance
  - Weight and balance
  - Contaminated runway data

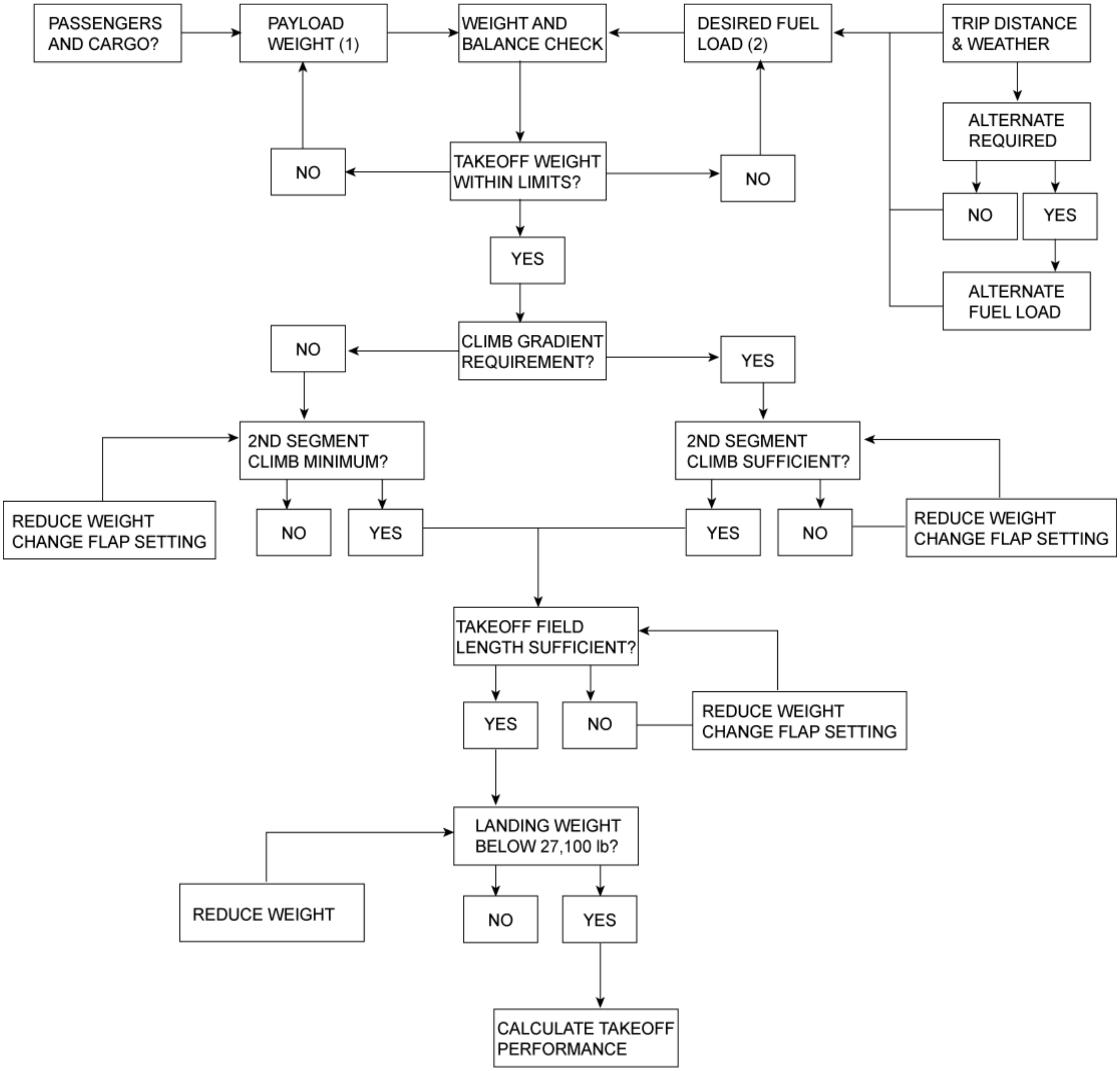
This section will demonstrate how to use the Citation Sovereign charts and tables to determine the aircraft weight and balance, enroute fuel burn and runway performance. Each step is illustrated by performance charts and recorded on worksheets.

In today's high-tech world it is obviously preferred to utilize a computer-based flight planning service or software package (such as the Cessna Performance Calculator or Electronic Operating Manual) for trip planning. The aircraft's Flight Management System (FMS) can also be used for flight planning purposes. These methods have proven to be safe, effective and efficient.

The purpose of demonstrating AFM-based performance planning in this chapter is for the pilot to develop a basic understanding of how aircraft performance for the Citation Sovereign is derived, in order to find numbers to use as a judgement to operate safely and legally. Since the Airplane Flight Manual is the regulatory document for operation of the aircraft, it is important that the crew understand where to find pertinent information and be able to apply it to a real-world scenario for verification of the computerized data. The AFM, with all of its shortcomings is still the most valuable safety tool a pilot can master. Each entry represents many hours of flight testing, engineering scrutiny and regulatory oversight designed to keep you and your passengers safe.

The CAE instructor will provide classroom instruction in the use of the AFM, as well as computerized flight planning materials (including the aircraft's Flight Management System) to supplement the material presented in this chapter.

Flight Planning Flow Chart



1. PAYLOAD WEIGHT - THIS IS THE TOTAL WEIGHT OF THE PASSENGERS, BAGGAGE, CREW, CHARTS AND NORMAL STOCK ITEMS.
2. FUEL LOAD - THIS IS THE TOTAL OF FUEL REQUIRED FOR THE FLIGHT, RESERVE FUEL AND FUEL TO ALTERNATE IF REQUIRED.

General Planning

Obtain a preflight briefing from a Flight Service Station or a commercial vendor. The briefing should consist of weather, airport, and enroute NAVAID information and NOTAMS.

Normally, plan the trip and determine the weight and balance computations first. However, when conditions at the departure airport are near maximum operating limits of the aircraft, determine takeoff performance data first to prevent planning a trip and then discovering that takeoff is impossible with the planned passenger and fuel load.

The trip planning charts from the Citation Sovereign Operating Manual require only that the initial planned flight level and flight level winds are known or estimated. When computer flight planning services are used, an estimate of the departure weight is usually required to come up with the trip fuel and time requirements and to obtain the flight plan. The Flight Planning Charts can be used to estimate trip fuel based on the cruise altitude, weight, and cruise winds.

The example in this chapter represents a trip from the Denver Centennial Airport to Westchester County Airport in White Plains, NY with an alternate in Portsmouth, NH. You are in the hotel in Denver when the boss calls to say you will be leaving at about 7:00 AM MST tomorrow morning. She will be traveling with five other passengers. Your mission, should you decide to accept it, is to bring the six travelers to the Signature FBO in White Plains by 12:30 PM EST for a one o'clock meeting downtown.

Pertinent information for each segment of planning is included with that section of the chapter. Unfortunately, the computer flight planning service is not available tonight, so you will have to figure the data yourself!

To understand flight planning, it is necessary to be thoroughly familiar with the terms involved. This section reviews the definitions of terms used throughout this chapter.

General Definitions

AGL: Above ground level.

Altitudes: Airfield altitudes between 0 and -1,000 feet are taken as equal to 0 feet when reading performance charts.

CAS – Calibrated airspeed: Airspeed indicator reading, corrected for static and pitot pressure source position error.

Height: Vertical distance from the lowest point of the aircraft to the airport surface.

- Gross height: Height reached using the gross climb gradient within a given period of time. Gross height is used to determine the level-off pressure altitude.
- Net height: Height reached using the net climb gradient within a given period of time.

Net height is used to determine a net flight path that permits an aircraft taking off from a dry runway to clear any obstacle by at least 35 feet and by 15 feet from a wet runway.

Hp – Pressure altitude: Vertical distance from a standard level reference corresponding to 29.92 in Hg.

Humidity: Effect taken into account in performance data in compliance with para. 25.101.

IAS – Indicated airspeed: Airspeed indicator reading, as installed in the aircraft.

Instrument error: Difference between reading and true, assumed in this manual to be zero.

KIAS – Indicated airspeed: Indicated airspeed expressed in knots.

KCAS – Calibrated airspeed: Calibrated airspeed expressed in knots.

M – True Mach number: Mach indicator reading, corrected for static and pitot pressure source position error.

MI – Indicated Mach number: Mach indicator reading, as installed in the aircraft.

Minimum engagement height: The height below which the autopilot must be disengaged.

OAT – Outside air temperature: Free air static (ambient) temperature.

Position error: The errors resulting from the location of static ports and pitot pressure probes are compensated for by corrections ΔMI, ΔIAS, ΔHi.

Since the pilot and copilot pressure sources are installed symmetrically, the position error is the same. The position error for the independent standby system is different.

At low speed, for pilot and copilot pitot-static systems, the tolerance on airspeed correction is ±1.5 knots; on altitude correction, the tolerance is ±50 feet.

QFE – Field pressure: Actual atmospheric pressure at the elevation of the airport.

Runway condition: All performance data is established based on a smooth, hard surfaced runway, dry or wet as applicable.

SAT: Static air temperature: Outside air temperature computed from TAT as indicated on the SAT indicator.

Temperature: Airfield temperatures between -40°C (-40°F) and -54°C (-65.2°F) are taken as equal to -40°C (-40°F) when reading performance charts.

Landing distances are established based on standard temperatures.

Temperature ISA: International Standard Atmosphere, as accepted by the International Civil Aviation Organization.

Temperature deviation: Deviation from standard temperature (ISA).

TAT – Total air temperature: Outside air temperature, plus adiabatic compression rise as indicated on the TAT indicator.

Usable fuel: Fuel available for propulsion of the aircraft.

Unusable and non-drainable fuel: Fuel remaining in the tanks and systems after the usable fuel has been consumed.

V_{SR} – Reference stall speed: Reference calibrated airspeed determined during the stall maneuver in the specific configuration.

Wind: Take-off and landing distances include correction factors for:

- 50% of reported headwind component
- 150% of reported tailwind component

Takeoff Definitions

Maximum Allowable Weights

Maximum takeoff weight is based upon the most restrictive of the following:

- Structural Limit
- Climb or WAT Limit
- Field Length Limit
- Brake Energy Limit
- Tire Speed Limit
- Obstacle Clearance Limit (if applicable)

Maximum Structural Weight

Maximum gross weight typically covers all phases of flight from engine start to engine shutdown. Part 25 aircraft segment the weights by condition and/or phase of flight, such as taxi, takeoff, zero fuel and landing. These weights are found within the limitations section of the AFM. The limits are structural, meaning that the airplane can be damaged even during taxi operations if the weight are exceeded.

Maximum Climb Weight

Part 25 aircraft must obtain a minimum ability to climb with one-engine inoperative. The conditions are typically reflected in Altitude (A) and Temperature (T) and the standard is met by reducing Weight (W). Thus the limitation of maximum weight for climb is typically referred to as Max WAT or WAT limiting.

The minimum climb capability with one-engine inoperative is determined at four phases of takeoff: At lift-off (with the gear extended), after gear retraction (prior to reaching 400 feet), clean configuration below 1500 and finally in the enroute configuration (above 1500 feet). These specific values are: >0% (a positive rate of climb), 2.4%, 1.2% and 1.1% respectively. The four phases overlap the definitions of 1st, 2nd, final and enroute segments, which are discussed later in this chapter. Airworthiness is maintained by keeping the maximum gross takeoff weight below the tabulated value corresponding to the temperature and field pressure altitude of the departure. This weight limit assures that all of the above climb segments are met.

> ***NOTE:*** Max WAT climb capability is limited to 1,500 feet and at most a 2.4% climb gradient, which is less than the minimum 200 ft/nm gradient (3.3%) required for IFR operations. This is an airworthiness requirement, not a departure procedure issue. The restricting weight applies to both instrument and visual rules.

Field Length Limits

A field length limited takeoff weight is reached when the field length determined from the AFM is equal to the field length available. Takeoff distance is the longest of Accelerate Stop, Accelerate Go or Factored Takeoff Distance.

Maximum takeoff weight on a wet runway must never be greater than the maximum takeoff weight on the same runway in dry conditions. Then, in case of takeoff weight limited by field length on a wet runway, this weight must be compared to the maximum takeoff weight on a dry runway.

Maximum Brake Energy

Brake energy limited takeoff weight is reached when the runway length determined for a speed $V_1 = V_{MBE}$ is equal to the field length available.

Such limitation is accounted for in the takeoff field length charts.

Takeoff and Landing Tire Speed

Assuming tailwind components limited as per section 1, tire speed in the Sovereign is limiting neither for takeoff in 15° or 7° flaps configuration, nor for landing in 35° flaps configuration.

Obstacle Clearance

An obstacle clearance limited takeoff weight is reached when the net takeoff flight path clears all obstacles by the minimum required margins.

Enroute Climb Performance

An enroute climb limited weight is reached when the available climb gradient equals the minimum gradient required and all obstacles are cleared by the minimum height specified in the relevant operating regulations.

Performance Ratings

Takeoff

Takeoff thrust rating is used for normal, all engines operating takeoff and go-around, with throttles in the TO detent. Use of takeoff rating is time limited to 5 minutes (10 minutes when operating on one engine).

Maximum Continuous

Maximum continuous thrust is obtained automatically (without pilot action) in the event of an engine failure, with throttles in the MCT detent. Use of maximum continuous rating is available for an unlimited time period; however, continued use of MCT may result in degraded engine life.

Procedures

The performance information of this section is based on the following procedures:

Take-off

- Full take-off thrust is set prior to brake release

With all engines operating, or if an engine failure occurs at or after the scheduled V_1 speed:

- Rotation of the aircraft is initiated at V_R
- Recommended nose-up attitude is set
- Gear retraction is initiated within 3 seconds after lift-off with all engines operating, and within 4.5 seconds after lift-off with one engine inoperative

Selection of Flap Setting at Takeoff

The 7° flaps position is selected when the 15° flaps take-off weight is limited by climb gradient:

- At high ambient temperatures
- At high altitudes

Accelerate-Go distance: The distance required to accelerate on all engines to V_{EF}, lose an engine, continue accelerating to V_1, continue accelerating to V_R, rotate, continue accelerating to V_{LOF}, liftoff, and continue accelerating to V_2 at a screen height of 35 feet (15 feet for wet runways). Note that the allowance for thrust reversers and the lower screen height on wet runways was necessary to require usable balance field lengths. The reversers shorten accelerate stop and the lower screen height allows the takeoff run portion of the accelerate go distance to be longer.

Accelerate-Stop distance: The distance required to accelerate on all engines to V_{ef}, continue accelerating to V_1, initiate a rejected takeoff (RTO) and stop.

Demonstrated crosswind: Satisfactory controllability during takeoffs and landings has been demonstrated with a 90° crosswind component up to 25 knots. Operation of the aircraft in crosswinds greater than the specified value is not necessarily a hazard. Therefore, operation in crosswinds of greater values is entirely at the operator's discretion. Operation in strong gusty crosswinds is not recommended.

Factored Takeoff Distance: The distance for a normal takeoff (no engine failure) to 35 feet. To this distance, 15% is added to give us the factored distance.

Final segment: Segment extending from the end of the transition segment to a height not less than 1,500 feet. The gradient of climb may not be less than 1.2%.

First segment: Segment extending from the point at which the aircraft becomes airborne to the point at which gear is retracted. The climb gradient without ground effect must be positive. The speed increases to V_2, to be attained at a height not greater than 35 feet.

Gross climb gradient: Demonstrated ratio expressed in percentage of change in height to horizontal distance travelled.

Ice Protection: The effect of anti-icing operation is shown on applicable charts based on these three systems being operated at the same time:

- Engine anti-ice (including wing fixed leading edge)
- Horizontal Stabilizer anti-ice

Net climb gradient: Gross climb gradient reduced by:

- 0.8% for takeoff flight path
- 1.1% for enroute flight path with one engine inoperative

Reference zero: A point on the runway at the end of the takeoff distance to which the height and distance coordinates of other points in the takeoff flight path are referred for obstacle clearance analysis.

Screen height: Height of an imaginary screen that the aircraft would just clear when taking off or landing in an unbanked attitude with landing gear extended.

Second segment: Segment extending from the end of the first segment (as soon as the gear is stowed) to a height of at least 400 feet. The steady gradient of climb may not be less than 2.4%. Aircraft speed is stabilized at V_2.

Takeoff Climb Increment (TCI): Altitude increment to be added to the airport barometric altitude to obtain level off altitude. The increment includes corrections for non-standard temperatures.

Takeoff distance on dry runway: Greater horizontal distance along the takeoff path from start of takeoff roll to the point at which the aircraft reaches a screen height of 35 feet with either:

- One engine failure at V_1

or

- All engines operating (factored by 115%)

Takeoff distance on wet runway: Greater horizontal distance along the takeoff path from start of takeoff roll to the point at which the aircraft reaches a screen height of either:

- 15 feet with one engine failing at V_1

or

- 35 feet with all engines operating (distance factored by 115%)

Takeoff Flight Path: The takeoff flight path is considered to begin 35 feet above the takeoff surface at the end of the takeoff distance and extend to a point where the aircraft's gross height is at least 1,500 feet above the takeoff surface and the aircraft has achieved the enroute configuration and final takeoff climb speed.

Takeoff safety height: Not less than 400 feet.

Transition segment (third segment): Part of the takeoff flight path during which the aircraft accelerates while the high lift devices are retracted. Engine power is reduced from takeoff to maximum continuous thrust (MCT) during the transition to enroute climb.

V_{LOF} – Lift-off speed: Speed at which the aircraft first becomes airborne.

V_{MBE} – Maximum brake energy speed: Maximum decision speed V_1 from which the maximum demonstrated brake energy is not exceeded.

V_{MCG} – Minimum control speed on the ground: Minimum groundspeed at which the aircraft is controllable using flight controls only, when one engine is made suddenly inoperative and the other is operating at maximum takeoff thrust.

V_{MCA} – Minimum control speed in the air: Minimum flight speed at which the aircraft is controllable, with a maximum bank angle of 5°, when one engine is made suddenly inoperative and the other is operating at maximum takeoff thrust.

V_R – Rotation speed: Speed at which rotation is initiated.

V_1 – Decision speed: Speed at and above which the takeoff must be continued. V_1 is equal to V_{EF} plus the speed gained during the time necessary to recognize the engine failure and react to it.

V_1 MIN: Minimum decision speed V_1 corresponding to an engine failure speed equal to V_{MCG}. V_1 MIN. is equal to V_{MCG} plus the speed gained during the time necessary to recognize the engine failure and react to it. For some aircraft, V_1 MIN is used in defining V_1 when a speed increase is utilized. This generally does not apply to aircraft the size of the Sovereign. In any case, V_1 must not be less than V_{MCG}.

V_1 MAX: Although there is technically no term defined as V_1 MAX , conceptually V_R is a "V_1 MAX", as the "decision speed" must not be extended beyond the point of rotation. Additionally, V_{MBE} (maximum brake energy) is a manufacturer limit on V_1 such that the aircraft can be brought to a stop without exceeding the maximum energy absorption of the brakes. V_{MBE} must always be greater than V_1.

V_2 – Takeoff safety speed: Initial climb speed reached by the aircraft prior to reaching 35 feet above the takeoff surface with one engine inoperative.

Wind components: Velocity and direction recorded at the height of 33 feet above the runway surface.

Headwind or tailwind: Component parallel to the flight path.

Crosswind: Component perpendicular to the flight path.

Wet runway: A runway is considered to be as wet when it is well soaked but without significant areas of standing water. A runway is considered well soaked when there is sufficient moisture on the runway surface to cause it to appear reflective.

Landing Definitions

Approach climb: The steady gradient of climb with one engine inoperative may not be less than 2.1%. Engine rating is takeoff thrust. The stabilized airspeed is V_{APP} for 15° or 7° flaps configuration.

Demonstrated crosswind: Satisfactory controllability during takeoffs and landings has been demonstrated with a 90° crosswind component up to 25 knots. Operation of the aircraft in crosswinds greater than the specified value is not necessarily a hazard; therefore, operation in crosswinds of greater values is entirely at the operator’s discretion. Operation in strong gusty crosswinds is not recommended.

Landing Field Length Limit

A field length limited landing weight is reached when the field length or the landing distance, as required by operating regulations, is equal to the runway length actually available.

The landing weight normally anticipated at the destination or alternate airport must not be greater than the maximum landing weight.

Landing climb: The steady gradient of climb in landing configuration with both engines operative may not be less than 3.2%. Engine rating is takeoff thrust. The stabilized airspeed is V_{REF}.

Landing distance: Horizontal distance required to land and come to a complete stop from a point at a screen height of 50 feet above the landing surface.

Landing field length: The demonstrated landing distance multiplied by a factor of 1.67 (1.0/0.60) or 1.92 (1.15/0.60). Factors are applied in accordance with the relevant operating regulations.

For approaches performed at the airport of departure immediately after takeoff, the selection of the same flap setting on approach as used for takeoff permits compliance with approach and landing climb gradient requirements.

V_{MCA} – Minimum control speed in the air: Minimum flight speed at which the aircraft is controllable, with a maximum bank angle of 5°, when one engine is made suddenly inoperative and the other is operating at the maximum takeoff thrust.

V_{MCL} – Minimum control speed during landing approach: Minimum flight speed at which the aircraft is controllable during landing approach, with a maximum bank angle of 5°, one engine inoperative and the other at the maximum takeoff thrust.

V_{REF} – Reference speed: Minimum speed at the height of 50 feet during a normal landing is V_{MCL}.

Wind components: Velocity and direction recorded at the height of 33 feet above the runway surface.

- **Headwind or tailwind**: Component parallel to the flight path
- **Crosswind**: Component perpendicular to the flight path

Additional Landing Distances

Overspeed at threshold: Each 10 knots overspeed at the threshold increases the landing distance by 12%.

Selection of Flap Setting for Approach

The 7° flaps position is selected when the 15° flaps approach weight is limited by climb gradient:

- At high ambient temperatures
- At high altitudes
- Single engine operations

Weight and Balance Definitions

Basic Empty Weight: Weight of airframe, powerplant, interior accommodation, systems, and equipment that are an integral part of a given version. (This is the weight without usable fuel, including all fluids contained in closed systems, the unusable and undrainable fuel and the engine oil.)

Basic Operating Weight: The sum of the basic empty weight plus operational items.

Operational Items: Crew and equipment (such as charts, galley supplies and potable water) required for a given mission and not included in the basic empty weight.

Payload: Weight of passengers, cargo and baggage.

Ramp Weight: The ramp weight is the sum of the ZFW and the usable fuel load. The ramp weight must not exceed the structural limit.

Takeoff Weight: The weight including everything and everyone at the beginning of the takeoff run.

Usable Fuel: Fuel available for propulsion of the aircraft.

Unusable and non-drainable fuel: Fuel remaining in the tanks and systems after the usable fuel has been consumed.

Zero Fuel Weight (ZFW): The zero fuel weight is the sum of the operating empty weight and the payload. The ZFW must not exceed the structural limitation.

Weight and Balance Computations

Precise weight computations are required to operate the aircraft within limitations and for performance calculations. Balance calculations are required to operate the aircraft within center-of-gravity limitations.

The Citation Sovereign Flight Manual provides general information and procedures to determine weight and balance and center-of-gravity data. The manual provides:

- Definitions
- Fuel moment charts
- Loading examples for various aircraft configurations
- Change in CG positions for all configurations
- Equipment lists
- Weight and balance charts
- Aircraft Specific Weight and Balance data

All the information is provided in either U.S. or metric units. We will use U.S. units for the purposes of this example.

The exact weight and balance data for a particular aircraft are determined by reference to the Weight and Balance section of the AFM and finding the current weight and balance information sheet. The process is begun with the aircraft empty weight found on the current weight and balance sheet. To that is added the following to determine the Basic Operating Weight (BOW):

- Crew
- Crew baggage
- Supplies
  - Manuals
  - Galley service items
  - Potable water
- Life raft(s)

The following example is based on an aircraft with the following Basic Empty Weight (BEW) data:

BEW	ARM	MOMENT
17,300 lbs	420.52 in.	72,750.00 in/lbs

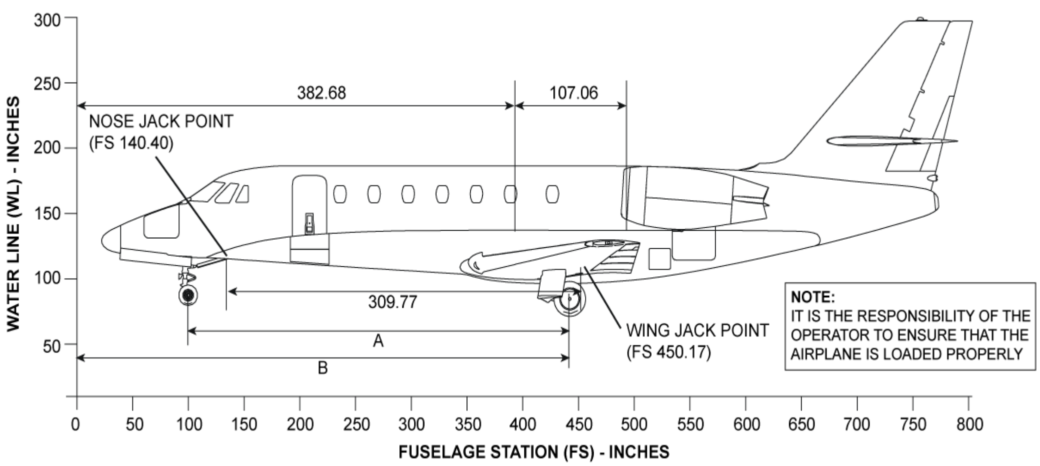
Since the Weight & Balance Computation Form starts with Basic Empty Weight as the first item, we will begin with the BEW data above. To the BEW we add payload (crew, passengers, baggage and operating items) to find the ZFW and to that, fuel, to determine the Ramp Weight.

If the ZFW is within specified boundaries, loading or burning fuel will not take the aircraft out of limits. The process in this example is completed through the Takeoff Weight (TOW) to show that the aircraft is within limits for takeoff.

The center-of-gravity of an empty aircraft is found by accurate weighing to determine the balance point. This point is then defined by labeling it in inches aft of a fixed reference line located forward of the aircraft nose. This line is called the Reference Datum Line. Selection of the Reference Datum line by the manufacturer is arbitrary, but it does provide a standard from which center-of-gravity movement along the longitudinal axis can be measured. The Reference Datum line for the Citation Sovereign is located 140.40 inches in front of the nose jack pad location, which puts it well forward of the nose cone. The addition of any weight in any location, therefore, results in a positive moment change.

The Basic Empty Weight center-of-gravity for a typical Citation Sovereign will be located approximately 420.0 inches aft of the Reference Datum Line. Depending on aircraft gross weight, the center-of-gravity of a loaded aircraft can move from 402.0 inches to 415.9 inches aft of the reference datum and remain within limits.

Using the Weight & Balance Computation Form and the Weight and Balance Chart, we will determine the required CG data. The numbers can be checked with the following formula:



CG in % MAC = (CG arm in inches - 382.68)/1.0706

NOTE:	CG arm (inches) is also referred to as FS (Fuselage Station).

Weight and Balance Chart

For the following discussion, refer to the Center-of-Gravity Limits graph on the following page. Along the left side of the chart is the weight scale in pounds per thousand. Along the bottom is the center-of-gravity in inches aft of the datum. Below this scale is a quick reference for % MAC.

Determination of Center-of-Gravity

When plotting the aircraft CG, find the weight at left and the CG at the bottom. Plot horizontally and vertically. The weight and CG plots should cross within the envelope. If not, you must change the loading to place the plots within the envelope.

Additional Center-of-Gravity Information

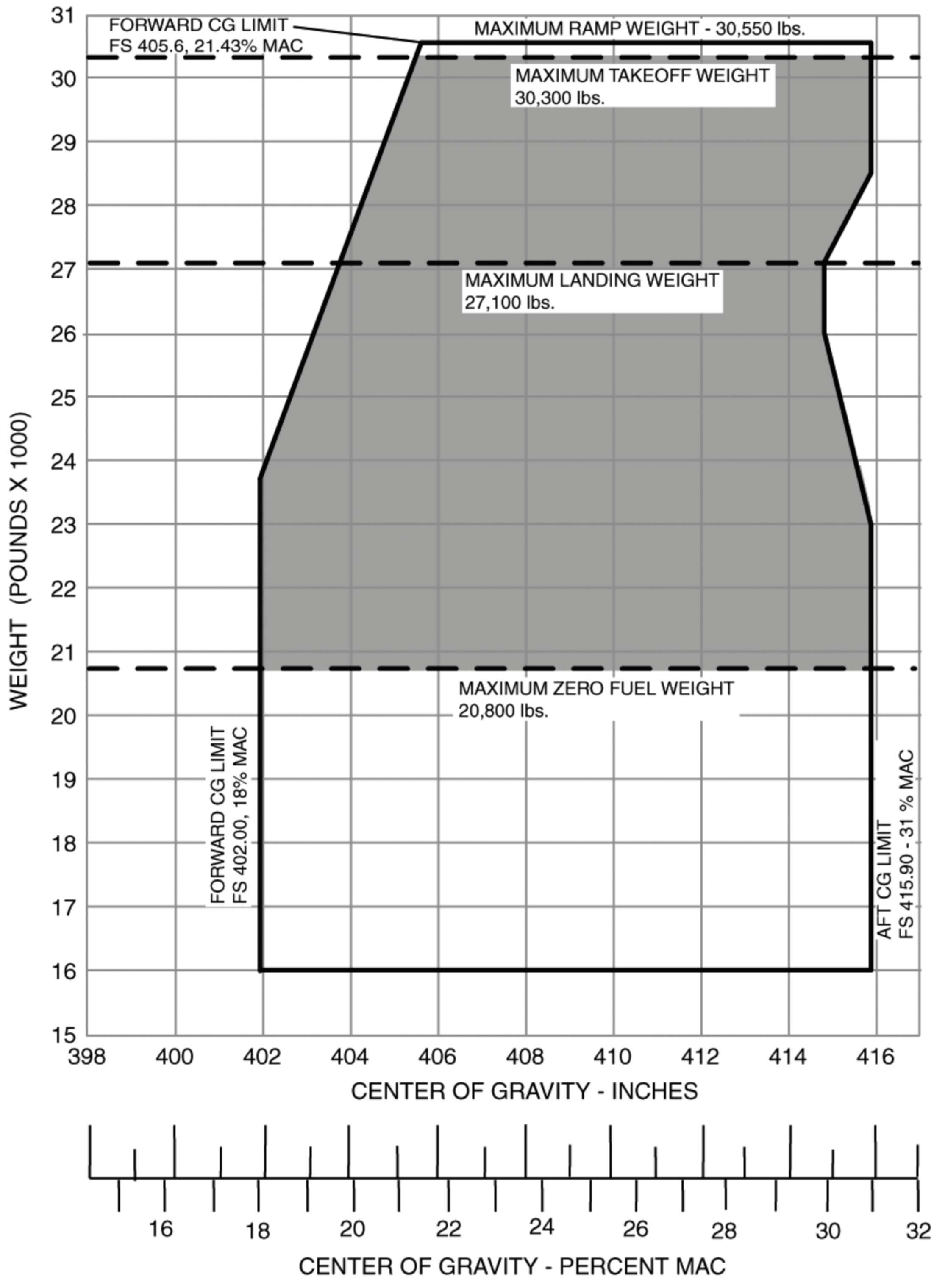
Center-of-Gravity Limits on the Ground

Entry into the tailcone service compartment under conditions of aft center-of-gravity may cause the aircraft to tip backwards. When the airplane is empty of crew, passengers, cargo and fuel, the CG will likely be just slightly aft of the published flight envelope but generally has no adverse effects on towing or servicing.

Effect of Snowfall

The quantity and density of snow accumulation can significantly alter CG. Accumulation of snow on the horizontal stabilizer and aft fuselage can cause the aircraft to tip backwards.

Center-of-Gravity Limits



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Weight and Balance Computation Form

A sample Weight and Balance Computation Form is presented on the following page with the BEW data given above from a representative aircraft. This is the blank form that we will use to complete the example.

All moments are divided by 100 to make the numbers more manageable.

The problem will be performed as follows:

1. **Insert Occupant information**. We will use standard weights for the passengers.
2. **Insert Non-Variables**. Crew, crew baggage, galley stock, and manuals. This information plus Basic Empty Weight is the Basic Operating Weight.
3. **Basic Empty Weight + Payload = Zero Fuel Weight**.
4. **Determine Allowable Fuel**. Subtract the Zero Fuel Weight from the Maximum Ramp Weight (30,550 pounds) to determine allowable fuel (not to exceed 11,223 pounds).
5. **Insert Fuel Loading**. This is the total fuel being carried in both wings.
6. **Ramp Weight = Zero Fuel Weight + Fuel Loading**.
7. **Insert Taxi Fuel**.
8. **Takeoff Weight = Ramp Weight – Taxi Fuel**.

The following step-by-step procedure illustrates a logical manner in which to determine the takeoff weight and center of gravity. Loading tables can be found in this manual and in the Sovereign Weight & Balance Data Sheets. Loading data is also available for computerized calculation in the CLCalc application as part of the CESNAV software package.

NOTE:	During computation of the following sample problem, weights are rounded to the nearest whole number (in pounds) for entry on the Weight and Balance Computation Form. Moment values are rounded to two (2) decimal places in order to maintain consistency with the published Cessna Weight & Balance Data Sheets.

Weight and Balance Computation Form

PAYLOAD COMPUTATIONS			
ITEM	ARM (INCHES)	WEIGHT (POUNDS)	MOMENT / 100
OCCUPANTS			
Pilot (PIC)	137.28		
Co-Pilot (SIC)	137.28		
SEAT 3	239.03		
SEAT 4	239.03		
SEAT 5	287.29		
SEAT 6	287.29		
SEAT 7	329.15		
SEAT 8	329.15		
SEAT 9	377.41		
SEAT 10	377.41		
SEAT 11	204.04		
SEAT ___			
SEAT ___			
SEAT ___			
Chart Cases	158.14		
LH Fwd Closet	173.95		
RH Fwd Ref Center	178.78		
LH Aft Vanity	417.85		
Aft Closet	440.82		
Tailcone Baggage	488.23 541.95		
Coat Rod	541.78		
PAYLOAD			

ITEM	WEIGHT (POUNDS)	MOMENT/ 100
1. BASIC EMPTY WEIGHT * Airplane CG= 420.52	17,300	72750.00
2. PAYLOAD		
3. ZERO FUEL WEIGHT (sub-total) (Do not exceed maximum zero fuel weight of 20,800 pounds.)		
4. FUEL LOADING		
5. RAMP WEIGHT (sub-total) (Do not exceed maximum ramp weight of 30,550 pounds.)		
6. LESS FUEL FOR TAXIING		
7. * * TAKEOFF WEIGHT (Do not exceed maximum takeoff weight of 30,300 pounds.) * * Airplane CG = ________		
8. LESS FUEL TO DESTINATION		
9. * * LANDING WEIGHT (Do not exceed maximum landing weight of 27,100 pounds.) * Airplane CG= ________		

* Airplane CG = $\frac{\text{MOMENT/100}}{\text{WEIGHT}} \times 100$

* * Totals must be within approved weight and center-of-gravity limits. It is the responsibility of the operator to Ensure that the airplane is loaded properly. The Basic Empty Weight CG is noted on the Airplane Weighing Form. If the airplane has been altered, refer to the Weight and Balance Record for information.

* * * Enter on the Center-of-Gravity Limits Envelope Graph to verify airplane is loaded within approved limits.

Zero Fuel Weight

To determine the Zero Fuel Weight, we have transferred the appropriate Fuselage Station (FS) numbers from the Cessna Weight and Balance Data Sheets to the Weight & Balance Computation Form. Form 2123 (crew and passengers) and Form 2127 (baggage and cabinet compartments) are presented on the following pages for reference.

Passengers

For this problem, assume a standard weight of 170 pounds for each crew member and passenger. The passengers have been arbitrarily assigned seats 3, 4, 5, 6, 9 and 10. Multiply the weight times the ARM and enter the calculations into the appropriate spaces on the Computation Form.

Supplies

We will assume that the following standard supplies are to be carried for this trip:

- Chart Cases - 15 pounds
- LH Fwd Closet - 20 pounds
- RH Fwd Ref Center - 60 pounds
- LH Aft Vanity - 10 pounds
- Aft Closet - 20 pounds

Enter these numbers on the form and calculate the moment for each section.

Baggage

There is one tailcone baggage compartment in the Citation Sovereign, with a forward and an aft section. There is also an aft closet that may be used for baggage as well. Moments are determined from the Weight and Balance Computation Form based on the weight in the respective compartment.

The amount of baggage that is to be carried on the trip and placed in the tailcone baggage compartment, aft section (CG arm 541.95) is 190 pounds. Enter these numbers on the Computation Form and find that the moment divided by 100 is 1,029.71.

You will find that adding fuel or passengers will shift the center-of-gravity forward since they are forward of the typical Basic Empty Weight center-of-gravity. The magnitude of the shift for any given weight is proportional to the length of the moment arm. Any weight placed in the aft baggage compartment will shift the center-of-gravity aft.

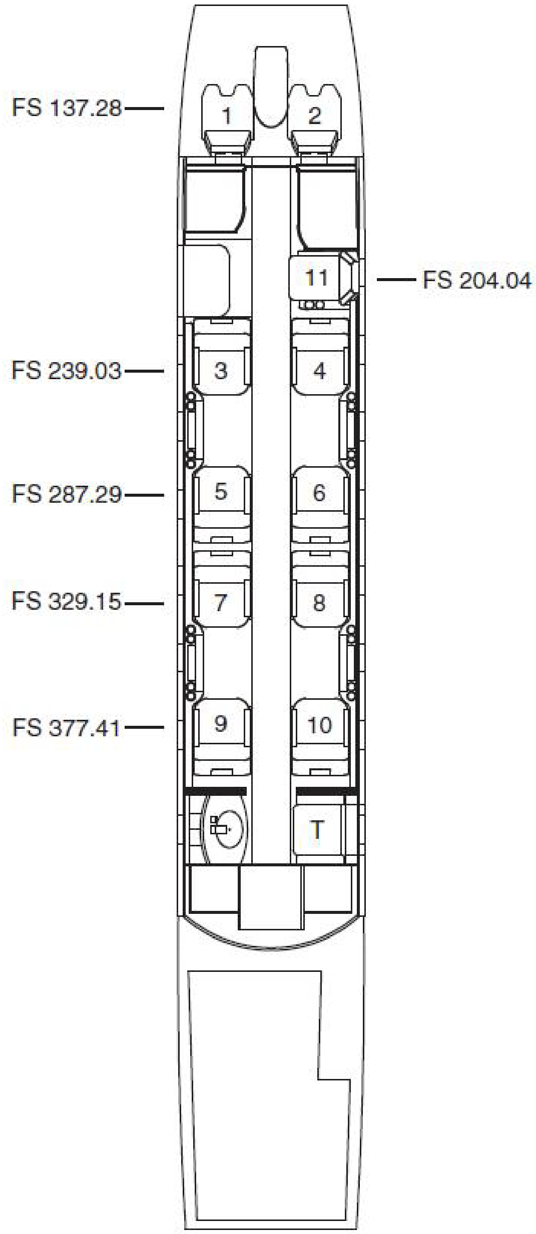
Crew and Passenger Compartments Weight and Moments Table

STANDARD DOUBLE CLUB SEAT ARRANGEMENT

CREW AND PASSENGER SEATS

WEIGHT (POUNDS)	MOMENT/100 (INCH - POUNDS)				
	SEAT 1 OR SEAT 2 ARM = FS 137.28 in.	SEAT 3 OR SEAT 4 ARM = FS 239.03 in.	SEAT 5 OR SEAT 6 ARM = FS 287.29 in.	SEAT 7 OR SEAT 8 ARM = FS 329.15 in.	SEAT 9 OR SEAT 10 ARM = FS 377.41 in.
50	68.64	119.52	143.65	164.58	188.71
60	82.37	143.42	172.37	197.49	226.45
70	96.10	167.32	201.10	230.41	264.19
80	109.82	191.22	229.83	263.32	301.93
90	123.55	215.13	258.56	296.24	339.67
100	137.28	239.03	287.29	329.15	377.41
110	151.01	262.93	316.02	362.07	415.15
120	164.74	286.84	344.75	394.98	452.89
130	178.46	310.74	373.48	427.90	490.63
140	192.19	334.64	402.21	460.81	528.37
150	205.92	358.55	430.94	493.73	566.12
160	219.65	382.45	459.66	526.64	603.86
170	233.38	406.35	488.39	559.56	641.60
180	247.10	430.25	517.12	592.47	679.34
190	260.83	454.16	545.85	625.39	717.08
200	274.56	478.06	574.58	658.30	754.82
210	288.29	501.96	603.31	691.22	792.56
220	302.02	525.87	632.04	724.13	830.30
230	315.74	549.77	660.77	757.05	868.04
240	329.47	573.67	689.50	789.96	905.78
250	343.20	597.58	718.23	822.88	943.53
260	356.93	621.48	746.95	855.79	981.27
270	370.66	645.38	775.68	888.71	1019.01
280	384.38	669.28	804.41	921.62	1056.75
290	398.11	693.19	833.14	954.54	1094.49
300	411.84	717.09	861.87	987.45	1132.23
310	425.57	740.99	890.60	1020.37	1169.97
320	439.30	764.90	919.33	1053.28	1207.71
330	453.02	788.80	948.06	1086.20	1245.45
340	466.75	812.70	976.79	1119.11	1283.19

CREW AND PASSENGER MOMENT ARMS



FORM NUMBER 2123, 18 May 2004

Baggage and Cabinet Compartments Weight and Moment Tables

FWD CABINET CONTENTS

WEIGHT (POUNDS)	MOMENT/100 (INCH - POUNDS) LH or RH CHART CASES ARM = F.S. 158.14 in.	LH FWD CLOSET ARM = F.S. 173.95 in.	REFRESHMENT CENTER ARM = F.S. 178.78 in.
10	15.81	17.40	17.88
20	31.63	34.79	35.76
30		52.19	53.63
40		69.58	71.51
50		86.98	89.39
60		104.37	107.27
70		121.77	125.15
80		139.16	143.02
90		156.56	160.90
100		173.95	178.78
110		191.35	196.66
120		208.74	214.54
130		226.14	232.41
140		243.53	

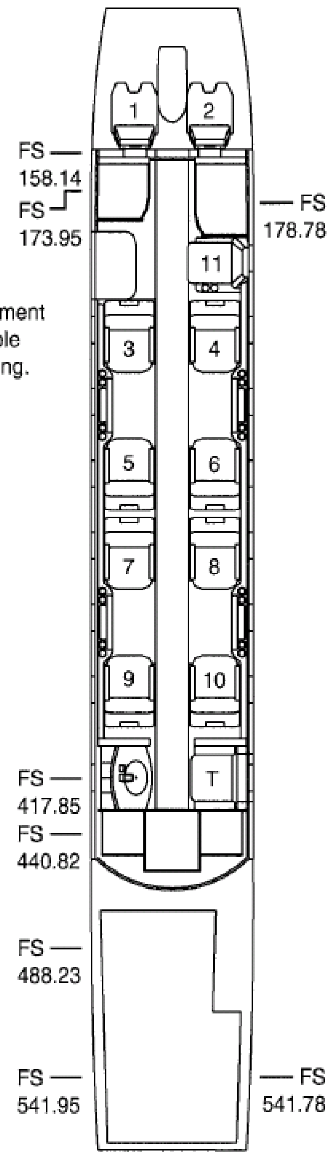
NOTE*** The 630 pound maximum capacity in the Aft Compartment includes 50 pounds allowable for Tailcone Coat Rod loading.

AFT CABINET CONTENTS

WEIGHT (POUNDS)	MOMENT/100 AFT VANITY ARM = F.S. 417.85 in.	AFT BULKHEAD CLOSET ARM = F.S. 440.82 in.
10	41.79	44.08
20	83.57	88.16
30	125.36	132.25
40	167.14	176.33
50	208.93	220.41
55	229.82	242.45
60		264.49
70		308.57
80		352.66
90		396.74
100		440.82
110		484.90
120		528.98
130		573.07
140		617.15
150		661.23
160		705.31
170		749.39
180		793.48
190		837.56
200		881.64
210		925.72
220		969.80
230		1013.89
240		1057.97
250		1102.05
260		1146.13
270		1190.21
280		1234.30
290		1278.38
295		1300.42

BAGGAGE COMPARTMENT CONTENTS

WEIGHT (POUNDS)	MOMENT/100 (INCH - POUNDS) FWD COMPARTMENT ARM = F.S. 488.23 in.	AFT COMPARTMENT ARM = F.S. 541.95 in.	TAILCONE COAT ROD ARM = F.S. 541.78 in.
10	48.82	54.20	54.18
30	146.47	162.59	162.53
50	244.12	270.98	270.89 ***
70	341.76	379.37	
90	439.41	487.76	
110	537.05	596.15	
130	634.70	704.54	
150	732.35	812.93	
170	829.99	921.32	
190	927.64	1029.71	
210	1025.28	1138.10	
230	1122.93	1246.49	
250	1220.58	1354.88	
270	1318.22	1463.27	
290	1415.87	1571.66	
310	1513.51	1680.05	
330	1611.16	1788.44	
350	1708.81	1896.83	
370	1806.45	2005.22	
390		2113.61	
410		2222.00	
430		2330.39	
450		2438.78	
470		2547.17	
490		2655.56	
510		2763.95	
530		2872.34	
550		2980.73	
570		3089.12	
590		3197.51	
610		3305.90	
630		3414.29	



FORM NUMBER 2127, 02 June 2004

Weight and Balance Computation Form

PAYLOAD COMPUTATIONS			
ITEM	ARM (INCHES)	WEIGHT (POUNDS)	MOMENT / 100
OCCUPANTS			
Pilot (PIC)	137.28	170	233.38
Co-Pilot (SIC)	137.28	170	233.38
SEAT 3	239.03	170	406.35
SEAT 4	239.03	170	406.35
SEAT 5	287.29	170	488.39
SEAT 6	287.29	170	488.39
SEAT 7	329.15	---	---
SEAT 8	329.15	---	---
SEAT 9	377.41	170	641.60
SEAT 10	377.41	170	641.60
SEAT 11	204.04	---	---
SEAT ___			
SEAT ___			
SEAT ___			
Chart Cases	158.14	15	23.72
LH Fwd Closet	173.95	20	34.79
RH Fwd Ref Center	178.78	60	107.27
LH Aft Vanity	417.85	10	41.79
Aft Closet	440.82	20	88.16
Tailcone Baggage	488.23 541.95	--- 190	--- 1029.71
Coat Rod	541.78		
PAYLOAD		1675	4864.88

ITEM	WEIGHT (POUNDS)	MOMENT/ 100
1. BASIC EMPTY WEIGHT * Airplane CG= 420.52	17300	72750.00
2. PAYLOAD	1675	4864.88
3. ZERO FUEL WEIGHT (sub-total) (Do not exceed maximum zero fuel weight of 20,800 pounds.)	18975	77614.88
4. FUEL LOADING		
5. RAMP WEIGHT (sub-total) (Do not exceed maximum ramp weight of 30,550 pounds.)		
6. LESS FUEL FOR TAXIING		
7. * * TAKEOFF WEIGHT (Do not exceed maximum takeoff weight of 30,300 pounds.) * * Airplane CG = ________		
8. LESS FUEL TO DESTINATION		
9. * * LANDING WEIGHT (Do not exceed maximum landing weight of 27,100 pounds.) * Airplane CG = ________		

* Airplane CG = $\frac{\text{MOMENT/100}}{\text{WEIGHT}}$ X 100

* * Totals must be within approved weight and center-of-gravity limits. It is the responsibility of the operator to ensure that the airplane is loaded properly. The Basic Empty Weight CG is noted on the Airplane Weighing Form. If the airplane has been altered, refer to the Weight and Balance Record for information.

* * * Enter on the Center-of-Gravity Limits Envelope Graph to verify airplane is loaded within approved limits.

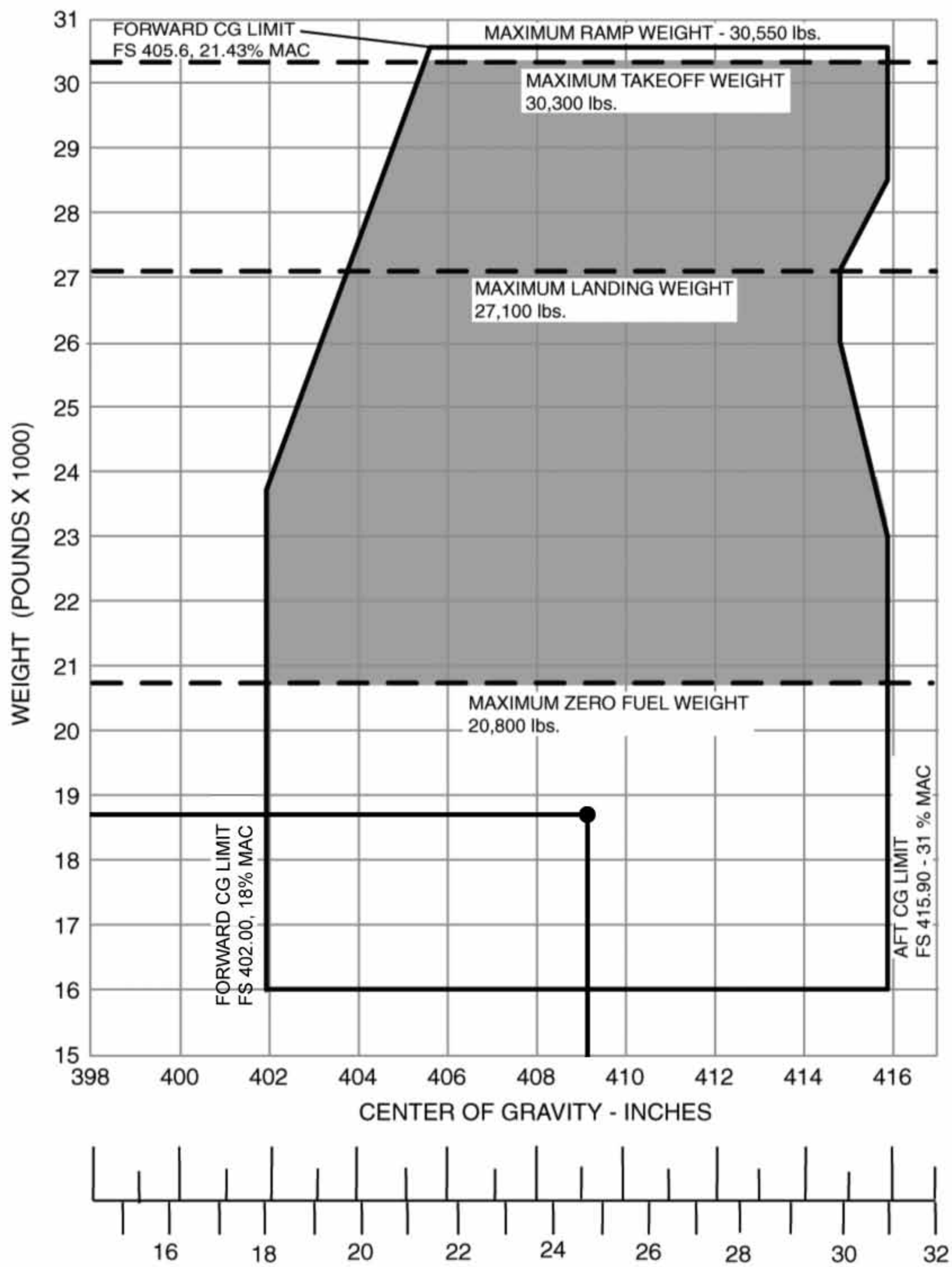
ZFW Totals

At this point, the payload weights and moments are totaled on the left side of the Computation Form. These numbers are placed in the Item 2 (Payload) blanks on the opposite side. Add Items 1 and 2 to determine the ZFW and the ZFW Moment. This must not exceed 20,800 pounds.

After adding our previous numbers, we determine that the ZFW for our trip is 18,975 pounds with a moment of 77,614.88 in/pounds which gives us a CG of 409.04. Insert this information into Item 3 (ZFW) on the Computation Form and plot on the Center-of-Gravity Limits chart to ensure that the aircraft is within CG limits. See the results of this example on the following page.

As long as the ZFW CG is within limits, adding fuel will not move the CG outside of the limit envelope. For this reason, ballast fuel is not required on the Citation Sovereign. When the takeoff weight is computed you will notice that the CG does move, but remains within the envelope.

Center-of-Gravity Limits - Zero Fuel Weight



Fuel Loading

Once we have the ZFW information, we only need to add fuel to determine the takeoff data. Fuel loading is comprised of taxi, takeoff, climb, cruise, descent, reserve (holding) and alternate fuel (if required). To help in this determination we must first get a standard weather brief from Flight Service for Denver Centennial to Westchester County. Upon completion of our phone call, the weather is as follows:

Metar KAPA 030053Z CALM 2SM FG OVC030 00/M10 A2980

PIREP report indicated tops at 10,000 feet in the Denver area

TAF KHPN 031740Z 031818 33007KT P6SM SCT 100

FM2200 32011KT P6SM SCT050 BKN100

FM0600 33015KT P6SM BKN050

FM1200 34005KT 5SM RA- BKN030 TEMP 1416 33015G25KT

1SM TSRA OVC021CB

According to our weather forecast for Westchester County, thunderstorms are forecasted for our arrival time. Therefore, upon further review of area weather we have selected Portsmouth, NH as the alternate. Now that we have our weather and have determined our alternate we can begin the trip planning to determine our fuel loading requirements.

Route of Flight	KAPA to KPHN (distance 1,475 NM)
Alternate	KPSM (distance 200 NM)
Altitude	TBD
Temp Deviation	ISA
Wind to destination	+ 100 Kts (tailwind)
Wind to alternate	0 Kts
Holding Fuel	45 minutes
Extra/Reserve Fuel	2,000 lbs
Taxi Fuel	200 lbs

With this information we can now break down the fuel loading into the appropriate segments as discussed above. This will take us into trip planning to determine the required fuel amounts.

Performance Worksheet

PERFORMANCE WORKSHEET			FLIGHT PLANNING	
DESTINATION:	KAPA to KHPN		ALTERNATE:	KPSM
DISTANCE:	1,475 NM		DISTANCE:	200 NM
ALTITUDE:	FL 450		ALTITUDE:	FL 250
TEMP DEV:	ISA		WIND:	NONE
WIND:	+ 100 KTS (TAILWIND)		HOLDING:	45 MIN
CRUISE MODE:	MCT		CRUISE MODE:	NORMAL

	WEIGHT	FUEL	TIME	DISTANCE
Zero Fuel Weight	18,975 lbs			
Taxi Fuel	200 lbs	200 lbs		
Takeoff / Climb				
Descent				
Approach				
Cruise				
Trip Fuel				
Reserve				
Alternate				
Totals				
Ramp Weight				
Takeoff Weight				
Weight at Dest				
Weight at Alternate				

Trip Planning

Information for flight planning is found in the Citation Sovereign Operating Manual. It contains all the charts and graphs necessary to determine fuel requirements. It also contains data for enroute loss of engine and drift down.

The planning charts are based on takeoff weight. We will use a Performance Worksheet to help keep track of our fuel requirements as they are determined by their respective charts. The top of the chart contains the flight planning information used for the performance charts.

The bottom of the chart is in four columns; weight, fuel, time, and distance. Fuel weight is added in the weight and fuel columns, and time and distance is totaled for the trip portion only. The data is totaled to find the Takeoff Weight, Ramp Weight, Weight at Destination, and Weight at Alternate.

Our first entry into the Worksheet is the ZFW from the Weight and Balance section.

Enter 18,975 pounds as the ZFW on the Performance Worksheet.

Taxi Fuel

Taxi fuel can be figured in two ways. A good rule of thumb for the aircraft is approximately 10 pounds/min (5 pounds/min/engine) during taxi. The alternate method is to use the difference between the Maximum Ramp Weight (30,550 pounds) and the Maximum Takeoff Weight (30,300 pounds) or 250 pounds.

Let's use 200 pounds, estimating a 20 minute taxi time.

Enter 200 pounds as the Taxi Fuel on the Performance Worksheet.

Cruise Climb

250 KIAS/0.64 INDICATED MACH

TIME, DISTANCE, FUEL, AND RATE OF CLIMB — ANTI-ICE SYSTEMS OFF

T.O. WEIGHT		30000	29000	28000	27000	24000	20000	30000	29000	28000	27000	24000	20000	30000	29000	28000	27000	24000	20000
PRESSURE ALTITUDE		5000 FEET ISA = 5°C = 41°F						10000 FEET ISA = -5°C = 23°F						15000 FEET ISA = -15°C = 6°F					
ISA +20°C	MIN	1	1	1	1	1	1	3	3	3	3	2	2	5	5	4	4	4	3
	NM	6	6	6	5	5	4	13	13	12	12	10	8	23	22	21	20	18	14
	LB	102	98	94	91	79	65	208	200	192	184	161	131	318	305	293	280	244	199
	FPM	3425	3566	3717	3878	4436	5424	2960	3087	3222	3366	3864	4744	2489	2601	2721	2848	3288	4063
ISA +10°C	MIN	1	1	1	1	1	1	2	2	2	2	2	2	4	4	4	3	3	3
	NM	5	5	5	4	4	3	11	11	10	10	9	7	19	18	17	16	14	12
	LB	95	92	88	85	74	61	191	184	176	169	148	122	289	278	266	256	224	183
	FPM	4103	4268	4443	4631	5281	6437	3625	3774	3933	4103	4693	5737	3102	3235	3377	3528	4052	4979
ISA	MIN	1	1	1	1	1	1	2	2	2	2	2	1	4	3	3	3	3	2
	NM	5	5	5	4	4	3	10	10	9	9	8	6	16	16	15	15	13	10
	LB	94	91	87	84	73	60	184	177	170	163	143	117	274	263	253	243	213	175
	FPM	4301	4472	4655	4850	5527	6731	4281	4452	4635	4831	5511	6717	3689	3842	4006	4180	4784	5856
ISA -10°C	MIN	1	1	1	1	1	1	2	2	2	2	2	1	3	3	3	3	3	2
	NM	5	5	5	4	4	3	10	10	9	9	8	6	15	15	14	14	12	10
	LB	94	90	86	83	73	60	182	175	168	161	142	116	267	256	246	236	207	170
	FPM	4228	4396	4576	4767	5434	6617	4596	4779	4973	5181	5903	7187	4197	4367	4549	4743	5417	6614
PRESSURE ALTITUDE		17000 FEET ISA = -19°C = -2°F						19000 FEET ISA = -23°C = -9°F						21000 FEET ISA = -27°C = -16°F					
ISA +20°C	MIN	6	5	5	5	4	3	7	6	6	6	5	4	8	7	7	7	6	5
	NM	28	26	25	24	21	17	33	31	30	29	25	20	39	37	36	34	29	24
	LB	365	350	335	321	280	228	414	396	380	363	316	257	466	446	427	409	355	288
	FPM	2258	2363	2474	2593	3002	3722	2009	2107	2210	2320	2699	3374	1832	1925	2023	2128	2487	3132
ISA +10°C	MIN	5	4	4	4	4	3	5	5	5	5	4	3	6	6	6	5	5	4
	NM	22	21	20	20	17	14	26	25	24	23	20	16	31	30	28	27	24	19
	LB	330	317	304	291	255	208	372	357	342	328	287	234	416	399	383	367	320	261
	FPM	2845	2970	3103	3245	3734	4600	2574	2691	2815	2947	3403	4217	2389	2500	2619	2745	3181	3964
ISA	MIN	4	4	4	4	3	3	5	5	4	4	4	3	5	5	5	5	4	3
	NM	19	19	18	17	15	12	23	22	21	20	17	14	26	25	24	23	20	16
	LB	311	299	287	275	241	198	348	335	322	308	270	221	388	373	358	343	300	246
	FPM	3445	3590	3745	3910	4482	5496	3159	3295	3440	3596	4132	5091	2821	2948	3082	3225	3719	4609
ISA -10°C	MIN	4	4	4	3	3	3	4	4	4	4	3	3	5	5	5	4	4	3
	NM	18	17	17	16	14	11	21	20	19	18	16	13	24	23	22	21	19	15
	LB	301	290	278	267	234	192	337	324	311	299	262	215	374	359	345	331	290	238
	FPM	3869	4028	4198	4380	5010	6127	3526	3674	3833	4002	4588	5637	3175	3313	3460	3617	4159	5135
PRESSURE ALTITUDE		23000 FEET ISA = -31°C = -23°F						25000 FEET ISA = -35°C = -30°F						27000 FEET ISA = -38°C = -37°F					
ISA +20°C	MIN	9	8	8	8	7	5	10	10	9	9	7	6	11	11	10	10	9	7
	NM	46	44	42	40	34	28	53	51	49	46	40	32	63	60	57	54	46	37
	LB	521	499	477	456	395	320	579	554	529	505	437	353	644	615	587	560	484	389
	FPM	1714	1804	1899	2000	2345	2971	1516	1603	1694	1790	2117	2703	1260	1342	1428	1518	1819	2351
ISA +10°C	MIN	7	7	6	6	5	4	8	8	7	7	6	5	9	9	8	8	7	6
	NM	36	34	33	32	27	22	42	40	38	36	32	25	48	46	44	42	36	29
	LB	462	443	424	406	354	289	510	488	468	448	390	317	562	538	515	493	428	347
	FPM	2285	2394	2510	2634	3057	3824	2039	2143	2254	2370	2769	3485	1721	1819	1922	2030	2395	3040
ISA	MIN	6	6	6	5	5	4	7	7	6	6	5	4	8	8	7	7	6	5
	NM	31	29	28	27	24	19	36	34	33	31	27	22	42	40	39	37	32	26
	LB	430	413	396	380	332	271	476	456	438	419	366	298	525	504	483	462	402	327
	FPM	2475	2591	2713	2844	3293	4105	2141	2248	2362	2482	2894	3633	1827	1929	2035	2147	2526	3196
ISA -10°C	MIN	6	6	5	5	4	4	6	6	6	6	5	4	7	7	7	6	6	5
	NM	28	27	26	25	21	17	32	31	30	28	25	20	37	36	34	33	29	23
	LB	413	397	381	365	320	262	455	437	419	402	351	287	500	480	460	441	385	314
	FPM	2829	2956	3092	3236	3732	4631	2475	2594	2719	2853	3310	4130	2142	2254	2372	2496	2917	3663
PRESSURE ALTITUDE		29000 FEET ISA = -42°C = -44°F						31000 FEET ISA = -46°C = -52°F						33000 FEET ISA = -50°C = -59°F					
ISA +20°C	MIN	13	12	12	11	10	8	14	14	13	12	11	8	16	15	14	13	11	9
	NM	73	69	66	63	54	43	82	78	74	70	60	47	91	86	82	78	66	52
	LB	713	680	648	617	530	425	769	732	697	663	568	454	825	784	746	708	605	482
	FPM	1475	1577	1686	1800	2185	2833	1448	1544	1646	1757	2152	2819	1332	1428	1529	1636	2010	2674
ISA +10°C	MIN	10	10	9	9	8	6	11	11	10	10	8	7	12	12	11	11	9	7
	NM	56	53	51	48	42	33	63	60	57	54	47	37	70	67	63	60	52	41
	LB	617	590	564	539	467	378	663	634	605	578	499	403	710	678	647	617	532	428
	FPM	1945	2062	2188	2320	2767	3529	1801	1909	2022	2146	2588	3339	1667	1774	1887	2007	2424	3167
ISA	MIN	9	9	8	8	7	6	10	10	9	9	8	6	11	11	10	10	8	7
	NM	49	47	45	43	37	30	55	53	50	48	41	33	62	59	56	54	46	37
	LB	577	552	529	505	439	356	621	594	568	543	470	381	665	636	608	580	502	405
	FPM	2062	2183	2311	2447	2908	3694	1926	2037	2155	2282	2739	3515	1753	1862	1977	2099	2524	3282
ISA -10°C	MIN	8	8	8	7	6	5	9	9	8	8	7	6	10	10	9	9	8	6
	NM	43	41	40	38	33	26	49	47	44	42	37	29	55	52	50	48	41	33
	LB	546	524	502	480	418	340	587	562	538	515	448	363	629	602	576	550	477	387
	FPM	2381	2511	2651	2798	3300	4160	2137	2255	2379	2514	2996	3819	1910	2023	2143	2270	2714	3505

68OM-00-01

Cruise Climb

250 KIAS/0.64 INDICATED MACH
TIME, DISTANCE, FUEL, AND RATE OF CLIMB — ANTI-ICE SYSTEMS OFF

PRESSURE ALTITUDE 35000 FEET — ISA = -54°C = -66°F

T.O. WEIGHT		30000	29000	28000	27000	24000	20000
ISA +20°C	MIN	17	16	16	15	13	10
	NM	101	96	91	86	72	57
	LB	882	837	795	755	643	510
	FPM	1196	1291	1392	1498	1856	2499
ISA +10°C	MIN	14	13	12	12	10	8
	NM	78	74	70	67	57	45
	LB	759	724	690	657	565	453
	FPM	1491	1596	1707	1824	2221	2933
ISA	MIN	12	12	11	11	9	7
	NM	70	66	63	60	51	41
	LB	712	680	649	619	533	429
	FPM	1541	1647	1759	1877	2278	2995
ISA -10°C	MIN	11	11	10	10	8	7
	NM	61	59	56	53	46	36
	LB	673	643	615	587	508	410
	FPM	1682	1792	1908	2030	2447	3192

PRESSURE ALTITUDE 37000 FEET — ISA = -57°C = -70°F

T.O. WEIGHT		30000	29000	28000	27000	24000	20000
ISA +20°C	MIN	19	18	17	16	14	11
	NM	113	107	101	95	80	62
	LB	944	894	848	803	682	539
	FPM	943	1031	1125	1223	1554	2120
ISA +10°C	MIN	15	14	14	13	11	9
	NM	87	83	78	74	63	50
	LB	811	772	735	699	599	479
	FPM	1192	1289	1391	1499	1862	2485
ISA	MIN	14	13	13	12	10	8
	NM	78	74	71	67	57	45
	LB	763	727	693	660	567	455
	FPM	1199	1295	1396	1503	1863	2482
ISA -10°C	MIN	13	12	11	11	9	7
	NM	69	66	63	60	51	40
	LB	720	688	656	626	540	435
	FPM	1330	1430	1535	1646	2020	2665

PRESSURE ALTITUDE 39000 FEET — ISA = -57°C = -70°F

T.O. WEIGHT		30000	29000	28000	27000	24000	20000
ISA +20°C	MIN	22	20	19	18	15	12
	NM	129	121	114	107	89	69
	LB	1020	964	910	860	726	571
	FPM	684	768	857	950	1263	1785
ISA +10°C	MIN	17	16	15	14	12	10
	NM	99	94	88	84	70	55
	LB	873	829	788	748	638	508
	FPM	920	1012	1109	1211	1555	2132
ISA	MIN	16	15	14	13	11	9
	NM	90	85	81	76	64	50
	LB	824	783	745	708	605	483
	FPM	910	1001	1096	1197	1535	2102
ISA -10°C	MIN	14	14	13	12	10	8
	NM	79	75	71	68	57	45
	LB	776	740	704	671	576	462
	FPM	1029	1123	1222	1326	1676	2267

PRESSURE ALTITUDE 41000 FEET — ISA = -57°C = -70°F

T.O. WEIGHT		30000	29000	28000	27000	24000	20000
ISA +20°C	MIN	25	24	22	21	17	13
	NM	152	141	131	123	100	77
	LB	1122	1052	988	929	776	605
	FPM	439	521	607	697	996	1491
ISA +10°C	MIN	20	18	17	16	14	11
	NM	115	108	101	95	79	62
	LB	949	897	849	803	680	538
	FPM	661	751	845	943	1270	1817
ISA	MIN	18	17	16	15	13	10
	NM	106	99	93	88	73	57
	LB	900	851	806	763	647	513
	FPM	632	719	810	906	1225	1757
ISA -10°C	MIN	17	16	15	14	12	9
	NM	93	88	83	78	65	51
	LB	844	801	760	721	615	490
	FPM	751	841	936	1035	1366	1919

PRESSURE ALTITUDE 43000 FEET — ISA = -57°C = -70°F

T.O. WEIGHT		30000	29000	28000	27000	24000	20000
ISA +20°C	MIN	33	29	26	24	19	15
	NM	199	177	160	147	116	87
	LB	1306	1193	1102	1025	837	644
	FPM	152	228	309	394	675	1133
ISA +10°C	MIN	24	22	20	19	15	12
	NM	140	129	120	111	91	69
	LB	1056	988	928	872	729	571
	FPM	362	448	537	631	940	1448
ISA	MIN	23	21	19	18	15	11
	NM	132	121	112	104	85	65
	LB	1009	944	885	833	696	546
	FPM	344	428	515	607	909	1404
ISA -10°C	MIN	20	18	17	16	13	10
	NM	113	105	98	91	75	58
	LB	932	878	828	782	659	521
	FPM	481	568	660	755	1072	1593

PRESSURE ALTITUDE 45000 FEET — ISA = -57°C = -70°F

T.O. WEIGHT		30000	29000	28000	27000	24000	20000
ISA +20°C	MIN	* 157	* 113	* 69	33	23	17
	NM	1004	726	440	201	141	100
	LB	4033	3035	2038	1217	926	692
	FPM	100	100	100	117	380	808
ISA +10°C	MIN	* 43	29	26	23	18	13
	NM	268	174	153	138	107	79
	LB	1523	1159	1057	976	792	609
	FPM	100	157	239	328	622	1097
ISA	MIN	* 47	28	25	22	17	13
	NM	288	167	147	132	101	75
	LB	1572	1117	1016	937	759	584
	FPM	100	147	228	315	602	1066
ISA -10°C	MIN	26	23	21	19	16	12
	NM	147	132	120	111	88	66
	LB	1073	990	921	860	712	555
	FPM	233	315	403	496	803	1300

PRESSURE ALTITUDE 47000 FEET — ISA = -57°C = -70°F

T.O. WEIGHT		30000	29000	28000	27000	24000	20000
ISA +20°C	MIN	* 291	* 247	* 203	* 158	30	19
	NM	1871	1592	1305	1009	187	118
	LB	6712	5710	4712	3710	1077	751
	FPM	150	150	150	150	188	606
ISA +10°C	MIN	* 169	* 126	* 82	* 38	22	16
	NM	1104	822	532	232	131	92
	LB	4293	3292	2296	1293	877	654
	FPM	142	142	143	142	414	881
ISA	MIN	* 174	* 130	* 85	* 39	21	15
	NM	1117	834	539	238	126	87
	LB	4289	3292	2290	1289	844	628
	FPM	138	138	138	138	400	857
ISA -10°C	MIN	* 70	33	28	25	18	13
	NM	437	192	162	142	105	76
	LB	2082	1211	1075	977	776	592
	FPM	100	113	195	284	584	1071

680M-00-04

* INDICATES STEP CLIMB REQUIRED
NOTE: STEP CLIMB DATA INCLUDES TIME, DISTANCE, AND FUEL USED IN CRUISE PORTION. BASED ON MAXIMUM CRUISE THRUST.

CRUISE CLIMB SPEED - KIAS

PRESSURE ALTITUDE - FEET										
0	5000	10000	15000	20000	25000	30000	35000	40000	45000	47000
250	250	250	250	250	250	239	213	189	168	160

WIND EFFECT ON CLIMB DISTANCE - NM
(SUBTRACT FOR HEADWIND, ADD FOR TAILWIND)

CLIMB TIME (MIN)	WIND 25KTS	50KTS	100KTS
5	2	4	8
10	4	8	16
15	6	12	25
20	8	16	33
25	10	20	41
30	12	25	50

NOTE: FOR CLIMB CONDITIONS REQUIRING A STEP CLIMB, THE FOLLOWING TABLE GIVES THE WEIGHT AT THE END OF THE STEP CRUISE AT THE STEP ALTITUDE, REQUIRED TO CONTINUE CLIMB.

STEP CLIMB ALT IN FEET	TEMPERATURE ISA -10°C	ISA +0°C	ISA +10°C	ISA +20°C
43000	——	28645	28698	26171
45000	28155	25901	25897	23467

Performance Worksheet

PERFORMANCE WORKSHEET		FLIGHT PLANNING	
DESTINATION:	KAPA to KHPN	ALTERNATE:	KPSM
DISTANCE:	1,475 NM	DISTANCE:	200 NM
ALTITUDE:	FL 450	ALTITUDE:	FL 250
TEMP DEV:	ISA	WIND:	NONE
WIND:	+ 100 KTS (TAILWIND)	HOLDING:	45 MIN
CRUISE MODE:	MCT	CRUISE MODE:	NORMAL

	WEIGHT	FUEL	TIME	DISTANCE
Zero Fuel Weight	18,975 lbs			
Taxi Fuel	200 lbs	200 lbs		
Takeoff / Climb	28,000 lbs	929 lbs	24 min	175 NM
Descent				
Approach				
Cruise				
Trip Fuel				
Reserve				
Alternate				
Totals				
Ramp Weight				
Takeoff Weight				
Weight at Dest				
Weight at Alternate				

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Takeoff and Climb Fuel

There are two sets of cruise climb charts that can be used to determine time, distance fuel, and rate-of-climb. These are based upon climbing at 250 KIAS/0.64 Indicated Mach, and are further split with anti-ice systems ON or OFF.

This performance is based on the following:

- Throttles set in the MCT detent
- Speedbrakes retracted
- Gear and flaps up
- Starting at sea level

Since Denver is not at sea level it is necessary to go into the charts twice. Check first for our cruise altitude, and then again for the initial altitude at Denver (approximately 5,000 feet MSL). Take the difference between the time, distance, and fuel values to provide the proper values for the climb.

In order to use these charts, we need to have a preliminary takeoff weight. One method of starting out is to simply begin with the maximum takeoff weight of 30,300 pounds. However, taking into account some basic rules-of-thumb and prior experience can give us an estimated takeoff weight based upon our projected flight time.

From our previous flying experience, we determine that the average flying time from Denver to New York is roughly 3.5 hours. Based upon that assumption, apply the following rule of thumb for a general fuel burn estimate. When we are finished, we'll compare our initial estimate to the computed numbers and see how it works out:

- 400 knots average cruise speed.

CE-680 average fuel burn (2 engines):

- Hour 1: 2,200 pounds
- Hour 2: 1,700 pounds
- Hour 3: 1,400 pounds
- Hour 4: 1,400 pounds
- Hour 5: 1,300 pounds
- Hour 6: 700 pounds (7/10 of an hour)

For 3.5 hours of flying time, we would burn about 4,800 pounds of fuel, including taxi. Add the following estimates:

Fuel to destination:	4,800 pounds
Fuel to alternate:	1,100 pounds
Holding & extra fuel:	3,000 pounds

For our planning purposes, we'll round 8,900 pounds up to 9,000 pounds planned fuel. So based upon a ZFW of approximately 19,000 pounds, our estimated takeoff weight will be 28,000 pounds in this example.

The next information we need is the cruise altitude. First we must determine what altitude we can reach. Anti-ice will be required initially, but upon clearing the tops at 10,000 feet it will be turned off. Our only option for climb speed in the published charts is 250 KIAS/0.64 Indicated Mach. We'll use the ANTI-ICE OFF charts.

Using the takeoff weight scan through the chart until you begin seeing an asterisk (*) next to the numbers. This indicates a step climb requirement. The weather indicates ISA + 10 at altitude. Therefore the highest we can climb to at 28,000 pounds takeoff and ISA is 45,000 feet. Since our trip is eastbound this is a proper altitude for direction of flight.

Enter 45,000 feet for the Altitude on the Worksheet.

Staying in the same group of numbers we can determine the first fuel, time and distance required numbers. This is 1,016 pounds, 25 minutes and 147 NM. Remember since Denver is 5,883 feet elevation we must go back to this column and determine the fuel required there. Using the 5,000 feet area under 28,000 pound takeoff and ISA we find 187 pounds, 1 minute and 5 NM. Subtract these two amounts. This tells us that it will require 929 pounds, 24 minutes, and 142 NM to climb to 45,000 feet.

Don't forget that we have a 100-knot tailwind, so our distance covered over the ground during climb will increase. According to the note below the table, we have to add 33 NM of distance for 20 minutes of climb. So our corrected climb distance is 175 NM.

Enter 929 pounds, 24 minutes and 175 NM for Takeoff/Climb on the Worksheet.

Normal Descent Chart

2000 FEET PER MINUTE RATE OF DESCENT
ANTI-ICE SYSTEMS OFF

SPEED BRAKES RETRACTED — **GEAR AND FLAPS UP**

PRESSURE ALTITUDE FEET	KIAS	WEIGHT AT START OF DESCENT - LBS 28000 TIME MIN	28000 DIST NM	28000 FUEL LBS	24000 TIME MIN	24000 DIST NM	24000 FUEL LBS	20000 TIME MIN	20000 DIST NM	20000 FUEL LBS
47,000	196	24.7	156	353	24.1	154	356	23.8	152	372
45,000	205	23.7	149	342	23.1	146	346	22.8	145	362
43,000	216	22.7	142	331	22.1	139	335	21.8	138	351
41,000	227	21.7	134	318	21.1	132	323	20.8	130	339
39,000	238	20.7	127	305	20.1	124	310	19.8	123	326
37,000	250	19.7	120	291	19.1	117	295	18.8	116	312
35,000	262	18.7	112	275	18.1	110	279	17.8	108	295
33,000	275	17.7	105	256	17.1	102	261	16.8	101	276
31,000	288	16.7	97	236	16.1	95	240	15.8	93	256
29,000	296	15.7	90	216	15.1	87	219	14.8	86	234
27,000	296	14.7	82	197	14.1	80	200	13.8	78	214
25,000	296	13.7	75	180	13.1	72	182	12.8	71	195
23,000	296	12.7	68	163	12.1	66	164	11.8	64	176
21,000	296	11.7	61	146	11.1	59	147	10.8	57	157
19,000	296	10.7	55	129	10.1	52	129	9.8	51	139
17,000	296	9.7	48	113	9.1	46	112	8.8	45	120
15,000	296	8.7	42	97	8.1	40	95	7.8	38	102
10,000	250	5.8	26	55	5.3	23	51	5.0	22	54
5,000	250	2.9	13	30	2.7	12	27	2.5	11	28

ANTI-ICE SYSTEMS ON

PRESSURE ALTITUDE FEET	KIAS	WEIGHT AT START OF DESCENT - LBS 28000 TIME MIN	28000 DIST NM	28000 FUEL LBS	24000 TIME MIN	24000 DIST NM	24000 FUEL LBS	20000 TIME MIN	20000 DIST NM	20000 FUEL LBS
41,000	227	22.0	136	372	21.4	133	375	20.9	131	384
39,000	238	21.0	129	357	20.5	126	361	19.9	123	369
37,000	250	20.0	121	341	19.5	119	345	18.9	116	353
35,000	262	19.0	114	323	18.5	111	327	17.9	109	335
33,000	275	18.0	106	302	17.5	104	306	16.9	101	314
31,000	288	17.0	99	280	16.5	96	283	15.9	94	291
29,000	296	16.1	91	257	15.5	89	260	14.9	86	268
27,000	296	15.1	84	237	14.5	81	240	13.9	79	246
25,000	296	14.1	77	217	13.5	74	219	12.9	71	224
23,000	296	13.1	70	198	12.5	67	199	11.9	65	203
21,000	296	12.1	63	180	11.5	60	180	10.9	58	182
19,000	296	11.1	57	161	10.5	54	160	9.9	51	162
17,000	296	10.1	50	143	9.5	48	141	8.9	45	141
15,000	296	9.1	44	125	8.5	41	121	7.9	39	120
10,000	250	6.1	27	77	5.6	25	70	5.0	23	66
5,000	250	3.1	13	42	2.9	12	38	2.5	11	34

68OM-00-01

WIND EFFECT ON DESCENT DISTANCE - NM
(SUBTRACT FOR HEADWIND, ADD FOR TAILWIND)

TIME (MIN)	WIND 25KTS	50KTS	100KTS
5	2	4	8
10	4	8	16
15	6	12	25
20	8	16	33
25	10	20	41
30	12	25	50

Performance Worksheet

PERFORMANCE WORKSHEET			FLIGHT PLANNING	
DESTINATION:	KAPA to KHPN		ALTERNATE:	KPSM
DISTANCE:	1,475 NM		DISTANCE:	200 NM
ALTITUDE:	FL 450		ALTITUDE:	FL 250
TEMP DEV:	ISA		WIND:	NONE
WIND:	+ 100 KTS (TAILWIND)		HOLDING:	45 MIN
CRUISE MODE:	MCT		CRUISE MODE:	NORMAL

	WEIGHT	FUEL	TIME	DISTANCE
Zero Fuel Weight	18,975 lbs			
Taxi Fuel	200 lbs	200 lbs		
Takeoff / Climb	929 lbs	929 lbs	24 min	175 NM
Descent	346 lbs	346 lbs	23 min	179 NM
Approach	200 lbs	200 lbs	5 min	------
Cruise				
Trip Fuel				
Reserve				
Alternate				
Totals				
Ramp Weight				
Takeoff Weight				
Weight at Dest				
Weight at Alternate				

Descent Fuel

The next fuel quantity we need is for descent to destination. The Normal Descent Chart in the Citation Sovereign Operating Manual gives the time, distance, and fuel information for a normal descent. The performance is based on the following:

- Maintaining fan speed, fuel flow, airspeed, rate of descent presented
- Gear and flaps UP
- Speed brakes retracted
- Anti-ice Systems OFF or ON

Charts are based upon either a normal descent (2,000 feet-per-minute) or a high-speed descent (3,000 feet-per-minute). As in the Climb charts, if descent is to an airport other than at sea level, you must reference the chart twice and subtract the two numbers. Since Westchester County is 439 feet we will not do any corrections. Scan down the left of the chart to find 45,000 feet. Going across will give us KIAS, Time, Fuel Used, and Distance. We will use the 24,000 pound column as our estimated weight for the start of descent.

The information we need, according to the chart, is 346 pounds of fuel, 23 minutes, and with a 100-knot tailwind 179 NM.

As you remember our forecast for Westchester County will require us to fly an instrument approach. Since this fuel was not included in the descent fuel chart we will add a standard approach fuel from the Citation Sovereign Operating Manual. This equals ten minutes approach fuel at 1,200 pounds per hour total fuel or roughly 200 pounds total. To get a more accurate time add five minutes to the descent time for the approach.

Enter 346 pounds, 23 min, 179 NM for Descent on the Worksheet. Enter 200 pounds and 5 minutes for Approach on the Worksheet.

Cruise Chart

CRUISE
45000 FEET

ANTI-ICE SYSTEMS OFF — **TWO ENGINES**

WT LBS	TEMP	RAT °C		FAN PERCENT RPM	FUEL FLOW LBS/HR	KIAS	IND MACH	KTAS	NAUTICAL MILES / 100 LBS FUEL: HEADWIND 100 KT	HEADWIND 50 KT	HEADWIND 25 KT	ZERO WIND	TAILWIND 25 KT	TAILWIND 50 KT	TAILWIND 100 KT
29000	ISA-10°C	-46	(1)	97.4	1363	187	.70	395	21.6	25.3	27.1	29.0	30.8	32.6	36.3
	-66°C	-47		97.0	1333	183	.690	387	21.5	25.3	27.1	29.0	30.9	32.8	36.5
		-47	(2)	96.6	1313	180	.68	381	21.4	25.2	27.1	29.0	30.9	32.8	36.6
28000	ISA-10°C	-45	(1)	97.2	1370	193	.72	405	22.3	25.9	27.8	29.6	31.4	33.2	36.9
	-66°C	-46		96.7	1337	189	.710	398	22.3	26.0	27.9	29.7	31.6	33.5	37.2
		-46		96.1	1312	186	.700	392	22.3	26.1	28.0	29.9	31.8	33.7	37.5
		-47		95.7	1290	183	.690	387	22.2	26.1	28.0	30.0	31.9	33.8	37.7
		-48	(2)	95.1	1259	178	.67	378	22.1	26.1	28.0	30.0	32.0	34.0	38.0
27000	ISA+10°C	-25	(1)	98.2	1318	181	.68	402	22.9	26.7	28.6	30.5	32.4	34.3	38.1
	-46°C	-25	(2)	98.2	1317	181	.68	401	22.9	26.7	28.6	30.5	32.4	34.3	38.1
	ISA+0°C	-36	(1)	96.2	1278	181	.69	393	22.9	26.8	28.8	30.7	32.7	34.7	38.6
	-56°C	-36	(2)	96.1	1272	180	.68	391	22.9	26.8	28.8	30.7	32.7	34.7	38.6
	ISA-10°C	-44	(1)	97.1	1377	197	.74	413	22.7	26.4	28.2	30.0	31.8	33.6	37.3
	-66°C	-45		96.0	1324	192	.720	403	22.9	26.7	28.6	30.5	32.3	34.2	38.0
		-46		95.0	1273	186	.700	392	23.0	26.9	28.8	30.8	32.8	34.7	38.7
		-47		94.1	1229	180	.680	381	22.8	26.9	29.0	31.0	33.0	35.1	39.1
		-48	(2)	93.6	1206	176	.67	374	22.7	26.9	28.9	31.0	33.1	35.2	39.3
26000	ISA+10°C	-24	(1)	98.1	1325	187	.70	413	23.6	27.4	29.3	31.2	33.1	34.9	38.7
	-46°C	-25		97.6	1294	183	.690	405	23.6	27.4	29.4	31.3	33.2	35.2	39.0
		-26		97.3	1272	180	.680	399	23.5	27.4	29.4	31.4	33.3	35.3	39.2
		-26		96.9	1251	177	.670	393	23.4	27.4	29.4	31.4	33.4	35.4	39.4
		-27	(2)	96.6	1230	174	.66	387	23.3	27.4	29.4	31.5	33.5	35.5	39.6
	ISA+0°C	-35	(1)	96.1	1289	187	.71	405	23.7	27.5	29.5	31.4	33.4	35.3	39.2
	-56°C	-36		95.5	1253	183	.690	396	23.6	27.6	29.6	31.6	33.6	35.6	39.6
		-36		95.2	1232	180	.680	390	23.5	27.6	29.6	31.7	33.7	35.7	39.8
		-37		94.9	1211	177	.670	384	23.5	27.6	29.7	31.7	33.8	35.8	40.0
		-38	(2)	94.6	1191	174	.66	378	23.4	27.6	29.6	31.7	33.8	35.9	40.1
	ISA-10°C	-43	(1)	97.0	1383	200	.75	420	23.1	26.7	28.5	30.3	32.1	34.0	37.6
	-66°C	-44		95.6	1316	194	.730	409	23.5	27.3	29.2	31.1	33.0	34.9	38.7
		-46		94.3	1260	189	.710	398	23.6	27.6	29.6	31.6	33.5	35.5	39.5
		-47		93.4	1213	183	.690	387	23.6	27.7	29.8	31.9	33.9	36.0	40.1
		-49	(2)	92.4	1152	174	.66	369	23.4	27.7	29.9	32.0	34.2	36.4	40.7
25000	ISA+10°C	-23	(1)	97.9	1329	191	.72	422	24.2	28.0	29.9	31.7	33.6	35.5	39.3
	-46°C	-24		97.2	1281	186	.700	411	24.3	28.2	30.1	32.1	34.0	36.0	39.9
		-26		96.5	1234	180	.680	399	24.2	28.3	30.3	32.3	34.4	36.4	40.4
		-27	(2)	95.8	1192	174	.66	387	24.1	28.3	30.4	32.5	34.6	36.6	40.8
	ISA+0°C	-34	(1)	96.0	1298	192	.72	414	24.2	28.1	30.0	31.9	33.9	35.8	39.6
	-56°C	-35		95.6	1266	189	.710	407	24.3	28.2	30.2	32.2	34.1	36.1	40.1
		-36		94.8	1217	183	.690	396	24.3	28.4	30.5	32.5	34.6	36.6	40.7
		-37		94.1	1175	177	.670	384	24.2	28.5	30.6	32.7	34.8	37.0	41.2
		-38	(2)	93.7	1153	174	.66	378	24.1	28.4	30.6	32.8	34.9	37.1	41.4
	ISA-10°C	-43	(1)	97.0	1388	203	.76	425	23.4	27.0	28.8	30.6	32.4	34.2	37.8
	-66°C	-44		94.5	1282	194	.730	409	24.1	28.0	30.0	31.9	33.9	35.8	39.7
		-46		93.4	1226	189	.710	398	24.3	28.4	30.4	32.5	34.5	36.5	40.6
		-47		92.7	1178	183	.690	387	24.3	28.6	30.7	32.8	34.9	37.1	41.3
		-49	(2)	91.6	1114	173	.66	369	24.1	28.6	30.8	33.1	35.3	37.6	42.0
24000	ISA+20°C	-16	(1)	96.9	1193	174	.66	396	24.8	29.0	31.1	33.2	35.3	37.4	41.6
	-36°C	-16	(2)	96.9	1193	174	.66	396	24.8	29.0	31.1	33.2	35.3	37.4	41.6
	ISA+10°C	-22	(1)	97.8	1330	195	.73	429	24.7	28.5	30.3	32.2	34.1	36.0	39.7
	-46°C	-24		96.9	1272	189	.710	417	24.9	28.8	30.8	32.7	34.7	36.7	40.6
		-25		96.1	1222	183	.690	405	25.0	29.0	31.1	33.1	35.2	37.2	41.3
		-26		95.3	1177	177	.670	393	24.9	29.1	31.3	33.4	35.5	37.6	41.9
		-27	(2)	94.7	1136	171	.65	380	24.7	29.1	31.3	33.5	35.7	37.9	42.3
	ISA+0°C	-33	(1)	96.0	1302	196	.73	421	24.7	28.5	30.4	32.4	34.3	36.2	40.0
	-56°C	-35		94.9	1232	189	.710	407	24.9	29.0	31.0	33.0	35.1	37.1	41.2
		-36		94.1	1183	183	.690	396	25.0	29.2	31.3	33.5	35.6	37.7	41.9
		-37		93.3	1140	177	.670	384	24.9	29.3	31.5	33.7	35.9	38.1	42.5
		-38	(2)	92.6	1099	170	.65	372	24.7	29.3	31.5	33.8	36.1	38.4	42.9
	ISA-10°C	-42	(1)	96.9	1392	205	.76	428	23.6	27.2	29.0	30.8	32.6	34.4	38.0
	-66°C	-44		93.7	1249	194	.730	409	24.7	28.7	30.7	32.7	34.7	36.8	40.8
		-46		92.3	1168	186	.700	392	25.0	29.3	31.4	33.6	35.7	37.9	42.1
		-48		91.2	1103	177	.670	375	25.0	29.5	31.8	34.0	36.3	38.6	43.1
		-49	(2)	90.4	1058	170	.64	361	24.7	29.4	31.8	34.1	36.5	38.8	43.6
23000	ISA+20°C	-15	(1)	96.8	1196	179	.68	407	25.6	29.8	31.9	34.0	36.1	38.2	42.4
	-36°C	-15		96.5	1180	177	.670	402	25.6	29.8	31.9	34.0	36.1	38.3	42.5
		-16		96.2	1160	174	.660	396	25.5	29.8	32.0	34.1	36.3	38.4	42.7
		-16		95.8	1141	171	.650	390	25.4	29.8	32.0	34.2	36.4	38.5	42.9
		-17	(2)	95.5	1125	169	.64	384	25.3	29.7	32.0	34.2	36.4	38.6	43.1
	ISA+10°C	-22	(1)	97.8	1332	197	.74	434	25.1	28.8	30.7	32.6	34.5	36.3	40.1
	-46°C	-23		96.7	1268	192	.720	422	25.4	29.4	31.3	33.3	35.3	37.3	41.2
		-24		95.8	1213	186	.700	411	25.6	29.7	31.8	33.9	35.9	38.0	42.1
		-26		95.0	1165	180	.680	399	25.6	29.9	32.1	34.2	36.4	38.5	42.8
		-28	(2)	93.6	1088	168	.64	376	25.3	29.9	32.2	34.5	36.8	39.1	43.7
	ISA+0°C	-33	(1)	95.9	1304	199	.74	427	25.0	28.9	30.8	32.7	34.6	36.5	40.4
	-56°C	-34		94.7	1228	192	.720	413	25.5	29.5	31.6	33.6	35.7	37.7	41.8
		-36		93.3	1152	183	.690	396	25.7	30.0	32.2	34.4	36.5	38.7	43.1
		-38		92.2	1088	174	.660	379	25.6	30.2	32.5	34.8	37.1	39.4	44.0
		-39	(2)	91.5	1049	168	.64	366	25.3	30.1	32.5	34.9	37.2	39.6	44.4
	ISA-10°C	-42	(1)	96.8	1395	207	.77	432	23.8	27.4	29.1	30.9	32.7	34.5	38.1
	-66°C	-44		93.6	1253	197	.740	415	25.1	29.1	31.1	33.1	35.1	37.1	41.1
		-46		92.1	1162	189	.710	398	25.6	29.9	32.1	34.2	36.4	38.5	42.8
		-47		90.9	1093	180	.680	381	25.7	30.3	32.6	34.9	37.1	39.4	44.0
		-50	(2)	89.3	1012	167	.64	356	25.3	30.3	32.7	35.2	37.7	40.1	45.1

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Note (1): Maximum Cruise Thrust,
Note (2): Approximate Thrust for Maximum Range

Performance Worksheet

PERFORMANCE WORKSHEET			FLIGHT PLANNING	
DESTINATION:	KAPA to KHPN		ALTERNATE:	KPSM
DISTANCE:	1,475 NM		DISTANCE:	200 NM
ALTITUDE:	FL 450		ALTITUDE:	FL 250
TEMP DEV:	ISA		WIND:	NONE
WIND:	+ 100 KTS (TAILWIND)		HOLDING:	45 MIN
CRUISE MODE:	MCT		CRUISE MODE:	NORMAL

	WEIGHT	FUEL	TIME	DISTANCE
Zero Fuel Weight	18,975 lbs			
Taxi Fuel	200 lbs	200 lbs		
Takeoff / Climb	929 lbs	929 lbs	24 min	175 NM
Descent	346 lbs	346 lbs	23 min	179 NM
Approach	200 lbs	200 lbs	5 min	------
Cruise	2,939 lbs	2,939 lbs	138 min	1121 NM
Trip Fuel				
Reserve				
Alternate				
Totals				
Ramp Weight				
Takeoff Weight				
Weight at Dest				
Weight at Alternate				

Cruise Fuel

Now that we have determined the cruise altitude, the fuel loading for cruise can be determined. The cruise performance charts in the Citation Sovereign Operating Manual are developed for each cruise altitude with two engines operating and anti-ice systems off. A correction chart for anti-ice on is included for each cruise altitude. The various fan speeds presented provide the specific ranges between maximum cruise thrust and the approximate maximum range thrust. Again, the boss bought the plane for speed so we will use the maximum cruise thrust numbers.

Find the 45,000 feet chart and find the appropriate weight at altitude box. This is determined by subtracting Climb Fuel (approximately 1,000 pounds) from Takeoff Weight (28,000 pounds) that equals Initial Cruise Weight (27,000 pounds). Round to the nearest weight if needed. Using the 27,000 pounds weight, we find that the N_1 setting for max cruise thrust is 96.2%.

Along this line we will find that with the throttles in the MCT detent our fuel burn will be 1,278 pounds/hr at 0.69 Indicated Mach and a true airspeed of 393 KTAS.

Earlier we determined that the trip was 1,475 NM to destination. Also, there is a 100-knot tailwind. Adding this to the true airspeed equals our groundspeed of 493 knots. Since we have already determined Climb and Descent distances we must subtract those from the trip distance to determine the Cruise distance. Adding the Climb (175 NM) and Descent (179 NM) minus Trip (1,475 NM) equals Cruise (1,121 NM). Dividing the Cruise distance of 1,121 NM by 493 knots ground speed equals roughly 2.3 hours. Multiplying 2.3 hours by the fuel burn 1,278 pounds/hr equals 2,939 pounds of fuel.

Enter 2,939 pounds, 138 minutes (2.3 hours), and 1,121 NM for Cruise on the Worksheet.

So far our total estimated fuel burn for the trip from KAPA to KPHN is approximately 4,600 pounds, and our estimated time enroute is approximately 3.1 hours. This is right on target with our initial rule-of-thumb estimates.

Another table that we can use for cross-checking is the MAX CRUISE Flight Planning Table (see example table on page 8-43). Using interpolation, we find that the fuel burn and time at cruise altitude numbers are close to what we've already computed.

Holding Fuel Chart

ANTI-ICE SYSTEMS OFF

SPEED BRAKES RETRACTED — GEAR AND FLAPS UP

WEIGHT		TOTAL POUNDS PER HOUR							
		PRESSURE ALTITUDE - FEET							
LBS	KIAS	SEA LEVEL	1,500	5,000	10,000	15,000	20,000	25,000	30,000
28,000	180	1448	1423	1369	1290	1228	1183	1151	1143
26,000	176	1382	1358	1304	1229	1163	1118	1086	1068
24,000	172	1318	1294	1240	1169	1101	1055	1022	998
22,000	168	1253	1232	1179	1111	1044	995	960	932
20,000	164	1188	1167	1119	1054	989	938	901	871
18,000	160	1125	1104	1058	997	935	883	843	813

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ANTI-ICE SYSTEMS ON

SPEED BRAKES RETRACTED — GEAR AND FLAPS UP

WEIGHT		TOTAL POUNDS PER HOUR							
		PRESSURE ALTITUDE - FEET							
LBS	KIAS	SEA LEVEL	1,500	5,000	10,000	15,000	20,000	25,000	30,000
28,000	180	1630	1601	1538	1444	1370	1319	1281	1270
26,000	180	1582	1554	1491	1399	1322	1270	1230	1212
24,000	180	1539	1510	1448	1358	1279	1224	1182	1158
22,000	180	1498	1470	1408	1320	1240	1181	1139	1110
20,000	180	1459	1433	1372	1285	1204	1142	1099	1067
18,000	180	1421	1397	1339	1254	1171	1106	1062	1029

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Cruise Chart

MAX CRUISE

STANDARD DAY — **CRUISE ALTITUDE 25000 FEET**

FAN SETTING FOR MAX CRUISE - PERCENT N1

CRUISE WEIGHT - LBS											
30000	29000	28000	27000	26000	25000	24000	23000	22000	21000	20000	19000
94.3	94.1	93.9	93.7	93.5	93.2	93.0	92.8	92.7	92.5	92.3	92.2

		TAILWIND						ZERO WIND		HEADWIND					
		100 KT		50 KT		25 KT				25 KT		50 KT		100 KT	
STAGE LENGTH NM	T.O. WEIGHT LBS	FUEL LBS	TIME HRS	FUEL LBS	TIME HRS	FUEL LBS	TIME HRS	FUEL LBS	TIME HRS	FUEL LBS	TIME HRS	FUEL LBS	TIME HRS	FUEL LBS	TIME HRS
200	30000	1460	0.62	1552	0.66	1606	0.69	1667	0.71	1737	0.74	1817	0.78	2024	0.88
	25000	1373	0.62	1462	0.66	1515	0.68	1575	0.71	1644	0.74	1723	0.78	1929	0.89
	20000	1296	0.61	1383	0.66	1434	0.68	1493	0.71	1561	0.75	1640	0.79	1847	0.90
400	30000	2393	0.99	2579	1.07	2688	1.12	2810	1.17	2948	1.23	3106	1.30	3502	1.47
	25000	2276	0.99	2457	1.07	2563	1.12	2682	1.17	2817	1.23	2972	1.30	3362	1.48
	20000	2171	0.99	2347	1.07	2451	1.12	2567	1.17	2699	1.24	2851	1.31	3238	1.50
600	30000	3319	1.36	3598	1.48	3761	1.55	3943	1.63	4148	1.72	4382	1.82	4962	2.07
	25000	3175	1.36	3447	1.48	3606	1.55	3783	1.63	3984	1.72	4212	1.82	4782	2.08
	20000	3042	1.36	3306	1.48	3461	1.55	3634	1.63	3830	1.72	4054	1.83	4618	2.11
800	30000	4238	1.74	4609	1.89	4825	1.98	5066	2.09	5337	2.20	5645	2.33	6405	2.67
	25000	4068	1.73	4429	1.89	4640	1.98	4875	2.09	5140	2.20	5441	2.34	6190	2.68
	20000	3909	1.73	4260	1.89	4465	1.98	4695	2.09	4954	2.21	5248	2.35	5989	2.71
900	30000	4695	1.92	5111	2.10	5353	2.20	5623	2.31	5927	2.44	6271	2.59	7120	2.96
	25000	4513	1.92	4918	2.09	5154	2.20	5418	2.31	5715	2.45	6052	2.60	6889	2.98
	20000	4341	1.92	4735	2.10	4965	2.20	5222	2.32	5512	2.45	5843	2.61	6674	3.02
1000	30000	5151	2.11	5612	2.30	5880	2.42	6179	2.54	6514	2.69	6894	2.85	7832	3.26
	25000	4956	2.10	5406	2.30	5667	2.41	5959	2.54	6288	2.69	6661	2.86	7585	3.28
	20000	4771	2.10	5209	2.30	5464	2.42	5748	2.55	6069	2.70	6435	2.87	7356	3.34
1100	30000	5605	2.29	6110	2.51	6404	2.63	6731	2.77	7099	2.93	7515	3.11	8547	3.56
	25000	5398	2.29	5891	2.51	6178	2.63	6499	2.77	6859	2.93	7267	3.12	8278	3.58
	20000	5201	2.29	5681	2.51	5960	2.64	6273	2.78	6625	2.95	7025	3.14		
1200	30000	6057	2.48	6606	2.71	6925	2.85	7281	3.00	7681	3.17	8136	3.37	9257	3.86
	25000	5839	2.48	6376	2.71	6688	2.85	7037	3.00	7428	3.18	7872	3.38	8969	3.88
	20000	5629	2.48	6151	2.71	6455	2.85	6795	3.01	7178	3.19				
1300	30000	6507	2.67	7101	2.92	7445	3.07	7831	3.23	8265	3.42	8756	3.63	9966	4.16
	25000	6279	2.66	6859	2.92	7196	3.06	7572	3.23	7995	3.42	8474	3.64	9657	4.18
	20000	6056	2.66	6620	2.92	6949	3.07	7316	3.24						
1400	30000	6956	2.85	7593	3.12	7966	3.28	8381	3.46	8847	3.66	9374	3.89	10672	4.46
	25000	6717	2.85	7340	3.12	7703	3.28	8106	3.46	8560	3.66	9073	3.90	10341	4.48
	20000	6482	2.85	7088	3.13	7441	3.29								
1500	30000	7403	3.04	8088	3.33	8486	3.50	8930	3.69	9428	3.90	9990	4.15	11375	4.76
	25000	7154	3.04	7820	3.33	8207	3.50	8639	3.69	9123	3.91	9671	4.16		
	20000	6906	3.04												
1600	30000	7851	3.22	8581	3.53	9005	3.71	9477	3.92	10006	4.15	10605	4.41	12076	5.06
	25000	7590	3.22	8299	3.53	8711	3.72	9169	3.92	9684	4.15	10266	4.41		
	20000	7330	3.22												
1700	30000	8300	3.41	9073	3.74	9522	3.93	10022	4.15	10583	4.39	11217	4.66		
	25000	8025	3.41	8776	3.74	9212	3.93	9698	4.15	10242	4.39				
	20000														
1800	30000	8747	3.60	9564	3.94	10038	4.15	10566	4.38	11158	4.63				
	25000	8459	3.59	9252	3.94	9712	4.15	10224	4.38						
	20000														
1900	30000	9192	3.78	10053	4.15	10552	4.36	11109	4.60	11732	4.88				
	25000	8891	3.78	9726	4.15	10210	4.37	10749	4.61						
	20000														
2000	30000	9637	3.97	10541	4.36	11066	4.58	11649	4.83						
	25000	9322	3.97	10199	4.36	10707	4.58								
	20000														
2100	30000	10081	4.16	11028	4.56	11577	4.80								
	25000	9752	4.15	10670	4.56										
	20000														
2200	30000	10524	4.34	11514	4.77										
	25000	10181	4.34												
	20000														
2300	30000	10966	4.53	11998	4.97										
	25000	10608	4.53												
	20000														
2400	30000	11406	4.71												
	25000														
	20000														

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NOTE: FUEL VALUES LARGER THAN THE MAXIMUM USABLE FUEL ARE PRESENTED FOR INTERPOLATION PURPOSES.

Performance Worksheet

PERFORMANCE WORKSHEET			FLIGHT PLANNING	
DESTINATION: KAPA to KHPN DISTANCE: 1,475 NM ALTITUDE: FL 450 TEMP DEV: ISA WIND: + 100 KTS (TAILWIND) CRUISE MODE: MCT			ALTERNATE: KPSM DISTANCE: 200 NM ALTITUDE: FL 250 WIND: NONE HOLDING: 45 MIN CRUISE MODE: NORMAL	
	WEIGHT	**FUEL**	**TIME**	**DISTANCE**
Zero Fuel Weight	18,975 lbs			
Taxi Fuel	200 lbs	200 lbs		
Takeoff / Climb	929 lbs	929 lbs	24 min	175 NM
Descent	346 lbs	346 lbs	23 min	179 NM
Approach	200 lbs	200 lbs	5 min	------
Cruise	2,939 lbs	2,939 lbs	138 min	1121 NM
Trip Fuel	4,614 lbs	4,614 lbs		
Reserve	3,000 lbs	3,000 lbs		
Alternate	1,400 lbs	1,400 lbs		
Totals				
Ramp Weight				
Takeoff Weight	27,775 lbs			
Weight at Dest	23,361 lbs			
Weight at Alternate				

Fuel Reserves and Alternate Fuel Plan

Reserve Fuel

Now that we have made it to our destination, we must also determine our reserve fuel and the fuel required to get from the destination to the alternate. The Holding Chart in the Citation Sovereign Operating Manual is based on a nominal speed with gear and flaps UP, and speed brakes retracted. Holding fuel in total pounds per hour is presented for various weights at several altitudes. There are two separate charts, one for Anti-ice ON and one for Anti-ice OFF. If the aircraft is diverted to the alternate carrying only the fuel specified by the appropriate chart,you will land at the alternate with only the holding fuel you have allowed for.

Since we are anticipating poor weather upon our arrival into White Plains, there is a possibility that we may have to hold. Using the Holding Fuel planning tables, with flaps up and anti-ice systems off, we can estimate 1,000 pounds for 45 minutes of holding at a weight of 24,000 pounds.

We will include this number on the Performance Worksheet in the Reserve Fuel block.

Most operators count on landing at the alternate with a minimum of 2,000 pounds. So, we will enter 2,000 pounds to the worksheet for Reserve fuel. This is arbitrary and you may add more or less.

Enter 3,000 pounds for Reserve Fuel on the Worksheet (Holding Fuel+ Extra Fuel).

Alternate Planning

The flight planned alternate is Portsmouth, NH, this was determined to be 200 NM from Westchester County. In reference to the distance and direction of flight we will select 25,000 feet as the altitude flown to the alternate. The same charts as previously used can be used to determine Alternate Fuel requirements. As well, the Flight Planning charts in the Citation Sovereign Operating Manual may be used for quick determination of time and fuel to destination.

The Flight Planning charts include Maximum Cruise Thrust, Normal Cruise Thrust, and Long Range Cruise Thrust. Maximum Cruise Thrust results in minimum time, Long Range Cruise Thrust results in optimum fuel consumption, and Normal Cruise represents a balance between the two.

Enroute time and fuel required can be approximated from the appropriate Flight Planning tables using the following criteria:

1. 175 pounds of taxi fuel
2. 250 KIAS/0.64 Mach climb schedule
3. 60% of the cruise wind factor applied to climb; 40% to descent
4. Descent to 10,000 feet from cruise altitude using the high speed descent profile
5. Thirty nautical miles from destination at 10,000 feet and long range cruise airspeed
6. Ten minutes approach fuel based upon 10,000 feet and 150 KIAS
7. NO RESERVE FUEL

We have determined that 25,000 feet will be the cruise altitude and the distance is 200 NM. All that is needed now is the aircraft weight. To find this subtract the Total Trip fuel (4,614 pounds) from the Takeoff Weight (28,000 pounds). This equals 23,386 pounds.

Using the Maximum Cruise Thrust chart for 25,000 feet, start on the left side and locate 200 NM under Stage Length. Move across to the appropriate weight. We are using 25,000 pounds as this is the closest weight to what was determined from above. Continue across the chart to the Zero Wind column and this will result in the fuel (1,575 pounds) and time (0.71 hrs.) required. Since we did not taxi we must subtract the 175 pounds of taxi fuel.

Enter 1,400 pounds for Alternate Fuel on the Worksheet.

Congratulations! You now have all the information needed to complete the Weight and Balance Computation Form and determine Takeoff and Landing performance.

Before the Fuel Loading can be finalized and entered into the Weight and Balance Computation Form we must first compare the allowable fuel to the required fuel that was previously determined.

From the Flight Planning Performance Worksheet add the Trip Fuel, Reserve fuel and Alternate Fuel in the fuel column. This is the minimum required Total Fuel for this trip. Since 9,014 pounds is less than the 11,223 pounds we can carry, we have no further adjustments to make.

Now we can determine the Ramp Weight by adding ZFW to Total Fuel. As well, determine the Weight at Alternate by subtracting the Alternate Fuel from the Weight at Destination. Reference the Performance Worksheet to locate these amounts.

Take the Total fuel of 9,014 pounds and round to 9,000 pounds. This is the fuel amount we will use for the remainder of the performance computations.

Performance Worksheet

PERFORMANCE WORKSHEET			FLIGHT PLANNING	
DESTINATION:	KAPA to KHPN		ALTERNATE:	KPSM
DISTANCE:	1,475 NM		DISTANCE:	200 NM
ALTITUDE:	FL 450		ALTITUDE:	FL 250
TEMP DEV:	ISA		WIND:	NONE
WIND:	+ 100 KTS (TAILWIND)		HOLDING:	45 MIN
CRUISE MODE:	MCT		CRUISE MODE:	NORMAL

	WEIGHT	FUEL	TIME	DISTANCE
Zero Fuel Weight	18,975 lbs			
Taxi Fuel	200 lbs	200 lbs		
Takeoff / Climb	929 lbs	929 lbs	24 min	175 NM
Descent	346 lbs	346 lbs	23 min	179 NM
Approach	200 lbs	200 lbs	5 min	------
Cruise	2,939 lbs	2,939 lbs	138 min	1121 NM
Trip Fuel	4,614 lbs	4,614 lbs		
Reserve	3,000 lbs	3,000 lbs		
Alternate	1,400 lbs	1,400 lbs		
Totals	9,000 lbs	9,014 lbs	3 + 10 hrs	1475 NM
Ramp Weight	27,975 lbs			
Takeoff Weight	27,775 lbs			
Weight at Dest	23,361 lbs			
Weight at Alternate	20,961 lbs			

Fuel Loading Weight and Moment

WING TANK FUEL			
Weight (Pounds)	Moment/100 Arm Varies (in-lbs)	Weight (Pounds)	Moment/100 Arm Varies (in-lbs)
237.6	910.82	5800	23292.81
400	1533.16	6000	24119.78
600	2297.48	6200	24948.16
800	3070.93	6400	25776.56
1000	3851.83	6600	26606.43
1200	4638.90	6800	27437.78
1400	5429.74	7000	28270.11
1600	6224.63	7200	29103.04
1800	7021.57	7400	29937.38
2000	7821.77	7600	30773.11
2200	8622.87	7800	31609.65
2400	9427.40	8000	32447.03
2600	10231.76	8200	33285.77
2800	11038.70	8400	34125.84
3000	11847.34	8600	34968.36
3200	12656.30	8800	35812.72
3400	13467.65	9000	36658.49
3600	14279.76	9200	37506.04
3800	15092.33	9400	38358.25
4000	15906.93	9600	39212.04
4200	16722.60	9800	40067.39
4400	17538.74	10000	40928.09
4600	18356.68	10200	41790.90
4800	19176.31	10400	42656.07
5000	19996.84	10600	43526.61
5200	20819.08	10800	44399.05
5400	21643.05	11000	45275.38
5600	22467.42	11223	46255.26

Weight and Balance Computation Form

PAYLOAD COMPUTATIONS			
ITEM	ARM (INCHES)	WEIGHT (POUNDS)	MOMENT / 100
OCCUPANTS			
Pilot (PIC)	137.28	170	233.38
Co-Pilot (SIC)	137.28	170	233.38
SEAT 3	239.03	170	406.35
SEAT 4	239.03	170	406.35
SEAT 5	287.29	170	488.39
SEAT 6	287.29	170	488.39
SEAT 7	329.15	---	---
SEAT 8	329.15	---	---
SEAT 9	377.41	170	641.60
SEAT 10	377.41	170	641.60
SEAT 11	204.04	---	---
SEAT ___			
SEAT ___			
SEAT ___			
Chart Cases	158.14	15	23.72
LH Fwd Closet	173.95	20	34.79
RH Fwd Ref Center	178.78	60	107.27
LH Aft Vanity	417.85	10	41.79
Aft Closet	440.82	20	88.16
Tailcone Baggage	488.23 541.95	--- 190	--- 1029.71
Coat Rod	541.78		
PAYLOAD		1675	4864.88

ITEM	WEIGHT (POUNDS)	MOMENT/ 100
1. BASIC EMPTY WEIGHT * Airplane CG= 420.52	17300	72750.00
2. PAYLOAD	1675	4864.88
3. ZERO FUEL WEIGHT (sub-total) (Do not exceed maximum zero fuel weight of 20,800 pounds.)	18975	77614.88
4. FUEL LOADING	9000	36658.49
5. RAMP WEIGHT (sub-total) (Do not exceed maximum ramp weight of 30,550 pounds.)		
6. LESS FUEL FOR TAXIING		
7. * * TAKEOFF WEIGHT (Do not exceed maximum takeoff weight of 30,300 pounds.) * * Airplane CG = ________		
8. LESS FUEL TO DESTINATION		
9. * * LANDING WEIGHT (Do not exceed maximum landing weight of 27,100 pounds.) * Airplane CG = ________		

$$\text{* Airplane CG} = \frac{\text{MOMENT/100}}{\text{WEIGHT}} \times 100$$

* * Totals must be within approved weight and center-of-gravity limits. It is the responsibility of the operator to ensure that the airplane is loaded properly. The Basic Empty Weight CG is noted on the Airplane Weighing Form. If the airplane has been altered, refer to the Weight and Balance Record for information.

* * * Enter on the Center-of-Gravity Limits Envelope Graph to verify airplane is loaded within approved limits.

Weight and Balance Completion

Now that we have completed our Fuel Loading calculations it is time to complete the remainder of the Weight and Balance Computation Form so that we can determine our Takeoff and Landing Performance calculations.

Fuel Loading

As we have just determined the total fuel will be 9,000 pounds. Using the Fuel Loading Weight and Moment Table from the Citation Sovereign Operating Manual, we find that the total moment for a fuel load of 9,000 pounds is 36,658.49.

Enter 9,000 pounds and 36,658.49 in/pounds in Fuel Loading section on the Computation Form.

Ramp Weight

The sum of ZFW and Allowable Fuel must not exceed the maximum Ramp Weight of 30,550 pounds. Divide the moment by the weight and multiply by 100 to determine the CG for Ramp Weight.

Enter 27,975 pounds and 114,273.37 in/pounds for the Ramp Weight on the Computation Form.

Fuel for Taxi

The 200 pounds of fuel for taxi is subtracted from the Ramp Weight. The corresponding moment is based upon the difference between the amount of fuel on board PRIOR to taxi and the amount of fuel on board AFTER taxi. Using the Fuel Weight and Moment Table, we subtract the fuel moment at 8,800 pounds of fuel from the fuel moment at 9,000 pounds of fuel to arrive at a moment shift of 845.77. Remember to subtract this number from the Ramp Weight moment.

Enter -200 pounds and -845.77 in/pounds for Taxi Fuel on the Computation Form.

Takeoff Weight

Subtract Taxi Fuel from Ramp Weight. This must not exceed maximum takeoff weight. Divide the moment by the weight and multiply by 100 to determine the CG for Takeoff Weight.

Enter 27,775 pounds and 113,427.60 in/pounds for the Takeoff Weight on the Computation Form. Enter 408.38 inches for aircraft CG. Check on CG Limits Graph.

Fuel Remaining at Arrival

Let's round off our Trip Fuel (Taxi, Climb, Cruise, Descent, and Approach) to 4,600 pounds in order to simplify the use of the Fuel Loading Weight and Moment Table. Subtract 4,600 pounds from the Ramp Weight to determine the projected Landing Weight. Note that the corresponding moment is NOT the moment for our actual fuel burn (4,600 pounds with a moment of 18,356.68 lb-in), but it is the moment for the amount of fuel we started with on takeoff (8,800 pounds) minus the moment for the amount of fuel we estimate will remain on board when we land (4,200 pounds). Looking at the Fuel Moment Table, this will be 35,812.72 - 16,722.60.

Enter 4,600 pounds and 19,090.12 in/pounds for Fuel Remaining on the Computation Form.

Landing Weight

The landing weight must not exceed the aircraft's maximum landing weight of 27,100 pounds. Divide the moment by the weight and multiply by 100 to determine the CG upon landing.

Enter 23,175 pounds and 94,337.48 in/pounds for the Landing Weight on the Computation Form. Enter 407.07 in for aircraft CG. Check on CG Limits Graph.

Congratulations! You have completed the Weight and Balance exercise. An example of the completed form is on the following page.

Weight and Balance Computation Form

PAYLOAD COMPUTATIONS			
ITEM	ARM (INCHES)	WEIGHT (POUNDS)	MOMENT / 100
OCCUPANTS			
Pilot (PIC)	137.28	170	233.38
Co-Pilot (SIC)	137.28	170	233.38
SEAT 3	239.03	170	406.35
SEAT 4	239.03	170	406.35
SEAT 5	287.29	170	488.39
SEAT 6	287.29	170	488.39
SEAT 7	329.15	---	---
SEAT 8	329.15	---	---
SEAT 9	377.41	170	641.60
SEAT 10	377.41	170	641.60
SEAT 11	204.04	---	---
SEAT ___			
SEAT ___			
SEAT ___			
Chart Cases	158.14	15	23.72
LH Fwd Closet	173.95	20	34.79
RH Fwd Ref Center	178.78	60	107.27
LH Aft Vanity	417.85	10	41.79
Aft Closet	440.82	20	88.16
Tailcone Baggage	488.23	---	---
	541.95	190	1029.71
Coat Rod	541.78		
PAYLOAD		1675	4864.88

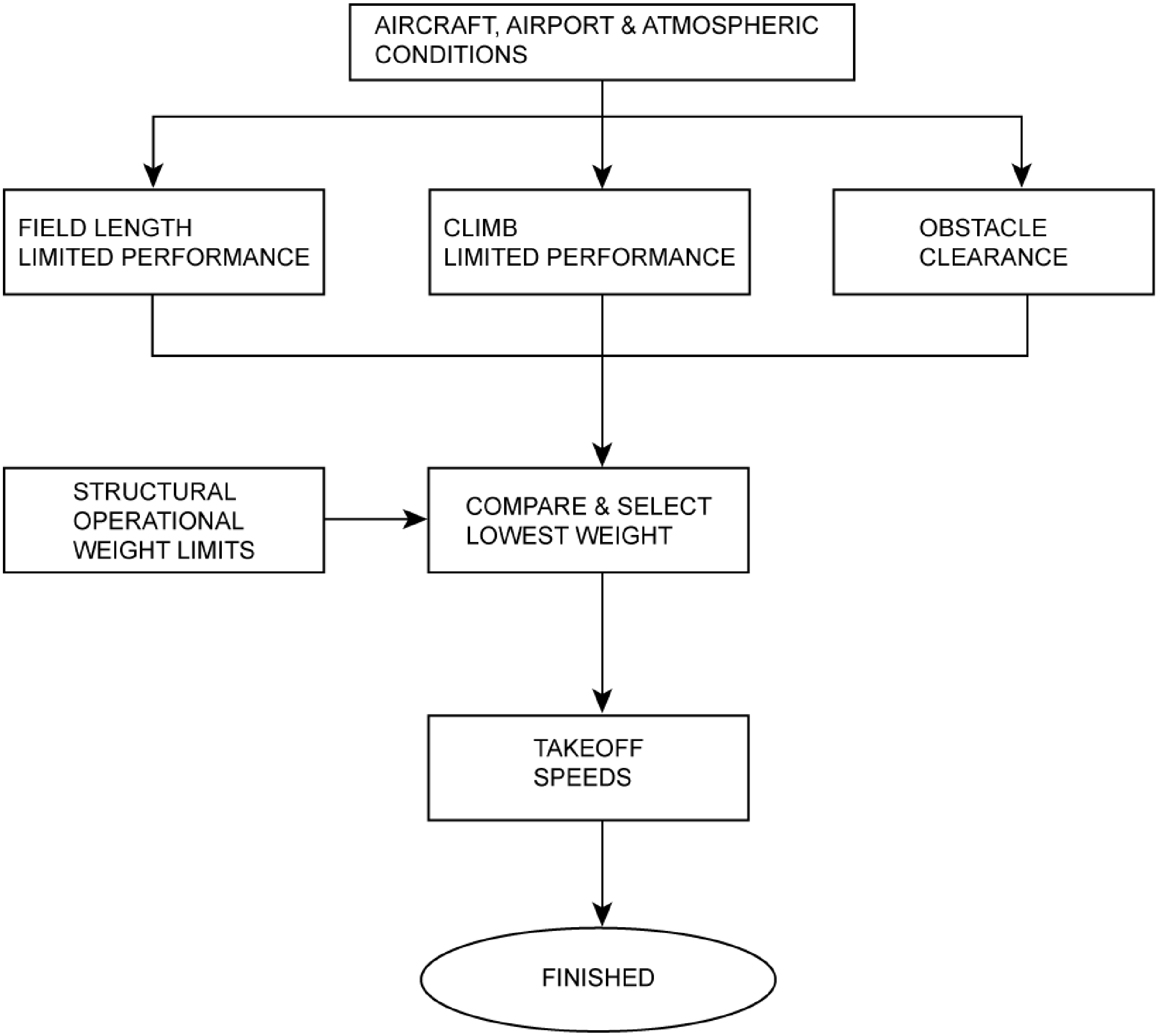
ITEM	WEIGHT (POUNDS)	MOMENT / 100
1. BASIC EMPTY WEIGHT * Airplane CG= 420.52	17300	72750.00
2. PAYLOAD	1675	4864.88
3. ZERO FUEL WEIGHT (sub-total) (Do not exceed maximum zero fuel weight of 20,800 pounds.)	18975	77614.88
4. FUEL LOADING	9000	36658.49
5. RAMP WEIGHT (sub-total) (Do not exceed maximum ramp weight of 30,550 pounds.)	27975	114273.37
6. LESS FUEL FOR TAXIING	- 200	-845.77
7. * * TAKEOFF WEIGHT (Do not exceed maximum takeoff weight of 30,300 pounds.) * * Airplane CG = 408.38	* * * 27775	113427.60
8. LESS FUEL TO DESTINATION	- 4600	-19090.12
9. * * LANDING WEIGHT (Do not exceed maximum landing weight of 27,100 pounds.) * Airplane CG= 407.07	* * * 23175	94337.48

$$\text{* Airplane CG} = \frac{\text{MOMENT/100}}{\text{WEIGHT}} \times 100$$

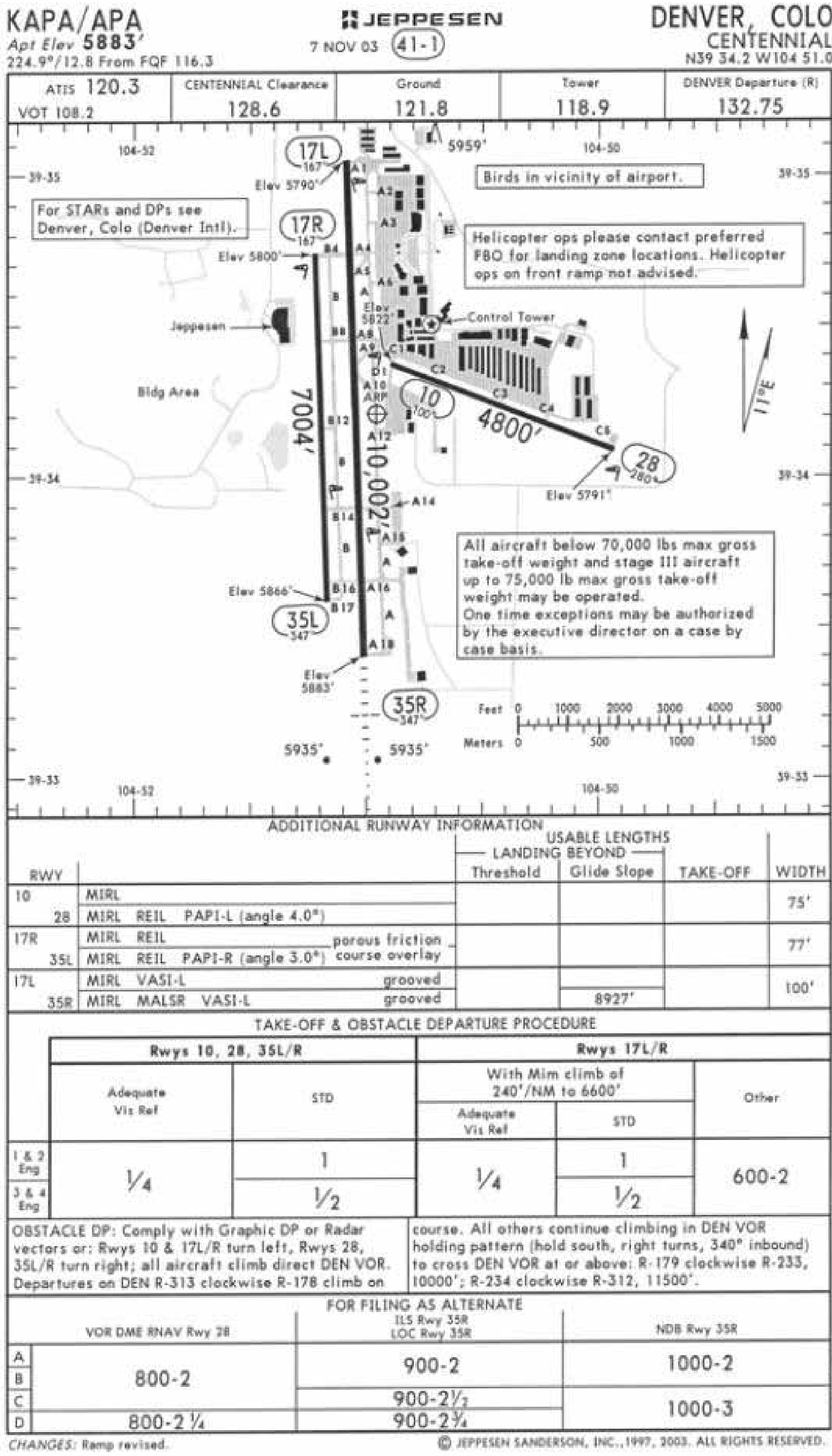
* * Totals must be within approved weight and center-of-gravity limits. It is the responsibility of the operator to Ensure that the airplane is loaded properly. The Basic Empty Weight CG is noted on the Airplane Weighing Form. If the airplane has been altered, refer to the Weight and Balance Record for information.

* * * Enter on the Center-of-Gravity Limits Envelope Graph to verify airplane is loaded within approved limits.

Takeoff Considerations/Limitations Flowchart



Departure Airport Diagram



Performance Worksheet

PERFORMANCE WORKSHEET		TAKEOFF DATA
ALTIMETER SETTING : 29.80 in PRESSURE ALTITUDE : 6,000 ft TEMPERATURE : 0°C WIND : CALM kts	RUNWAY : 10,002 ft. SLOPE : 1.0 % CONDITION DRY / WET ANTI-ICE: OFF / ON	CLIMB REQUIREMENTS: 240 ft/NM to 6,600 ft
PLANNED TAKEOFF WEIGHT		
LIMITATIONS	FLAPS 15°	FLAPS 7°
MAX T.O. WEIGHT	30,300 LBS	
CLIMB		
RUNWAY (DRY)		
RUNWAY(WET)		
OBSTACLE		
RUNWAY REQ. (DRY)	ft	ft
RUNWAY REQ. (WET)	ft	ft
SPEEDS		
V_1(DRY)	kts	kts
V_1(WET)	kts	kts
V_R	kts	kts
V_2	kts	kts
V_{ENR}	kts	kts
OTHER		
TAKEOFF N_1	N_1	
2nd SEG GRADIENT	%	%

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Takeoff Performance

The Aircraft Flight Manual (AFM) contains charts and tables that enable the pilot to determine all the necessary limitations and “numbers” to safely conduct the takeoff and landing.

Takeoff planning is a process of determining maximum performance without exceeding specific limitations. Basic aircraft weight limitations (See Table 22-1) must be adjusted by data from charts in the Aircraft Flight Manual (AFM) as modified by existing conditions.

The Citation Sovereign may be limited by:

- Maximum takeoff weight
- Climb limits
- Field length limits
- Obstacle clearance

Other limits to take into account:

- Maximum landing weight at the destination
- Runway conditions

Refer to the airport chart for Centennial (KAPA) Airport and review the METAR report:

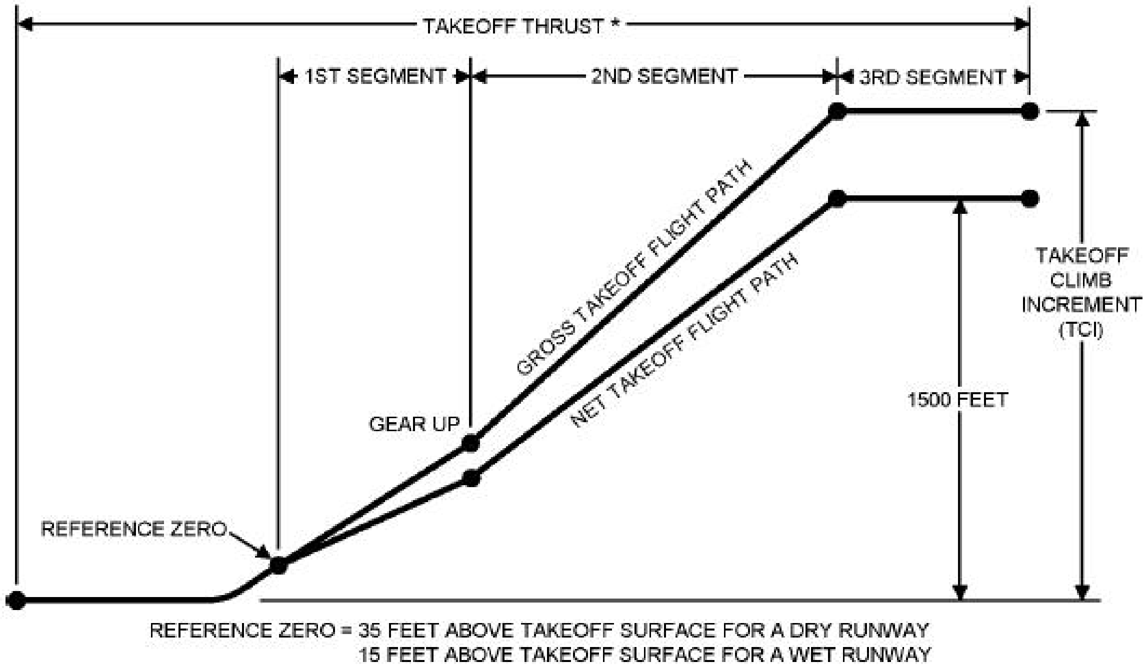
- Elevation – 5,883 feet
- Runway 17L
- Length – 10,002 feet
- Takeoff elevation – 5,790 feet
- Departure elevation – 5,883 feet
- Climb requirement – 240 ft/NM to 6,600 feet

Limitation	0173
Max. Ramp Weight	30,550 lbs
Max. Takeoff Weight	30,300 lbs
Max. Landing Weight	27,100 lbs
Max Zero Fuel Weight	20,800 lbs

Table 8-1: Basic Aircraft Weight Limitations

The Citation Sovereign Airplane Flight Manual describes a takeoff path profile for flaps 7° and flaps 15° (see diagrams on the following 2 pages).The criteria outlined in the path profile (along with engine time limits) must be considered when calculating appropriate engine inoperative obstacle clearance performance planning and weight restrictions. This is particularly true for obstacles or gradients that extend above 1,500 feet.

Takeoff Flight Path
(One Engine Inoperative) - Flaps 7°



SINGLE ENGINE FLIGHT PATH CONDITIONS:			
	FIRST SEGMENT	SECOND SEGMENT	THIRD SEGMENT
LANDING GEAR	DOWN TRANSITION TO UP	UP	UP
WING FLAP DEGREES	7	7	7 TRANSITIONING TO 0
SPEEDBRAKES	RETRACT	RETRACT	RETRACT
INOPERATIVE ENGINE	WINDMILLING	WINDMILLING	WINDMILLING
OPERATIVE ENGINE	T.O. THRUST	T.O. THRUST *	T.O. THRUST *
AIRSPEED	V_2	V_2	V_2 TRANSITIONING TO V_{ENR}

* TAKEOFF THRUST IS LIMITED TO TEN MINUTES MAXIMUM AND THEREAFTER TO MAXIMUM CONTINUOUS THRUST.

Single Engine Takeoff - Flaps 15°

ANTI-ICE - OFF

SEA LEVEL

CONDITIONS: REFER TO PAGE PRECEDING THIS TABLE

WT LBS	TEMP DEG C	TAILWIND 10 KTS				ZERO WIND				HEADWIND 10 KTS				HEADWIND 30 KTS			
		1ST FT	2ND FT	3RD FT	TCI FT	1ST FT	2ND FT	3RD FT	TCI FT	1ST FT	2ND FT	3RD FT	TCI FT	1ST FT	2ND FT	3RD FT	TCI FT
30300	-54	1570	33262	47745	2330	1367	28379	40074	2280	1300	26798	37630	2260	1165	23704	32910	2230
	-30	1643	32780	48452	2090	1440	28182	40946	2050	1373	26692	38552	2030	1238	23771	33924	2010
	-20	1672	32590	48818	2010	1470	28100	41220	1970	1402	26643	38846	1950	1267	23788	34256	1930
	-10	1701	32411	49039	1930	1499	28022	41648	1890	1431	26597	39280	1880	1296	23803	34716	1850
	0	1730	32330	49507	1860	1527	28022	42146	1820	1460	26623	39795	1810	1325	23879	35245	1780
	10	1757	32466	50182	1790	1554	28203	42816	1760	1487	26818	40463	1750	1352	24100	35908	1720
	20	1783	32797	51199	1730	1580	28546	43787	1700	1513	27165	41418	1690	1378	24455	36831	1670
	30	1809	33414	53081	1680	1606	29114	45210	1650	1539	27719	42804	1640	1404	24983	38146	1620
	40	1818	45752	72182	1720	1615	39564	61188	1670	1547	37578	57746	1660	1412	33715	51280	1630
	50	1836	73637	112037	1860	1634	62617	93715	1780	1566	59168	88150	1760	1431	52571	77516	1710
	55	1849	104664	158462	2050	1646	87133	127054	1930	1579	81817	118652	1890	1444	71862	103175	1820
30000	-54	1565	32181	46412	2320	1363	27463	38920	2270	1295	25935	36536	2250	1160	22942	32054	2220
	-30	1638	31721	47131	2080	1436	27278	39800	2040	1368	25837	37462	2030	1233	23011	32935	2000
	-20	1668	31540	47342	2000	1465	27200	40213	1960	1398	25792	37890	1940	1263	23028	33397	1920
	-10	1697	31370	47719	1920	1494	27127	40495	1880	1427	25749	38189	1870	1292	23044	33728	1850
	0	1725	31292	48030	1850	1522	27128	40845	1810	1455	25775	38551	1800	1320	23118	34243	1780
	10	1752	31419	48857	1780	1549	27299	41646	1750	1482	25959	39345	1740	1347	23329	34891	1720
	20	1778	31730	49682	1720	1575	27624	42447	1690	1508	26289	40135	1680	1373	23667	35802	1660
	30	1804	32307	51525	1670	1601	28158	43995	1640	1534	26810	41643	1630	1399	24166	37080	1610
	40	1812	43831	69519	1700	1610	37934	59015	1660	1542	36038	55689	1640	1407	32347	49407	1620
	50	1829	69249	106321	1830	1626	59024	89188	1760	1559	55810	83860	1730	1424	49648	73855	1690
	55	1841	96203	144683	1990	1638	80537	118546	1880	1571	75744	111029	1850	1436	66716	96809	1780
29000	-54	1551	28917	42241	2280	1349	24692	35453	2240	1281	23320	33378	2220	1146	20628	29107	2190
	-30	1623	28521	42986	2050	1421	24540	36327	2010	1353	23245	34156	2000	1218	20701	30091	1980
	-20	1652	28365	43207	1970	1450	24475	36600	1930	1382	23209	34587	1920	1247	20722	30411	1900
	-10	1681	28220	43601	1890	1478	24415	37029	1860	1411	23176	34883	1850	1276	20741	30862	1830
	0	1709	28151	43898	1820	1506	24416	37368	1790	1439	23200	35371	1780	1304	20808	31230	1760
	10	1735	28253	44522	1760	1533	24560	37978	1730	1465	23356	35988	1720	1330	20990	31838	1700
	20	1761	28509	45448	1700	1559	24832	38872	1670	1491	23633	36716	1660	1356	21277	32681	1640
	30	1787	28975	47012	1650	1584	25271	40168	1620	1517	24065	37981	1610	1382	21693	33739	1590
	40	1795	38263	61876	1660	1592	33186	52654	1620	1525	31546	49768	1610	1390	28343	44055	1590
	50	1804	57420	90613	1750	1601	49223	76378	1690	1534	46620	71889	1670	1399	41593	63436	1630
	55	1815	75341	116387	1840	1612	63872	97127	1760	1545	60288	91221	1740	1410	53445	80123	1690
28000	-54	1536	26092	38642	2250	1334	22287	32480	2210	1266	21048	30417	2200	1131	18613	26693	2170
	-30	1608	25747	39412	2020	1405	22160	33210	1990	1338	20990	31324	1980	1203	18689	27529	1960
	-20	1637	25613	39642	1940	1434	22106	33481	1910	1367	20962	31604	1900	1232	18711	27841	1880
	-10	1665	25487	39874	1870	1462	22056	33907	1840	1395	20937	31894	1830	1260	18733	28290	1810
	0	1693	25426	40337	1800	1490	22058	34227	1770	1422	20959	32376	1760	1287	18794	28635	1740
	10	1719	25509	40931	1730	1516	22179	34812	1710	1449	21092	32959	1700	1314	18951	29211	1680
	20	1744	25721	41635	1680	1542	22409	35497	1650	1474	21327	33628	1640	1339	19197	29869	1630
	30	1770	26103	42944	1620	1567	22774	36719	1600	1500	21688	34823	1590	1365	19549	30861	1570
	40	1777	33704	55550	1630	1575	29274	47406	1600	1507	27839	44755	1580	1372	25025	39635	1560
	50	1779	48566	78793	1680	1577	41787	66479	1630	1509	39619	62641	1620	1374	35408	55399	1590
	55	1789	61284	97736	1750	1587	52329	82064	1680	1519	49497	77292	1660	1384	44043	67991	1630
27000	-54	1522	23622	35547	2230	1319	20178	29791	2190	1252	19055	27866	2180	1117	16843	24394	2150
	-30	1592	23323	36172	2000	1390	20072	30514	1970	1322	19011	28754	1960	1187	16920	25335	1940
	-20	1621	23204	36405	1920	1418	20026	30783	1890	1351	18985	29032	1880	1216	16943	25639	1860
	-10	1649	23094	36647	1850	1446	19985	31059	1820	1379	18969	29322	1810	1244	16965	25946	1790
	0	1676	23039	36940	1780	1473	19987	31526	1750	1406	18989	29785	1740	1271	17020	26281	1730
	10	1702	23107	37664	1710	1499	20090	32076	1690	1432	19104	30341	1680	1297	17159	26822	1670
	20	1727	23284	38333	1660	1525	20286	32720	1630	1457	19305	30976	1630	1322	17371	27439	1610
	30	1752	23601	39405	1600	1550	20593	33725	1580	1482	19610	31961	1570	1347	17671	28379	1560
	40	1759	29899	50283	1600	1557	25993	42761	1570	1489	24724	40467	1560	1354	22231	35865	1540
	50	1761	41536	69119	1630	1558	35845	58389	1590	1491	34014	55083	1580	1356	30444	48724	1550
	55	1763	51131	84010	1680	1561	43855	70720	1620	1493	41547	66534	1610	1358	37036	58751	1580
26000	-54	1509	21437	32587	2200	1307	18311	27349	2170	1239	17290	25676	2160	1104	15278	22430	2140
	-30	1580	21167	33222	1980	1378	18220	28072	1950	1310	17256	26420	1940	1175	15355	23224	1930
	-20	1609	21062	33457	1900	1406	18181	28334	1870	1339	17239	26698	1870	1204	15379	23520	1850
	-10	1637	20965	33694	1830	1434	18146	28606	1800	1367	17223	26979	1790	1231	15402	23818	1780
	0	1664	20915	34146	1760	1461	18148	29065	1740	1394	17242	27292	1730	1259	15454	24281	1710
	10	1688	20975	34520	1700	1486	18238	29440	1680	1418	17342	27808	1670	1283	15572	24791	1650
	20	1711	21130	35305	1640	1508	18408	30187	1620	1441	17516	28396	1610	1306	15755	25364	1600
	30	1734	21400	36329	1590	1532	18671	30989	1570	1464	17777	29327	1560	1329	16013	26116	1550
	40	1741	26672	45558	1580	1538	23201	38896	1550	1471	22069	36766	1540	1336	19843	32632	1530
	50	1742	35969	61191	1590	1539	31103	51905	1560	1472	29529	48897	1550	1337	26453	43262	1530
	55	1742	43265	73059	1620	1540	37234	61672	1580	1472	35297	58073	1560	1337	31525	51284	1540

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Weather Conditions

METAR KAPA 030053Z CALM 2SM FG OVC030 00/M10 A29.80

PIREP indicated tops at 10,000 feet.

Examination of the airport and the current weather gives the following conditions for takeoff:

Altimeter setting. . . . . .29.80 IN

Pressure altitude . . . . 6,000 FT

Temperature . . . . .0°C (32°F)

Wind 0

Runway . . . . 10,002 FT

Slope 1.0% . . . . UP

Runway condition . . . . .DRY

Ceiling . . . . 3,000 FT

Visibility . . . . 2 MILES

Anti-ice. . . . . .OFF

Climb requirement . . . . .240 FT/NM TO 6,600 FT

From the Trip Planning section, the Planned Takeoff Weight is 27,775 pounds.

Enter 27,775 pounds in the Takeoff Data Worksheet Planned Takeoff Weight Box.

Limitations

We begin by examining the limitations imposed on takeoff. Our desired takeoff weight of 27,775 pounds cannot exceed the lowest of the weights limited by:

- Maximum certificated takeoff weight
- Climb limit
- Field length limit
- Obstacle clearance limit
- Maximum certificated landing weight

The flow chart on page 8-53 illustrates the steps to follow to determine the maximum allowable takeoff gross weight.

Maximum Certificated Takeoff Weight

As indicated in the table on page 8-57, the maximum certificated takeoff weight is 30,300 pounds.

We will be using the charts and tables for takeoff with flaps 15° and Anti-Ice Systems OFF for the rest of the computations.

Maximum Takeoff Weight - Pounds Permitted by Climb Requirements

ANTI-ICE - OFF **FLAPS - 15°**

ALTITUDE = SEA LEVEL		ALTITUDE = 1000 FEET		ALTITUDE = 2000 FEET		ALTITUDE = 3000 FEET	
TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT
-54 TO 55	30300	-54 TO 52	30300	-54 TO 49	30300	-54 TO 45	30300
				50	30210	48	29570

ALTITUDE = 4000 FEET		ALTITUDE = 5000 FEET		ALTITUDE = 6000 FEET		ALTITUDE = 7000 FEET	
TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT
-54 TO 41	30300	-54 TO 36	30300	-54 TO 32	30300	-54 TO 27	30300
45	29200	40	29400	35	29600	30	29760
46	28920	44	28270	40	28220	35	28440
				42	27670	40	27110

ALTITUDE = 8000 FEET		ALTITUDE = 9000 FEET		ALTITUDE = 10,000 FEET		ALTITUDE = 11,000 FEET	
TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT
-54 TO 23	30300	-54 TO 19	30300	-54 TO 14	30300	-54 TO 9	30300
25	29910	20	30050	15	30160	10	30210
30	28590	25	28720	20	28860	15	28910
35	27320	30	27460	25	27570	20	27650
38	26550	35	26230	30	26380	25	26440
		36	25990	33	25660	30	25280
						31	25050

ALTITUDE = 12,000 FEET		ALTITUDE = 13,000 FEET		ALTITUDE = 14,000 FEET	
TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT	TEMP DEG. C	MAXIMUM TAKEOFF WEIGHT
-54 TO 5	30300	-54 TO 0	30300	-54 TO -5	30300
10	28960	5	29050	0	29150
15	27700	10	27740	5	27820
20	26480	15	26530	10	26570
25	25330	20	25370	15	25410
29	24430	25	24260	20	24310
		27	23820	25	23220

WHERE CONDITIONS ALLOW FOR 7° OR 15° FLAP SETTING, IT IS DESIRED TO SELECT THE FLAP SETTING WHICH GIVES THE SHORTER TAKEOFF FIELD LENGTH.

Performance Worksheet

PERFORMANCE WORKSHEET		TAKEOFF DATA
ALTIMETER SETTING : 29.80 in PRESSURE ALTITUDE : 6,000 ft TEMPERATURE : 0°C WIND : CALM kts	RUNWAY : 10,002 ft. SLOPE : 1.0 % CONDITION DRY / WET ANTI-ICE: OFF / ON	CLIMB REQUIREMENTS: 240 ft/NM to 6,600 ft
PLANNED TAKEOFF WEIGHT		
LIMITATIONS	FLAPS 15°	FLAPS 7°
MAX T.O. WEIGHT	30,300 LBS	
CLIMB	30,300 lbs	
RUNWAY (DRY)		
RUNWAY(WET)		
OBSTACLE		
RUNWAY REQ. (DRY)	ft	ft
RUNWAY REQ. (WET)	ft	ft
SPEEDS		
V_1(DRY)	kts	kts
V_1(WET)	kts	kts
V_R	kts	kts
V_2	kts	kts
V_{ENR}	kts	kts
OTHER		
TAKEOFF N_1	N_1	
2nd SEG GRADIENT	%	%

Climb Limit

To determine the climb limit, refer to the Maximum Take-off Weight Permitted by Climb Requirements – flaps - 15° Anti-ice Systems OFF because of the ambient conditions.

1. Scan the chart for the appropriate pressure altitude of 6,000 feet
2. Find the corresponding temperature range for the current temperature of 0°C (32°F)
3. Move across to the Maximum Takeoff Weight of 30,300 pounds

The maximum weight equals the maximum takeoff weight.

Enter 30,300 pounds in the Takeoff Data Worksheet CLIMB box.

Note that this does not take into account the minimum climb gradient required by the departure procedure; this is the maximum takeoff weight based upon minimum second segment climb gradient requirements (WAT limiting). We will discuss the obstacle clearance requirement separately.

Field Length Limit

The AFM contains takeoff field length charts for both dry and wet runways. When takeoff is performed on a wet runway, both must be consulted. Because of the 15 feet screen height used in the wet runway charts, there are situations where the wet runway takeoff field length is less than the dry runway takeoff field length for the same takeoff weight. Therefore both distances must be determined and the longer of the two must be used as the minimum runway required.

Each set of charts (dry, wet, anti-ice on, off) contains a separate chart for each 1,000 foot pressure altitude from sea level (0 feet) to 14,000 feet. Be careful to use the chart for the appropriate conditions.

Each set of charts begins with a Takeoff Corrections Graph. First determine takeoff field length and V speeds from the proper pressure altitude chart and correct V_1 and takeoff field length for runway gradient. If the required distance is greater than the available distance, the airplane weight must be reduced.

In order to determine the maximum takeoff weight for Denver Centennial, the same charts as determining required takeoff distance are used. To save time we will only determine the required takeoff distance at our proposed takeoff weight. If runway required is equal to or less than runway available, then no further adjustments need to be made.

Takeoff Field Length

TAKEOFF FIELD LENGTH - FEET

(OVER 35 FOOT SCREEN HEIGHT)

FLAPS - 15°
6000 FEET

CONDITIONS: DRY RUNWAY
RUNWAY GRADIENT - ZERO
LANDING GEAR - DOWN
SPEEDBRAKES - RETRACT

ANTI-ICE - OFF
INOPERATIVE ENGINE - WINDMILLING AFTER V1
OPERATIVE ENGINE - TAKEOFF THRUST

SOME CONDITIONS DO NOT MEET CLIMB REQUIREMENTS. OBTAIN ALLOWABLE WEIGHT FROM MAXIMUM TAKEOFF WEIGHT TABLES.

WEIGHT = 30300 LBS — VENR = 180 KIAS

TEMP DEG C	TAILWIND 10 KTS V1 KIAS	TAILWIND 10 KTS DIST FT	ZERO WIND V1 KIAS	ZERO WIND DIST FT	HEADWINDS 10 KTS V1 KIAS	HEADWINDS 10 KTS DIST FT	HEADWINDS 20 KTS V1 KIAS	HEADWINDS 20 KTS DIST FT	HEADWINDS 30 KTS V1 KIAS	HEADWINDS 30 KTS DIST FT	VR KIAS	V2 KIAS
-40	109	4680	106	3650	106	3440	107	3230	107	3020	109	115
-35	109	4760	106	3720	106	3500	107	3290	107	3080	109	115
-30	109	4830	106	3790	106	3570	106	3350	107	3140	109	115
-25	109	4900	106	3850	106	3630	106	3410	107	3200	109	115
-20	109	4960	106	3920	106	3690	106	3470	107	3260	109	115
-15	109	5060	106	3990	106	3760	106	3540	107	3320	109	115
-10	109	5130	106	4060	106	3830	106	3600	107	3390	109	115
-5	109	5210	106	4120	106	3890	106	3660	107	3450	109	115
0	109	5290	106	4190	106	3960	106	3730	107	3510	109	115
5	109	5380	106	4270	106	4030	106	3800	107	3580	109	115
10	109	5700	106	4480	107	4230	107	3990	107	3760	109	115
15	109	6160	107	4710	108	4450	108	4200	108	3950	109	114
20	109	6750	109	5010	109	4730	109	4470	109	4220	109	114
25	110	7470	110	5410	110	5140	110	4880	110	4630	110	113
30	110	8370	110	5960	110	5690	110	5400	110	5120	110	113
32	110	8800	110	6240	110	5940	110	5640	110	5350	110	113
33	110	9040	110	6380	110	6080	110	5780	110	5480	110	113

WEIGHT = 30000 LBS — VENR = 180 KIAS

TEMP DEG C	TAILWIND 10 KTS V1 KIAS	TAILWIND 10 KTS DIST FT	ZERO WIND V1 KIAS	ZERO WIND DIST FT	HEADWINDS 10 KTS V1 KIAS	HEADWINDS 10 KTS DIST FT	HEADWINDS 20 KTS V1 KIAS	HEADWINDS 20 KTS DIST FT	HEADWINDS 30 KTS V1 KIAS	HEADWINDS 30 KTS DIST FT	VR KIAS	V2 KIAS
-35	108	4680	105	3670	106	3450	106	3240	106	3030	109	115
-30	108	4760	105	3730	106	3510	106	3300	106	3090	109	115
-25	108	4830	105	3800	105	3580	106	3360	106	3150	109	115
-20	108	4900	105	3860	105	3640	106	3420	106	3210	109	115
-15	108	4980	105	3930	105	3700	106	3480	106	3270	109	115
-10	108	5060	105	4000	105	3770	106	3550	106	3330	109	115
-5	108	5130	105	4060	105	3830	106	3610	106	3390	109	115
0	108	5210	105	4130	105	3900	106	3670	106	3450	109	115
5	108	5300	105	4210	105	3970	106	3740	106	3520	109	115
10	109	5580	106	4410	106	4170	106	3930	107	3700	109	114
15	108	6030	107	4640	107	4380	107	4130	107	3890	108	113
20	109	6580	108	4910	108	4650	108	4380	109	4130	109	113
25	109	7270	109	5280	109	5010	109	4760	109	4500	109	113
30	109	8120	109	5810	109	5530	109	5250	109	4980	109	113
33	110	8750	110	6200	110	5900	110	5600	110	5320	110	113
35	110	9250	110	6500	110	6190	110	5880	110	5580	110	113
37	110	9830	110	6840	110	6520	110	6200	110	5890	110	113

WEIGHT = 29000 LBS — VENR = 180 KIAS

TEMP DEG C	TAILWIND 10 KTS V1 KIAS	TAILWIND 10 KTS DIST FT	ZERO WIND V1 KIAS	ZERO WIND DIST FT	HEADWINDS 10 KTS V1 KIAS	HEADWINDS 10 KTS DIST FT	HEADWINDS 20 KTS V1 KIAS	HEADWINDS 20 KTS DIST FT	HEADWINDS 30 KTS V1 KIAS	HEADWINDS 30 KTS DIST FT	VR KIAS	V2 KIAS
-35	106	4450	103	3480	103	3280	104	3070	104	2880	107	114
-30	106	4520	103	3550	103	3340	104	3130	104	2930	107	114
-25	106	4590	103	3610	103	3400	104	3190	104	2990	107	114
-20	106	4660	103	3670	103	3450	104	3250	104	3050	107	114
-15	106	4730	103	3730	103	3520	104	3310	104	3100	107	114
-10	106	4800	103	3800	103	3580	103	3370	104	3160	107	114
-5	106	4870	103	3860	103	3640	103	3430	104	3220	107	114
0	106	4950	103	3920	103	3700	103	3480	104	3280	107	114
5	106	5030	103	3990	103	3770	103	3550	104	3340	107	114
10	107	5280	104	4180	104	3950	104	3720	105	3500	107	113
15	107	5620	104	4390	105	4150	105	3910	105	3670	107	112
20	107	6060	105	4610	105	4350	106	4100	106	3860	107	111
25	107	6650	107	4900	107	4630	107	4370	107	4130	107	111
30	107	7360	107	5310	107	5050	107	4790	107	4530	107	111
35	108	8270	108	5880	108	5590	108	5310	108	5030	108	111
37	108	8730	108	6160	108	5860	108	5560	108	5280	108	111
40	108	9550	108	6650	108	6330	108	6020	108	5710	108	111

WEIGHT = 28000 LBS — VENR = 180 KIAS

TEMP DEG C	TAILWIND 10 KTS V1 KIAS	TAILWIND 10 KTS DIST FT	ZERO WIND V1 KIAS	ZERO WIND DIST FT	HEADWINDS 10 KTS V1 KIAS	HEADWINDS 10 KTS DIST FT	HEADWINDS 20 KTS V1 KIAS	HEADWINDS 20 KTS DIST FT	HEADWINDS 30 KTS V1 KIAS	HEADWINDS 30 KTS DIST FT	VR KIAS	V2 KIAS
-35	104	4230	102	3360	102	3140	102	2930	102	2730	106	112
-30	103	4290	102	3430	102	3200	102	2990	102	2780	106	112
-25	103	4360	102	3490	102	3260	102	3040	102	2830	106	112
-20	103	4430	102	3550	102	3320	102	3100	102	2890	106	112
-15	103	4490	102	3620	102	3380	102	3160	102	2940	106	112
-10	103	4560	102	3680	102	3440	102	3220	102	3000	106	112
-5	103	4630	102	3740	102	3500	102	3270	102	3050	106	112
0	103	4690	102	3800	102	3560	102	3330	102	3110	106	112
5	103	4770	101	3860	101	3620	101	3380	102	3170	106	112
10	104	5000	101	3970	102	3740	102	3520	102	3310	106	112
15	105	5250	102	4160	102	3920	103	3690	103	3470	105	111
20	105	5630	103	4360	103	4110	103	3870	104	3640	105	110
25	105	6090	104	4580	104	4330	104	4080	105	3840	105	109
30	105	6700	105	4880	105	4620	105	4380	105	4140	105	109
35	106	7440	106	5340	106	5080	106	4820	106	4560	106	109
40	106	8460	106	5970	106	5680	106	5390	106	5100	106	109
42	106	8980	106	6280	106	5970	106	5670	106	5380	106	109

WEIGHT = 27000 LBS — VENR = 180 KIAS

TEMP DEG C	TAILWIND 10 KTS V1 KIAS	TAILWIND 10 KTS DIST FT	ZERO WIND V1 KIAS	ZERO WIND DIST FT	HEADWINDS 10 KTS V1 KIAS	HEADWINDS 10 KTS DIST FT	HEADWINDS 20 KTS V1 KIAS	HEADWINDS 20 KTS DIST FT	HEADWINDS 30 KTS V1 KIAS	HEADWINDS 30 KTS DIST FT	VR KIAS	V2 KIAS
-35	102	4050	102	3340	102	3120	102	2910	102	2700	104	111
-30	102	4120	102	3400	102	3180	102	2970	102	2760	104	111
-25	102	4190	102	3460	102	3230	102	3020	102	2810	104	111
-20	102	4250	102	3520	102	3290	102	3070	102	2860	104	111
-15	102	4320	102	3590	102	3360	102	3140	102	2920	104	111
-10	102	4390	102	3650	102	3420	102	3190	102	2980	104	111
-5	102	4460	102	3710	102	3470	102	3250	102	3030	104	111
0	102	4530	102	3770	102	3530	102	3300	102	3090	104	111
5	102	4590	102	3820	102	3590	102	3360	102	3140	104	111
10	102	4740	99	3770	99	3540	100	3330	100	3130	104	110
15	103	4970	100	3930	100	3710	100	3490	101	3280	104	109
20	104	5220	101	4110	101	3880	101	3650	101	3440	104	109
25	103	5630	101	4310	102	4070	102	3830	102	3600	103	108
30	103	6110	102	4550	103	4290	103	4050	103	3800	103	107
35	104	6730	104	4880	104	4620	104	4380	104	4140	104	107
40	104	7550	104	5390	104	5120	104	4850	104	4590	104	107
42	104	7960	104	5640	104	5360	104	5080	104	4810	104	107

WEIGHT = 26000 LBS — VENR = 180 KIAS

TEMP DEG C	TAILWIND 10 KTS V1 KIAS	TAILWIND 10 KTS DIST FT	ZERO WIND V1 KIAS	ZERO WIND DIST FT	HEADWINDS 10 KTS V1 KIAS	HEADWINDS 10 KTS DIST FT	HEADWINDS 20 KTS V1 KIAS	HEADWINDS 20 KTS DIST FT	HEADWINDS 30 KTS V1 KIAS	HEADWINDS 30 KTS DIST FT	VR KIAS	V2 KIAS
-35	102	4010	102	3310	102	3100	102	2890	102	2690	103	110
-30	102	4080	102	3380	102	3160	102	2950	102	2740	103	110
-25	102	4150	102	3440	102	3220	102	3000	102	2800	103	110
-20	102	4220	102	3490	102	3270	102	3050	102	2850	103	110
-15	102	4280	102	3560	102	3330	102	3120	102	2910	103	110
-10	102	4350	102	3620	102	3390	102	3170	102	2960	103	110
-5	102	4420	102	3680	102	3450	102	3230	102	3020	103	110
0	102	4480	102	3740	102	3510	102	3280	102	3070	103	110
5	102	4550	102	3790	102	3560	102	3330	102	3110	103	110
10	99	4490	99	3740	99	3500	99	3280	99	3060	103	109
15	100	4690	97	3720	98	3500	98	3290	98	3090	102	108
20	101	4910	98	3880	99	3660	99	3440	99	3230	102	107
25	102	5200	99	4060	99	3830	100	3610	100	3390	102	107
30	101	5610	100	4270	100	4020	100	3780	101	3550	101	106
35	102	6110	101	4510	101	4250	101	4000	102	3770	102	105
40	102	6780	102	4890	102	4630	102	4390	102	4150	102	105
42	102	7110	102	5090	102	4830	102	4570	102	4320	102	105

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Takeoff Field Length - Feet, With Flaps 15°

(DRY RUNWAY OVER A 35 FOOT SCREEN HEIGHT)

(ANTI-ICE OFF)

Determine takeoff field length, V_1, V_R, V_2 and V_{ENR} from the appropriate chart. If the runway has a gradient, adjust V_1 and takeoff field length using the chart below.

If the required distance is greater than the available distance, the airplane weight must be reduced until distance required is less than or equal to distance available.

TAKEOFF FIELD LENGTH AND V_1 ADJUSTED FOR RUNWAY GRADIENT - FLAPS 15°, ANTI-ICE - OFF

TAKEOFF FIELD LENGTH (ZERO GRADIENT)	UPHILL GRADIENT FOR BOTH SHADED AND NON-SHADED				DOWNHILL GRADIENT SHADED		DOWNHILL GRADIENT NON-SHADED	
	2%	1.5%	1%	0.5%	-1%	-2%	-1%	-2%
2000	2300	2200	2150	2100	1950	1900	2100	2100
2200	2500	2400	2350	2300	2150	2100	2300	2300
2400	2750	2650	2550	2500	2350	2300	2500	2500
2600	3100	2900	2800	2700	2550	2500	2700	2700
2800	3450	3200	3050	2950	2750	2700	2900	2900
3000	3800	3550	3350	3150	2950	2900	3100	3150
3200	4250	3900	3650	3400	3150	3100	3300	3350
3400	4700	4250	3900	3650	3350	3300	3500	3550
3600	5200	4550	4200	3850	3550	3500	3700	3750
3800	5650	4900	4450	4100	3750	3650	3900	3950
4000	6150	5300	4750	4350	3950	3850	4100	4150
4200	6800	5750	5050	4600	4150	4050	4300	4350
4400	7550	6200	5400	4850	4350	4250	4550	4550
4600	8500	6700	5700	5100	4550	4400	4750	4750
4800	9500	7200	6050	5350	4700	4550	4950	4950
5000	10850	7800	6400	5600	4850	4750	5150	5150
5200	12650	8500	6800	5850	5050	4900	5350	5350
5400	15050	9150	7150	6100	5250	5050	5500	5500
5600		9800	7550	6350	5450	5250	5700	5700
5800		10450	7900	6600	5600	5400	5900	5900
6000		11050	8250	6850	5800	5600	6100	6100
6200		11700	8600	7100	5950	5750	6300	6250
6400		12350	8950	7350	6100	5900	6450	6450
6600		12950	9300	7600	6200	6050	6650	6650
6800		13600	9650	7800	6350	6150	6850	6850
7000		14350	9950	8050	6500	6300	7050	7050
7200		15100	10300	8300	6650	6400	7200	7200
7400			10650	8550	6800	6550	7400	7400
7600			11000	8800	6950	6650	7600	7550
7800			11350	9050	7100	6800	7750	7700
8000			11750	9300	7250	6950	7900	7850
8500			12750	9950	7650	7250	8350	8250
9000			13800	10600	8000	7550	8750	8650
9500			15000	11250	8350	7850	9150	9050
10000				11950	8700	8100	9550	9450
10500				12600	9000	8350	9900	9800
11000				13250	9300	8650	10250	10150
11500				13900	9600	8900	10600	10450
12000				14550	9900	9150	10900	10750
12500				15200	10200	9350	11150	11000
13000					10500	9600	11450	11250
13500					10800	9800	11700	11450
14000					11100	10000	11900	11650
14500					11400	10200	12100	11850
15000					11700	10400	12300	12050
V_1 ADJUSTMENT*	V_1 + 4 Knots	V_1 + 3 Knots	V_1 + 2 Knots	V_1 + 1 Knot	V_1 - 2 Knots	V_1 - 4 Knots	V_1 + 1 Knot	V_1 + 1 Knot

* If the adjusted V_1 is greater than V_R, the value of V_R must be used for V_1.

Performance Worksheet

PERFORMANCE WORKSHEET		TAKEOFF DATA
ALTIMETER SETTING : 29.80 in PRESSURE ALTITUDE : 6,000 ft TEMPERATURE : 0°C WIND : CALM kts	RUNWAY : 10,002 ft. SLOPE : 1.0 % CONDITION DRY / WET ANTI-ICE: OFF / ON	CLIMB REQUIREMENTS: 240 ft/NM to 6,600 ft
PLANNED TAKEOFF WEIGHT		
LIMITATIONS	FLAPS 15°	FLAPS 7°
MAX T.O. WEIGHT	30,300 LBS	
CLIMB	30,300 lbs	
RUNWAY (DRY)	30,300 lbs	
RUNWAY(WET)		
OBSTACLE		
RUNWAY REQ. (DRY)	4,450 ft	ft
RUNWAY REQ. (WET)	ft	ft
SPEEDS		
V_1(DRY)	kts	kts
V_1(WET)	kts	kts
V_R	kts	kts
V_2	kts	kts
V_{ENR}	kts	kts
OTHER		
TAKEOFF N_1	N_1	
2^{nd} SEG GRADIENT	%	%

Takeoff Field Length - Dry runway, anti-ice OFF, flaps - 15° altitude 6,000 feet:

1. Our planned takeoff weight is 27,775 pounds. The sub charts are broken into even thousands. We will round up to the nearest thousand. This puts us in the 28,000 pounds sub chart.
2. Start with the left side (temperature) and go down to the ambient temperature (0°C).
3. Move across to the right until you are in the correct wind column of zero wind.
4. The two numbers located here are the uncorrected V_1 and Takeoff Field Length. These are 102 KIAS and 3,800 feet respectively.

Continue across to the far right and the two numbers here are V_R and V_2. These are 106 KIAS and 112 KIAS respectively.

Takeoff Corrections – flaps - 15°

Recall that the departure runway at Denver Centennial had a 1% uphill slope. We must correct V_1 and Takeoff Field Length for that slope. Start with the small table at the top to adjust V_1. According to the table for 1% uphill and Non-shaded V_1 we will correct V_1 to V_1 + 2. Using the same table, we determine the corrected Takeoff Field Length to be 4,450 feet. Referencing the data for a weight of 30,300 pounds, we see that aircraft weight is not limiting for this runway length.

Enter 4,450 feet in the Takeoff Data Worksheet RUNWAY REQ. (DRY) Box and 30,300 pounds in the RUNWAY (DRY) FLAPS 15° Box.

Second Segment Takeoff Net Climb - Percent Flaps 15 °

FLAPS - 15°

CONDITIONS: ANTI-ICE - OFF
LANDING GEAR - UP
AIRSPEED - V2
SPEEDBRAKES - RETRACT
INOPERATIVE ENGINE - WINDMILLING
OPERATIVE ENGINE - TAKEOFF THRUST

ALT	TEMP	WEIGHT - POUNDS																								
	DEG	30300					29000					28000					27000					26000				
FT	C	WIND KNOTS					WIND KNOTS					WIND KNOTS					WIND KNOTS					WIND KNOTS				
		-10	0	10	20	30	-10	0	10	20	30	-10	0	10	20	30	-10	0	10	20	30	-10	0	10	20	30
4000	-30	4.6	5.3	5.6	5.9	6.3	5.3	6.1	6.5	6.8	7.2	5.9	6.8	7.1	7.5	8.0	6.5	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-25	4.6	5.3	5.6	5.9	6.3	5.3	6.1	6.5	6.8	7.2	5.9	6.8	7.2	7.5	8.0	6.5	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-20	4.7	5.4	5.6	5.9	6.3	5.3	6.1	6.5	6.8	7.2	5.9	6.8	7.2	7.5	8.0	6.5	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-15	4.7	5.4	5.6	5.9	6.3	5.4	6.2	6.5	6.8	7.2	5.9	6.8	7.2	7.5	8.0	6.5	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-10	4.7	5.4	5.6	5.9	6.3	5.4	6.2	6.5	6.8	7.2	5.9	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-5	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	0	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.1	6.0	6.8	7.1	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.2	8.3	8.7	9.1	9.6
	5	4.7	5.3	5.6	5.9	6.2	5.4	6.1	6.4	6.8	7.1	5.9	6.8	7.1	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.2	8.3	8.7	9.1	9.6
	10	4.7	5.3	5.6	5.9	6.2	5.4	6.1	6.4	6.7	7.1	5.9	6.8	7.1	7.5	7.9	6.6	7.5	7.8	8.2	8.7	7.2	8.2	8.6	9.1	9.6
	15	4.5	5.2	5.4	5.7	6.0	5.2	5.9	6.2	6.5	6.9	5.8	6.6	6.9	7.3	7.6	6.4	7.3	7.6	8.0	8.4	7.0	8.0	8.4	8.8	9.3
	20	3.9	4.4	4.6	4.9	5.1	4.5	5.2	5.4	5.7	6.0	5.1	5.8	6.1	6.4	6.7	5.6	6.4	6.8	7.1	7.5	6.3	7.2	7.5	7.9	8.3
	25	3.2	3.7	3.9	4.1	4.3	3.8	4.4	4.6	4.9	5.1	4.4	5.0	5.2	5.5	5.8	4.9	5.6	5.9	6.2	6.5	5.5	6.3	6.6	7.0	7.3
	30	2.6	3.0	3.2	3.3	3.5	3.2	3.7	3.9	4.1	4.3	3.7	4.2	4.5	4.7	4.9	4.2	4.9	5.1	5.4	5.7	4.8	5.5	5.8	6.1	6.4
	35	2.0	2.4	2.5	2.6	2.8	2.6	3.0	3.2	3.3	3.5	3.1	3.5	3.7	3.9	4.1	3.6	4.1	4.3	4.6	4.8	4.1	4.7	5.0	5.2	5.5
	40	1.5	1.7	1.8	2.0	2.1	2.0	2.3	2.5	2.6	2.8	2.5	2.8	3.0	3.2	3.4	2.9	3.4	3.6	3.8	4.0	3.4	4.0	4.2	4.4	4.7
	45	0.9	1.1	1.2	1.3	1.4	1.4	1.7	1.8	1.9	2.0	1.9	2.2	2.3	2.4	2.6	2.3	2.7	2.8	3.0	3.2	2.8	3.2	3.4	3.6	3.8
	46	0.8	1.0	1.1	1.1	1.2	1.3	1.6	1.7	1.8	1.9	1.7	2.0	2.2	2.3	2.4	2.2	2.5	2.7	2.8	3.0	2.7	3.1	3.3	3.4	3.6
5000	-35	4.6	5.3	5.6	5.9	6.3	5.3	6.1	6.5	6.8	7.2	5.9	6.8	7.1	7.5	8.0	6.5	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-30	4.7	5.4	5.6	5.9	6.3	5.3	6.1	6.5	6.8	7.2	5.9	6.8	7.2	7.5	8.0	6.5	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-25	4.7	5.4	5.6	5.9	6.3	5.4	6.2	6.5	6.8	7.2	5.9	6.8	7.2	7.5	8.0	6.6	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-20	4.7	5.4	5.6	5.9	6.3	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	8.0	6.6	7.5	7.9	8.3	8.8	7.2	8.3	8.7	9.2	9.7
	-15	4.7	5.4	5.7	5.9	6.3	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	8.0	6.6	7.5	7.9	8.3	8.8	7.3	8.3	8.7	9.2	9.7
	-10	4.7	5.4	5.7	5.9	6.3	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.6	8.0	6.6	7.6	7.9	8.3	8.8	7.3	8.3	8.7	9.2	9.7
	-5	4.7	5.4	5.7	5.9	6.3	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	7.9	6.6	7.6	7.9	8.3	8.8	7.3	8.3	8.7	9.2	9.7
	0	4.7	5.4	5.7	5.9	6.2	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.8	7.3	8.3	8.7	9.2	9.6
	5	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.1	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.3	8.3	8.7	9.1	9.6
	10	4.6	5.2	5.5	5.8	6.1	5.3	6.0	6.3	6.6	7.0	5.9	6.7	7.0	7.3	7.7	6.5	7.4	7.7	8.1	8.5	7.1	8.1	8.5	8.9	9.4
	15	3.9	4.5	4.7	4.9	5.2	4.6	5.2	5.5	5.8	6.1	5.1	5.9	6.1	6.4	6.8	5.7	6.5	6.8	7.2	7.6	6.3	7.2	7.6	8.0	8.4
	20	3.3	3.8	3.9	4.1	4.4	3.9	4.5	4.7	4.9	5.2	4.4	5.1	5.3	5.6	5.9	5.0	5.7	6.0	6.3	6.6	5.6	6.4	6.7	7.1	7.4
	25	2.7	3.1	3.2	3.4	3.6	3.3	3.7	3.9	4.1	4.4	3.8	4.3	4.5	4.8	5.0	4.3	4.9	5.2	5.4	5.7	4.9	5.6	5.9	6.2	6.5
	30	2.1	2.4	2.6	2.7	2.9	2.7	3.1	3.2	3.4	3.6	3.1	3.6	3.8	4.0	4.2	3.6	4.2	4.4	4.6	4.9	4.2	4.8	5.1	5.3	5.6
	35	1.5	1.8	1.9	2.0	2.2	2.1	2.4	2.6	2.7	2.9	2.5	2.9	3.1	3.3	3.4	3.0	3.5	3.7	3.9	4.1	3.5	4.1	4.3	4.5	4.8
	40	1.0	1.2	1.3	1.4	1.5	1.5	1.8	1.9	2.0	2.1	1.9	2.3	2.4	2.5	2.7	2.4	2.8	2.9	3.1	3.3	2.9	3.3	3.5	3.7	3.9
	44	0.6	0.7	0.8	0.8	0.9	1.1	1.3	1.4	1.4	1.5	1.5	1.7	1.8	1.9	2.1	1.9	2.2	2.4	2.5	2.6	2.4	2.8	2.9	3.1	3.3
6000	-35	4.6	5.3	5.6	5.9	6.2	5.3	6.1	6.4	6.8	7.1	5.9	6.8	7.1	7.5	7.9	6.5	7.5	7.9	8.3	8.7	7.2	8.2	8.7	9.1	9.6
	-30	4.7	5.3	5.6	5.9	6.2	5.3	6.1	6.4	6.8	7.2	5.9	6.8	7.1	7.5	7.9	6.5	7.5	7.9	8.3	8.7	7.2	8.3	8.7	9.1	9.6
	-25	4.7	5.4	5.6	5.9	6.2	5.4	6.1	6.5	6.8	7.2	5.9	6.8	7.1	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.2	8.3	8.7	9.1	9.6
	-20	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.2	8.3	8.7	9.1	9.6
	-15	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.3	8.3	8.7	9.1	9.6
	-10	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.2	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.3	8.3	8.7	9.1	9.6
	-5	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.1	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.3	8.3	8.7	9.1	9.6
	0	4.7	5.4	5.6	5.9	6.2	5.4	6.2	6.5	6.8	7.1	6.0	6.8	7.2	7.5	7.9	6.6	7.5	7.9	8.3	8.7	7.3	8.3	8.7	9.1	9.6
	5	4.7	5.3	5.6	5.8	6.1	5.4	6.1	6.4	6.7	7.1	6.0	6.8	7.1	7.4	7.8	6.6	7.5	7.8	8.2	8.6	7.2	8.2	8.6	9.0	9.5
	10	4.0	4.6	4.8	5.0	5.3	4.7	5.3	5.6	5.9	6.2	5.2	6.0	6.2	6.5	6.9	5.8	6.6	6.9	7.3	7.7	6.5	7.4	7.7	8.1	8.5
	15	3.3	3.8	4.0	4.2	4.5	4.0	4.6	4.8	5.0	5.3	4.5	5.2	5.4	5.7	6.0	5.1	5.8	6.1	6.4	6.7	5.7	6.5	6.8	7.1	7.5
	20	2.7	3.2	3.3	3.5	3.7	3.3	3.8	4.0	4.2	4.5	3.8	4.4	4.6	4.9	5.1	4.4	5.0	5.3	5.5	5.8	5.0	5.7	6.0	6.3	6.6
	25	2.2	2.5	2.6	2.8	2.9	2.7	3.1	3.3	3.5	3.7	3.2	3.7	3.9	4.1	4.3	3.7	4.3	4.5	4.7	5.0	4.3	4.9	5.1	5.4	5.7
	30	1.6	1.9	2.0	2.1	2.2	2.2	2.5	2.6	2.8	2.9	2.6	3.0	3.2	3.3	3.5	3.1	3.6	3.7	3.9	4.2	3.6	4.2	4.4	4.6	4.9
	35	1.1	1.3	1.4	1.5	1.6	1.6	1.9	2.0	2.1	2.2	2.0	2.4	2.5	2.6	2.8	2.5	2.9	3.0	3.2	3.4	3.0	3.4	3.6	3.8	4.0
	40	0.5	0.7	0.8	0.8	0.9	1.0	1.2	1.3	1.4	1.5	1.4	1.7	1.8	1.9	2.0	1.9	2.2	2.3	2.5	2.6	2.4	2.7	2.9	3.0	3.2
	42	0.3	0.5	0.5	0.6	0.6	0.8	1.0	1.1	1.1	1.2	1.2	1.4	1.5	1.6	1.7	1.6	1.9	2.0	2.2	2.3	2.1	2.5	2.6	2.7	2.9
7000	-40	4.6	5.3	5.5	5.8	6.2	5.3	6.1	6.4	6.7	7.1	5.9	6.7	7.1	7.4	7.8	6.5	7.4	7.8	8.2	8.7	7.1	8.2	8.6	9.0	9.6
	-35	4.6	5.3	5.6	5.8	6.2	5.3	6.1	6.4	6.7	7.1	5.9	6.7	7.1	7.4	7.8	6.5	7.4	7.8	8.2	8.7	7.1	8.2	8.6	9.1	9.6
	-30	4.6	5.3	5.6	5.8	6.2	5.3	6.1	6.4	6.7	7.1	5.9	6.7	7.1	7.4	7.8	6.5	7.4	7.8	8.2	8.7	7.2	8.2	8.6	9.1	9.6
	-25	4.7	5.3	5.6	5.9	6.2	5.3	6.1	6.4	6.7	7.1	5.9	6.8	7.1	7.5	7.9	6.5	7.5	7.8	8.2	8.7	7.2	8.2	8.6	9.1	9.6
	-20	4.7	5.3	5.6	5.9	6.2	5.4	6.1	6.4	6.7	7.1	5.9	6.8	7.1	7.5	7.9	6.6	7.5	7.8	8.2	8.7	7.2	8.2	8.6	9.1	9.6
	-15	4.7	5.3	5.6	5.9	6.2	5.4	6.1	6.4	6.7	7.1	6.0	6.8	7.1	7.5	7.9	6.6	7.5	7.8	8.2	8.7	7.2	8.3	8.6	9.1	9.6
	-10	4.7	5.3	5.6	5.9	6.2	5.4	6.1	6.4	6.7	7.1	6.0	6.8	7.1	7.5	7.8	6.6	7.5	7.9	8.2	8.7	7.3	8.3	8.7	9.1	9.6
	-5	4.7	5.4	5.6	5.9	6.2	5.4	6.1	6.4	6.7	7.1	6.0	6.8	7.1	7.5	7.8	6.6	7.5	7.9	8.2	8.7	7.3	8.3	8.7	9.1	9.5
	0	4.7	5.3	5.6	5.9	6.1	5.4	6.1	6.4	6.7	7.1	6.0	6.8	7.1	7.4	7.8	6.6	7.5	7.8	8.2	8.6	7.3	8.2	8.6	9.1	9.5
	5	4.1	4.7	4.9	5.2	5.4	4.8	5.5	5.7	6.0	6.3	5.3	6.1	6.4	6.7	7.0	5.9	6.8	7.1	7.4	7.8	6.6	7.5	7.8	8.2	8.6
	10	3.4	3.9	4.1	4.3	4.5	4.1	4.6	4.9	5.1	5.4	4.6	5.2	5.5	5.8	6.1	5.2	5.9	6.2	6.5	6.8	5.8	6.6	6.9	7.2	7.6
	15	2.8	3.2	3.4	3.6	3.7	3.4	3.9	4.1	4.3	4.5	3.9	4.5	4.7	4.9	5.2	4.5	5.1	5.3	5.6	5.9	5.0	5.8	6.0	6.3	6.7
	20	2.2	2.6	2.7	2.9	3.0	2.8	3.2	3.4	3.6	3.7	3.3	3.8	3.9	4.1	4.4	3.8	4.3	4.6	4.8	5.1	4.4	5.0	5.2	5.5	5.8
	25	1.7	2.0	2.1	2.2	2.3	2.2	2.6	2.7	2.8	3.0	2.7	3.1	3.2	3.4	3.6	3.2	3.6	3.8	4.0	4.2	3.7	4.2	4.4	4.7	4.9
	30	1.1	1.4	1.5	1.5	1.6	1.7	1.9	2.1	2.2	2.3	2.1	2.4	2.6	2.7	2.9	2.6	3.0	3.1	3.3	3.5	3.1	3.5	3.7	3.9	4.1
	35	0.6	0.8	0.9	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.5	1.8	1.9	2.0	2.1	2.0	2.3	2.4	2.6	2.7	2.5	2.8	3.0	3.2	3.3
	40	0.1	0.2	0.3	0.3	0.3	0.6	0.7	0.8	0.9	0.9	1.0	1.2	1.3	1.3	1.4	1.4	1.7	1.8	1.9	2.0	1.9	2.2	2.3	2.4	2.6

68FM-05-00

Performance Worksheet

PERFORMANCE WORKSHEET		TAKEOFF DATA
ALTIMETER SETTING : 29.80 in PRESSURE ALTITUDE : 6,000 ft TEMPERATURE : 0°C WIND : CALM kts	RUNWAY : 10,002 ft. SLOPE : 1.0 % CONDITION DRY / WET ANTI-ICE: OFF / ON	CLIMB REQUIREMENTS: 240 ft/NM to 6,600 ft
PLANNED TAKEOFF WEIGHT		
LIMITATIONS	FLAPS 15°	FLAPS 7°
MAX T.O. WEIGHT	30,300 LBS	
CLIMB	30,300 lbs	
RUNWAY (DRY)	30,300 lbs	
RUNWAY(WET)		
OBSTACLE	30,300 lbs	
RUNWAY REQ. (DRY)	4,450 ft	ft
RUNWAY REQ. (WET)	ft	ft
SPEEDS		
V_1(DRY)	kts	kts
V_1(WET)	kts	kts
V_R	kts	kts
V_2	kts	kts
V_{ENR}	kts	kts
OTHER		
TAKEOFF N_1	N_1	
2nd SEG GRADIENT	6.8 %	%

Obstacle Clearance

Refer back to the airport chart for Centennial Airport. Under the section, “Take-off & Obstacle Departure Procedure” for Runways 17 L/R we see that we can take off with visible reference as low as ¼ mile (for commercial operators) if we can make a minimum climb of 240 feet per nautical mile up to an altitude of 6,600 feet. If we cannot make that climb, the weather must be at least a 600 feet ceiling and 2 miles visibility.

The climb charts we have are in % gradient so we must first convert feet per nautical mile into gradient. Gradient is equal to the height gained divided by the distance traveled (x 100 to put the decimal in the correct position). In this case the height is 240 feet and the distance is 1 nautical mile (about 6,000 feet) [240 ÷ 6,000 x 100 = 4.0%].

Therefore we must be able to make a 4.0% climb gradient up to an altitude of 6,600 feet; a climb of 600 feet from our takeoff pressure altitude of 6,000 feet.

As our weather conditions are better than 600 feet and 2 miles visibility, we do not need to meet the climb gradient. We still must meet the required VFR climb gradient of 1.6%.

Second Segment Takeoff Net Climb Gradient – Percent charts are found in the Citation Sovereign Aircraft Flight Manual Section IV. These charts are broken into groups very similar to the Takeoff Distance charts. This gives us four sets of charts depending on flap setting and anti-ice operation. Altitudes range from sea level (0 feet) up 18,000 feet. It is very important that you reference the correct chart.

Just with the Takeoff Distance charts the Second Segment charts are the same used to determine maximum weight to meet a required climb gradient. Again, to save time we will determine the second segment climb gradient at the proposed takeoff weight. If that gradient is equal to or more than the required climb gradient then no further adjustments will be needed.

Second Segment Takeoff Net Climb Gradient – Percent Flaps – 15°

1. Along the left edge of the chart locate the appropriate Pressure Altitude (6,000 feet). This may require turning some pages.
2. The next column over is the temperature.
3. Finding the current temperature (0°C) move across to the appropriate weight column. As discussed earlier we will round up (28,000 pounds).
4. Within the weight column are wind columns. Locate the appropriate wind column (0).
5. This results in the Climb Gradient for the specified condition. Upon completion of this we find that the climb gradient is 6.8%. Well above the 1.6% needed.

If we would have been required to meet an obstacle clearance climb gradient of greater than 6.8% then we would have had to reduce the takeoff weight, reference the flaps 7° climb gradients, or since the winds are calm choose another runway without a required climb gradient for obstacles. Since we meet the current requirement, no further adjustments are required.

Referencing the appropriate column for a maximum weight of 30,300 pounds, we see that we could meet the required climb gradient even at that weight.

Referencing the appropriate column for a maximum weight of 30,300 pounds, we see that we could meet the required climb gradient even at that weight.

Enter 30,300 pounds in the Takeoff Data Worksheet OBSTACLE BOX and 6.8% in 2nd SEG. GRADIENT box.

Limitations - Conclusion

This completes the takeoff limitations. An examination of the Worksheet to this point reveals that the maximum takeoff weight for the existing conditions is 35,300 pounds with no limiting factors. Fortunately this is greater than our planned takeoff weight, so we can continue without making any other adjustments!

Another point to mention on the subject of limitations is the destination maximum landing weight. Typically, this comes into play when a short trip is being planned and you want to tanker fuel from the departure airport for whatever reason. As this trip is planned close to required trip fuel, destination landing weight is not a concern tonight.

Ensure the Takeoff Performance Worksheet is complete with all the data previously discussed.

Takeoff Speeds

With the takeoff weight and runway requirements established, we proceed to the takeoff speeds. We will determine:

- V_1
- V_R
- V_2
- V_{ENR}

V_1

Although V_1 is defined as the “Takeoff Decision Speed”, this is not completely accurate. Calling it a ‘decision speed’ implies that there is still time to make a Go-No Go decision when V_1 is reached. This is not the case; V_1 is an action speed and is more accurately defined as:

The maximum speed in the takeoff at which the pilot must take the first action to stop the aircraft within the accelerate-stop distance, and the minimum speed in the takeoff, following a failure of the critical engine at VEF, at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance.

V_R and V_2

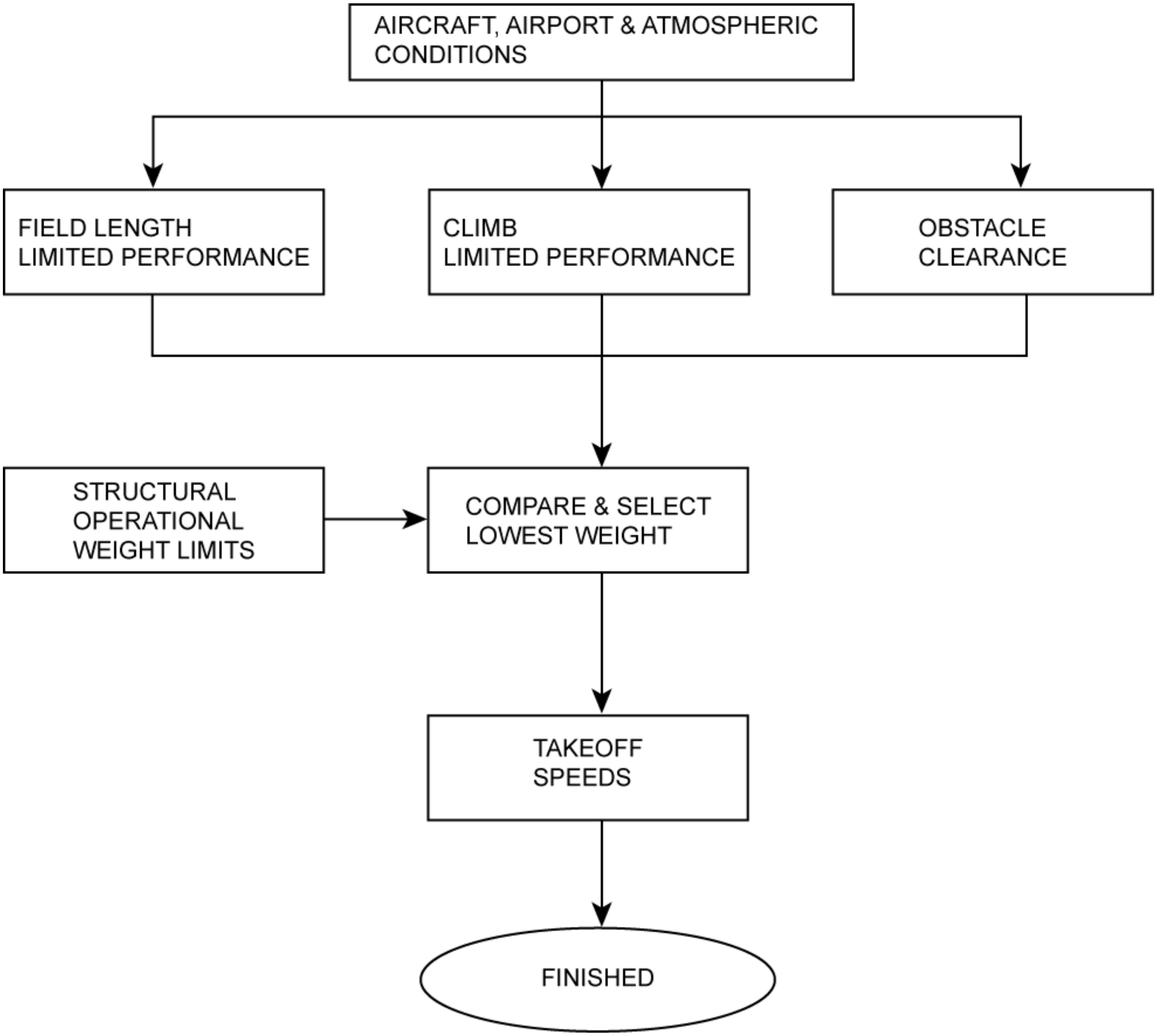
V_R and V_2 are found on the same chart as the **Takeoff Field Length**

- Dry Runway Anti – Ice OFF Flaps - 15° Altitude: 6,000 feet.

Recommended Attitude

The flight director command bars can be positioned to 10° pitch with the pushing of the Go Around button on either throttle.

Takeoff/Go Around Thrust Settings



Performance Worksheet

PERFORMANCE WORKSHEET		TAKEOFF DATA
ALTIMETER SETTING : 29.80 in PRESSURE ALTITUDE : 6,000 ft TEMPERATURE : 0°C WIND : CALM kts	RUNWAY : 10,002 ft. SLOPE : 1.0 % CONDITION DRY / WET ANTI-ICE: OFF / ON	CLIMB REQUIREMENTS: 240 ft/NM to 6,600 ft
PLANNED TAKEOFF WEIGHT		
LIMITATIONS	FLAPS 15°	FLAPS 7°
MAX T.O. WEIGHT	30,300 LBS	
CLIMB	30,300 lbs	
RUNWAY (DRY)	30,300 lbs	
RUNWAY(WET)		
OBSTACLE	30,300 lbs	
RUNWAY REQ. (DRY)	4,450 ft	ft
RUNWAY REQ. (WET)	ft	ft
SPEEDS		
V_1(DRY)	102 kts	kts
V_1(WET)	kts	kts
V_R	106 kts	kts
V_2	112 kts	kts
V_{ENR}	180 kts	kts
OTHER		
TAKEOFF N_1	100.8% N_1	
2nd SEG GRADIENT	6.8 %	%

V_{ENR}

This is also referred to as Enroute Climb Speed – Clean. In the Citation Sovereign, this is a constant speed regardless of aircraft weight, pressure altitude, temperature, or anti-ice systems operation. For the Citation Sovereign this speed is 180 knots.

Since we found no limitations exceeded our planned takeoff weight, the V speeds previously determined can be used for our actual takeoff performance. Don't forget about the correction to V_1 due to the uphill slope.

Enter V_1 as 102 knots, V_R as 106 knots, V_2 as 112 knots, and V_{ENR} as 180 knots into the Performance Worksheet under speeds.

Takeoff N_1

Takeoff Thrust (N_1) is found in two tables in the Citation Sovereign Aircraft Flight Manual, Standard Charts, Section IV: One for Anti-ice systems ON and one for Anti-ice Systems OFF.

Takeoff/Go-Around Thrust Settings – Anti-Ice Systems OFF

1. Starting at the bottom of the chart, locate the appropriate temperature (0°C).
2. Draw a line straight up until it intersects the correct Pressure Altitude reference line (6,000 feet).
3. At that point draw a line across to the left side of the chart to determine the N_1 thrust setting.
4. This indicates 100.8% RPM.

Enter 100.8% on the Performance Worksheet in the TAKEOFF N_1 box.

This completes the other section of the Performance Worksheet, as we have previously determined the 2ND Segment Climb Gradient.

Remember, the FADEC computes and sets takeoff power automatically, so this chart is for reference only.

Landing Performance

The landing performance for the Citation Sovereign is determined in similar manner to the takeoff performance.

For landing, the Citation Sovereign may be limited by:

- Maximum landing weight
- Climb limit
- Field length limit

Refer to the airport chart for Westchester County Airport (KHPN) and the TAF report:

- Elevation - 439 feet
- Runway 34:
    - Length – 6,548 feet

Enter 6,548 feet on the RUNWAY line in the top box on the Performance Worksheet. Also, fill in the remainder of information in the top box.

TAF KHPN 031740Z 031818 33007KT P6SM SCT 100

FM2200 32011KT P6SM SCT050 BKN100

FM0600 33015KT P6SM BKN050

FM1200 34005KT 5SM R- BKN030 TEMP 1416

33015G25KT 1SM TSRA OVC021CB

Review of the airport and the forecast weather gives the following conditions for landing:

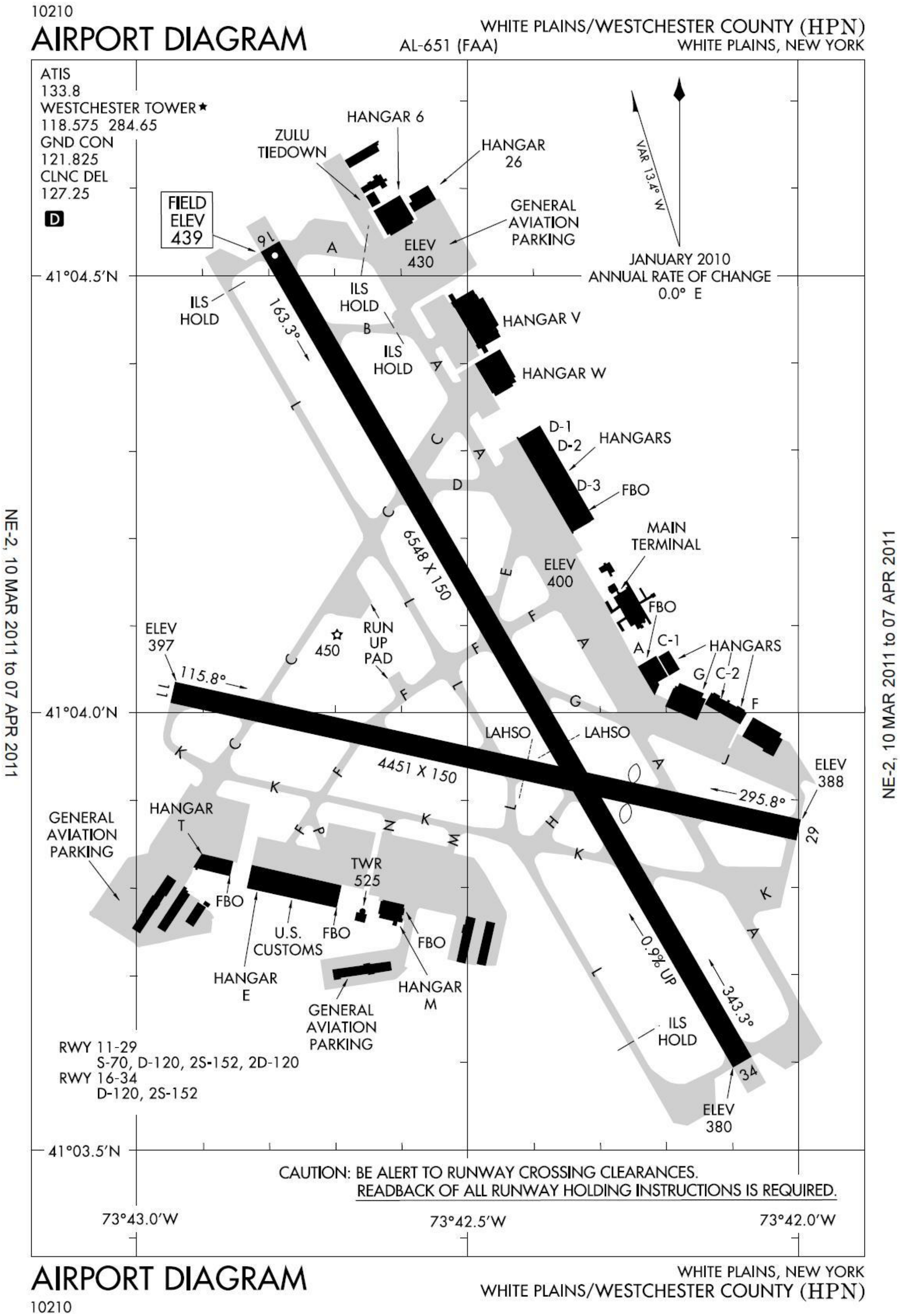
▪ Pressure altitude	round up to 1,000 ft.
▪ Temperature	15°C (59°F)
▪ Wind	330 15 Gusts to 25 Kts
▪ Runway	6,548 ft.
▪ Runway condition	dry/wet (determine both)
▪ Ceiling	2,100 Overcast
▪ Visibility	5 miles
▪ Anti-ice	OFF

Since there is a temporary line in the forecast, we will plan for the worst-case scenario. Also, we will determine both wet and dry runway landing distances.

From the Trip Planning section, the planned landing weight is 23,175 pounds. For ease of use in the charts we will round this to 24,000 pounds. The flap setting used throughout will be Landing with FULL flaps and 15° flaps for approach.

Enter 24,000 pounds in the PLANNED LANDING WEIGHT box on the Performance Worksheet.

Destination Airport Diagram

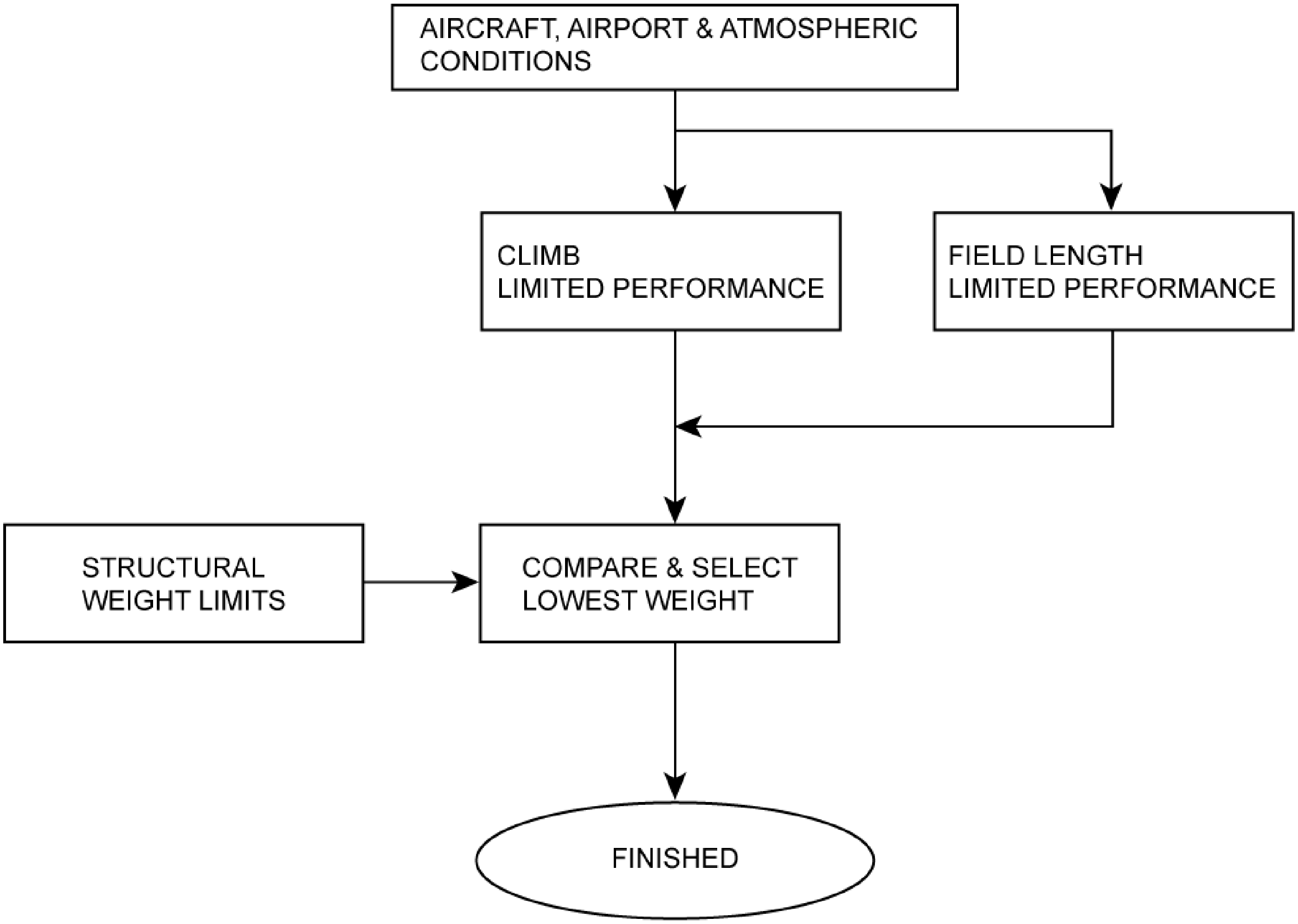


Performance Worksheet

PERFORMANCE WORKSHEET		LANDING DATA	
ALTIMETER SETTINGS:	29.80 in	RUNWAY :	6,548 ft.
PRESSURE ALTITUDE :	1000 ft.	CONDITION:	DRY/WET
TEMPERATURE :	15 °C	ANTI-ICE :	ON/OFF
WIND DIR: 330	20 kt		

PLANNED LANDING WEIGHT	24,000 lbs	
LIMITATIONS		
MAX LANDING WEIGHT: 27,100 LBS	lbs.	
CLIMB	lbs.	15° or 7° FLAPS
RUNWAY	lbs.	
RUNWAY REQUIRED		
LANDING DISTANCE	ft.	
LANDING FIELD LENGTH – DRY	ft.	
LANDING FIELD LENGTH – WET	ft.	
SPEEDS		
V_{REF}	kts	
V_{APP}	kts	15° Flaps
	kts	7° Flaps

Landing Weight Considerations/Determination



Maximum Landing Weight Permitted by Climb Requirements or Brake Energy Limits - Pounds

ANTI-ICE - OFF

CONDITIONS: REFER TO PAGE PRECEDING THIS TABLE

APPROACH FLAPS - 15°
LANDING FLAPS - 35°

ALT FT	TEMP DEG C	WIND - KNOTS																			
		-10				0				10				20				30			
		RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT			
		-2	0	1	2	-2	0	1	2	-2	0	1	2	-2	0	1	2	-2	0	1	2
0	-25	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	-20	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	-15	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	-10	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	-5	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	0	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	5	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	10	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	15	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
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	30	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	35	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	40	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	45	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	50	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	55	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100

ALT FT	TEMP DEG C	WIND - KNOTS																			
		-10				0				10				20				30			
		RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT			
		-2	0	1	2	-2	0	1	2	-2	0	1	2	-2	0	1	2	-2	0	1	2
1000	-25	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	-20	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	-15	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
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	0	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	5	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
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	52	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100

ALT FT	TEMP DEG C	WIND - KNOTS																			
		-10				0				10				20				30			
		RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT				RNWY GRADIENT PERCENT			
		-2	0	1	2	-2	0	1	2	-2	0	1	2	-2	0	1	2	-2	0	1	2
2000	-30	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
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	-15	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
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	30	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
	35	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100
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	50	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100	27100

68FM 05-00

Performance Worksheet

PERFORMANCE WORKSHEET		LANDING DATA	
ALTIMETER SETTINGS:	29.80 in	RUNWAY :	6,548 ft.
PRESSURE ALTITUDE :	1000 ft.	CONDITION:	DRY/WET
TEMPERATURE :	15 °C	ANTI-ICE :	ON/OFF
WIND DIR: 330	20 kt		

PLANNED LANDING WEIGHT	24,000 lbs	
LIMITATIONS		
MAX LANDING WEIGHT: 27,100 LBS	27,100 lbs.	
CLIMB	27,100 lbs.	15° or 7° FLAPS
RUNWAY	lbs.	
RUNWAY REQUIRED		
LANDING DISTANCE	ft.	
LANDING FIELD LENGTH – DRY	ft.	
LANDING FIELD LENGTH – WET	ft.	
SPEEDS		
V_{REF}	kts	
V_{APP}	kts	15° Flaps
	kts	7° Flaps

Maximum Allowable Landing Weight Determination

The charts in the Citation Sovereign Aircraft Flight Manual, Section IV allow determination of approach and landing climb performance, landing field requirements and approach speed values. The flow chart on the next page illustrates the steps to be followed in determining maximum allowable landing gross weight.

Limitations

As with the takeoff, we begin by examining the limitations imposed on landing. Our planned landing weight of 23,175 pounds cannot exceed the lowest of the weights limited by:

- Maximum certificated landing weight
- Climb limit
- Field length limit

Maximum Certificated Landing Weight

The normal maximum landing weight is 27,100 pounds. Therefore, we will use 27,100 pounds as the maximum landing weight.

Enter 27,100 pounds in the MAX LANDING WEIGHT box on the Performance Worksheet.

Climb Requirements or Brake Energy Limits

To determine this limit, refer to the **Maximum Landing Weight Permitted by Climb Requirements or Brake Energy Limits – Approach 15° Flaps – Landing Flaps Full.**

1. Scan the left side of the sub charts to find the appropriate pressure altitude (1,000 feet).
2. Move across to the temperature column and find the appropriate temperature (15°C).
3. Continue across to the appropriate wind column. Since there are gusty winds, we will incorporate a gust factor to the steady state winds. Subtracting the max gust (25) from the steady wind (15) and dividing by two gives a five (5) knots gust factor. Add this to the steady winds for a total of 20 knots wind.
4. Within the wind column find the proper runway gradient. Referencing back to the airport diagram, we determine runway 34 has a 1% uphill slope. Using this number the limitation is 27,100 pounds.

Enter 27,100 pounds in the CLIMB box on the Performance Worksheet.

Landing Distance

ACTUAL DISTANCE

FLAPS - 35°
1000 FEET

CONDITIONS: LANDING GEAR - DOWN
THRUST - IDLE AT 50 FEET
AIRSPEED - VREF AT 50 FEET
ANTI-ICE - ON OR OFF
SPEEDBRAKES - EXTEND AFTER TOUCHDOWN

SOME CONDITIONS MAY BE BRAKE ENERGY OR CLIMB LIMITED. OBTAIN ALLOWABLE WEIGHT FROM MAXIMUM LANDING WEIGHT TABLES.

*WEIGHT = 30300 POUNDS, VREF = 116 KIAS, VAPP = 124 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-25	3140	2640	2500	2360	2220
-20	3170	2680	2540	2400	2260
-15	3210	2710	2570	2430	2290
-10	3250	2750	2600	2460	2330
-5	3280	2780	2640	2500	2360
0	3320	2820	2670	2530	2390
5	3360	2850	2710	2560	2420
10	3390	2890	2740	2600	2460
15	3430	2920	2780	2630	2490
20	3470	2960	2810	2660	2520
25	3510	3000	2840	2700	2560
30	3550	3030	2880	2740	2590
35	3590	3070	2920	2770	2620
40	3630	3100	2950	2810	2660
45	3660	3140	2990	2840	2690
50	3700	3180	3020	2870	2730
52	3720	3190	3040	2890	2740

WEIGHT = 27100 POUNDS, VREF = 110 KIAS, VAPP = 117 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-25	2940	2460	2320	2190	2050
-20	2980	2490	2350	2210	2080
-15	3010	2520	2380	2250	2110
-10	3040	2560	2410	2280	2140
-5	3080	2590	2440	2310	2170
0	3110	2620	2480	2340	2200
5	3140	2650	2510	2370	2230
10	3180	2680	2540	2400	2260
15	3210	2710	2570	2430	2290
20	3250	2750	2600	2460	2320
25	3280	2780	2630	2490	2360
30	3320	2810	2670	2530	2390
35	3360	2850	2700	2560	2420
40	3390	2880	2730	2590	2450
45	3430	2920	2770	2620	2480
50	3460	2950	2800	2650	2510
52	3470	2960	2810	2670	2520

WEIGHT = 26500 POUNDS, VREF = 108 KIAS, VAPP = 116 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-25	2900	2420	2290	2150	2020
-20	2940	2450	2320	2180	2050
-15	2970	2490	2350	2210	2080
-10	3010	2520	2380	2240	2110
-5	3040	2550	2410	2270	2140
0	3070	2580	2440	2300	2170
5	3100	2610	2470	2330	2200
10	3140	2640	2500	2360	2220
15	3170	2670	2530	2390	2250
20	3210	2710	2560	2420	2290
25	3240	2740	2600	2450	2320
30	3270	2770	2630	2490	2350
35	3310	2810	2660	2520	2380
40	3350	2840	2690	2550	2410
45	3380	2870	2720	2580	2440
50	3420	2900	2760	2610	2470
52	3430	2920	2770	2620	2480

WEIGHT = 26000 POUNDS, VREF = 107 KIAS, VAPP = 115 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-25	2870	2400	2260	2120	1990
-20	2910	2420	2290	2150	2020
-15	2940	2460	2320	2180	2050
-10	2970	2490	2350	2210	2080
-5	3000	2520	2380	2240	2110
0	3030	2550	2410	2270	2140
5	3070	2580	2440	2300	2170
10	3100	2610	2470	2330	2190
15	3130	2640	2500	2360	2220
20	3170	2670	2530	2390	2250
25	3200	2710	2560	2420	2280
30	3240	2740	2600	2450	2320
35	3270	2770	2620	2480	2350
40	3310	2800	2660	2510	2380
45	3340	2830	2690	2550	2400
50	3380	2870	2720	2580	2430
52	3390	2880	2730	2590	2450

WEIGHT = 25000 POUNDS, VREF = 105 KIAS, VAPP = 113 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-25	2810	2330	2200	2060	1940
-20	2840	2370	2230	2090	1970
-15	2870	2400	2260	2120	1990
-10	2900	2420	2290	2150	2020
-5	2940	2450	2320	2180	2050
0	2970	2480	2350	2210	2080
5	3000	2510	2370	2240	2100
10	3030	2540	2400	2270	2130
15	3060	2570	2430	2290	2160
20	3100	2600	2460	2330	2190
25	3130	2640	2490	2360	2220
30	3160	2670	2530	2390	2250
35	3200	2700	2560	2410	2280
40	3230	2730	2590	2440	2310
45	3260	2760	2620	2470	2340
50	3300	2800	2650	2510	2370
52	3310	2810	2660	2520	2380

WEIGHT = 24000 POUNDS, VREF = 103 KIAS, VAPP = 110 KIAS

TEMP DEG C	TAILWIND 10 KTS	ZERO WIND	HEADWINDS 10 KTS	20 KTS	30 KTS
-25	2750	2270	2140	2010	1880
-20	2780	2300	2170	2030	1910
-15	2810	2330	2190	2060	1940
-10	2840	2360	2220	2090	1960
-5	2870	2390	2250	2120	1990
0	2900	2420	2280	2150	2010
5	2930	2450	2310	2170	2040
10	2960	2470	2340	2200	2070
15	2990	2500	2370	2230	2100
20	3020	2540	2400	2260	2130
25	3050	2570	2420	2290	2160
30	3090	2600	2450	2320	2180
35	3120	2630	2490	2350	2210
40	3150	2660	2520	2380	2240
45	3190	2690	2550	2400	2270
50	3220	2720	2580	2430	2300
52	3230	2730	2590	2440	2310

68FM-05-00

TO OBTAIN LANDING DISTANCE WITH NEGATIVE (DOWNHILL) RUNWAY GRADIENT, REFER TO LANDING PROCEDURES
* FOR USE IN AN EMERGENCY WHICH REQUIRES LANDING IN EXCESS OF THE MAXIMUM DESIGN LANDING WEIGHT OF 27100 POUNDS

Performance Worksheet

PERFORMANCE WORKSHEET			LANDING DATA	
ALTIMETER SETTINGS:		29.80 in	RUNWAY :	6,548 ft.
PRESSURE ALTITUDE :		1000 ft.	CONDITION:	DRY/WET
TEMPERATURE :		15 °C	ANTI-ICE :	ON/OFF
WIND	DIR: 330	20 kt		

PLANNED LANDING WEIGHT	24,000 lbs	
LIMITATIONS		
MAX LANDING WEIGHT: 27,100 LBS	27,100 lbs.	
CLIMB	27,100 lbs.	15° or 7° FLAPS
RUNWAY	lbs.	
RUNWAY REQUIRED		
LANDING DISTANCE	6,548 ft.	
LANDING FIELD LENGTH – DRY	2,230 ft.	
LANDING FIELD LENGTH – WET	2,900 ft.	
SPEEDS		
V_{REF}	kts	
V_{APP}	kts	15° Flaps
	kts	7° Flaps

Field Length Limit

We will first determine our landing distance requirement then compare that to the actual runway available instead of actually determining the Field Length Limit maximum weight. Since the runway will most likely be wet due to the TAF information, we must then make a wet runway correction and again compare this to the actual runway available.

We will determine the dry landing distances first, then make the necessary corrections found in the Advisory Section of the Aircraft Flight Manual.

The chart used is Landing Distance – Feet – Flaps – Full 1,000 FEET

The Aircraft Flight Manual includes charts for flaps 35° only.

1. Find the charts for the 1,000 feet pressure altitude.
2. Scan down the sub charts to find the appropriate landing weight chart (27,000 pounds).
3. Along the left side of the sub chart locate the appropriate temperature (15°C).
4. Move across to the appropriate wind column (20 knots).
5. This indicates our landing distance of 2,230 feet.

Enter 2,230 feet in the LANDING DISTANCE FIELD LENGTH - DRY box on the Performance Worksheet.

Landing Distance Performance Criteria

The distances and weights found in the Landing Distance Charts are based on the following conditions:

1. Landing Gear – Down
2. Speed Brakes – Extend After Touchdown
3. Airspeed – V_{REF} at 50 feet
4. Flaps – FULL or 15°
5. Anti-Ice Systems – ON or OFF
6. Thrust – Idle
7. Thrust Reversers – NOT Deployed
8. Runway Gradient – 0%
9. Runway Surface – Dry
10. Touchdown at a rate of no more than 6 ft/sec (360 ft/min).

Any changes from those listed above will require a correction to be made. These corrections will be found in either the Citation Sovereign Abnormal Procedures Checklist or Landing Correction Charts in the Aircraft Flight Manual.

Corrections

The first correction we must consider is that the runway has a 1% uphill slope. According to the Citation Sovereign Aircraft Flight Manual no corrections are necessary for uphill slope.

The next correction to determine is for a wet runway surface. The advisory section in the Citation Sovereign Aircraft Flight Manual contains data for Wet, Slush, Snow, and Ice Covered Runways. This data is for takeoff and landing corrections.

There are three different charts available for Landing Corrections Flaps – Full, one without thrust reversers and two with thrust reversers. One thrust reverser chart is based on V_{REF} and the other is based on V_{REF} +10.

For our example, the data chart for **Landing Distance – Feet Flaps – Full Without Thrust Reversers** will be used.

1. Starting on the left side of the chart, find the approximate predetermined dry runway length. Since 2,230 feet was previously determined we will round to the next highest length of 2,400 feet.
2. Move across to the appropriate V-speed correction. In this case it will be V_{REF}.
3. This indicates that the corrected runway length is 2,900 feet.

Enter 2,900 feet in the LANDING FIELD LENGTH – WET box on the Performance Worksheet.

Compare this number to our available runway length (6,548 feet). Since the corrected number is less than the available runway, no further adjustments need to be made.

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Landing Speeds

With the landing weight and runway requirements established, we proceed to the landing speeds. We will determine:

- V_{REF}
- V_{APP}

All landing speeds can be determined from the previous use of the **Landing Distance - Feet, Flaps - Full, 1,000 FEET** chart.

Since we have not made any adjustments to our landing weight, we can go back to this chart and determine the required V speeds. Again, be sure you are using the right chart.

1. Find the charts for 1,000 feet pressure altitude.
2. Scan down the sub charts to find the appropriate landing weight chart (27,000 pounds).
3. Along the top of the chart under the Weight are the V_{REF} and V_{APP} for the listed weight.
4. This indicates a V_{REF} of 103 KIAS and a V_{APP} of 110 KIAS.

Enter 103 KIAS for V_{REF} and 110 KIAS for V_{APP} in the SPEEDS box on the Performance Worksheet.

This concludes the Landing Problem!

HOORAY! We have now completed all the required planning calculations and required corrections to determine the feasibility of the boss' request. Let's look back and see how it matches up.

Departure time is 7 a.m. MST and the flight will take just over 3 hours, putting us on the ramp at Westchester County by 12:30 pm EST. The aircraft will be fueled to 9,000 pounds, allowing enough reserve for the weather in New York.

GREAT JOB! Call the boss and let her know she needs to bring umbrellas.

Landing Distance – Data For
Wet, Slush, Snow and Ice Covered Runways

LANDING DISTANCE - FEET

FLAPS - 35°

AIRSPEED - V_{REF}

DRY RUNWAY WITHOUT THRUST REVERSERS	ADVERSE RUNWAY CONDITIONS (WITHOUT THRUST REVERSERS, ALL WINDS, 50 FT SCREEN HEIGHT)													
	WATER COVERED RUNWAY - INCHES *					SLUSH OR WET SNOW COVERED RUNWAY - INCHES *					DRY SNOW INCHES *		COMPACT SNOW	WET ICE *
	0.125	0.2	0.3	0.4	0.5	0.125	0.2	0.3	0.4	0.5	1.0	2.0		
1400	1900	1850	1750	1650	1600	2000	1900	1850	1750	1700	2250	2050	2300	5700
1600	2200	2100	2000	1900	1850	2350	2250	2100	2000	1950	2700	2400	2750	6600
1800	2500	2400	2250	2150	2100	2700	2550	2400	2300	2200	3150	2750	3150	7750
2000	2850	2700	2550	2450	2350	3050	2850	2700	2600	2500	3600	3100	3600	9450
2200	3200	3050	2850	2700	2600	3450	3200	3000	2850	2750	4000	3500	4100	12300
2400	3550	3350	3150	2950	2850	3800	3550	3300	3150	3000	4350	3850	4450	15650
2600	3950	3700	3450	3250	3100	4200	3900	3650	3400	3250	4650	4200	4750	
2800	4300	4000	3750	3500	3300	4600	4250	3950	3700	3500	5000	4600	5100	
3000	4650	4350	4000	3700	3550	4950	4600	4250	3950	3700	5350	4900	5450	
3200	5050	4700	4300	3950	3750	5300	4900	4500	4200	3950	5700	5200	5800	
3400	5450	5000	4550	4200	3950	5700	5250	4800	4450	4150	6050	5550	6150	
3600	5850	5350	4850	4450	4200	6150	5600	5100	4700	4400	6450	5900	6450	
3800	6250	5700	5150	4700	4400	6600	6000	5450	5000	4650	6800	6250	6750	
4000	6700	6050	5450	5000	4650	7100	6400	5800	5300	4900	7200	6550	7100	
4200	7200	6450	5800	5300	4900	7550	6800	6150	5600	5150	7550	6900	7450	
4400	7650	6850	6150	5600	5200	8000	7200	6500	5900	5450	7900	7250	7800	
4600	8150	7300	6500	5950	5500	8500	7650	6850	6200	5750	8300	7600	8100	
4800	8650	7750	6850	6250	5800	9000	8100	7200	6550	6050	8650	7950	8400	
5000	9150	8200	7200	6600	6100	9500	8550	7550	6850	6350	9050	8250	8750	
5200	9650	8650	7550	6900	6400	10000	9000	7900	7200	6650	9400	8600	9100	
5400	10150	9100	7900	7250	6700	10500	9450	8250	7500	6950	9800	8950	9450	
5600	10650	9550	8250	7550	7000	11000	9900	8600	7850	7250	10150	9300	9800	
5800	11150	10000	8600	7900	7300	11500	10350	8950	8150	7550	10500	9600	10150	
6000	11650	10450	8950	8200	7600	12000	10800	9300	8500	7850	10900	9950	10500	
6200	12150	10900	9300	8550	7900	12500	11250	9650	8800	8150	11250	10250	10850	
6400	12650	11350	9650	8850	8200	13000	11700	10000	9150	8450	11600	10600	11200	
6600	13150	11800	10000	9200	8500	13500	12150	10350	9450	8750	12000	10950	11550	
6800	13650	12250	10350	9500	8800	14000	12600	10700	9800	9050	12350	11250	11900	
7000	14150	12700	10700	9850	9100	14500	13050	11050	10100	9350	12700	11600	12250	
7200	14650	13150	11050	10150	9400	15000	13500	11400	10450	9650	13100	11950	12600	
7400	15150	13600	11400	10500	9700		13950	11750	10750	9950	13450	12250	12950	
7600		14050	11750	10800	10000		14400	12100	11100	10250	13800	12600	13300	
7800		14500	12100	11150	10300		14850	12450	11400	10550	14150	12900	13650	
8000		14950	12450	11450	10600		15300	12800	11750	10850	14550	13250	14000	
8500		16100	13350	12250	11350			13700	12550	11600	15450	14050	14900	
9000			14200	13100	12100			14550	13400	12350		14900	15750	
9500			15100	13900	12850			15450	14200	13100		15700		
10000				14750	13600				15050	13850				
10500				15550	14350					14600				
11000					15100					15350				
11500														
12000														

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NOTE

The published limiting maximum tailwind component for this airplane is 10 knots: however, Cessna does not recommend landings on precipitation-covered runways with any tailwind component.

* Landings should not be attempted in any precipitation depth greater than the highest depth presented or if any of the following limits are exceeded. If no limit is presented use the dry runway limit.

Contaminate	Temperature	Gross Weight	Wind
Wet Ice	Less than -10°C	Less than 22,000 lbs	No Tailwinds

Performance Worksheet

PERFORMANCE WORKSHEET			LANDING DATA	
ALTIMETER SETTINGS:		29.80 in	RUNWAY :	6,548 ft.
PRESSURE ALTITUDE :		1000 ft.	CONDITION:	DRY/WET
TEMPERATURE :		15 °C	ANTI-ICE :	ON/OFF
WIND	DIR: 330	20 kt		

PLANNED LANDING WEIGHT	24,000 lbs	
LIMITATIONS		
MAX LANDING WEIGHT: 27,100 LBS	27,100 lbs.	
CLIMB	27,100 lbs.	15° or 7° FLAPS
RUNWAY	27,100 lbs.	
RUNWAY REQUIRED		
LANDING DISTANCE	6,548 ft.	
LANDING FIELD LENGTH – DRY	2,230 ft.	
LANDING FIELD LENGTH – WET	2,900 ft.	
SPEEDS		
V_{REF}	103 kts	
V_{APP}	110 kts	15° Flaps
	kts	7° Flaps

Additional Flight Planning Information

Step Climbs

The flight planning charts are FINAL ALTITUDE. If your trip is long enough to include a step climb, use the chart for the final altitude, not the initial cruise altitude. The climb data for the conditions requiring a step climb are based on climbing direct to the highest obtainable altitude as shown in the step climb weight table, cruising at that altitude until the desired weight is achieved, and then climbing to the desired altitude or the next step altitude per the step altitude climb table.

Drift Down Performance

The Citation Sovereign Operating Manual contains charts and tables that enable the pilot to determine the time, distance, and fuel to descend, as well as, the final descent altitude. A sub chart indicates Driftdown Speed and another for cruise wind corrections.

Let's assume we have the following cruise conditions:

Weight	27,000 pounds
Altitude	FL 410
Temp Deviation	ISA + 10°C (50°F)

1. Scan the chart to find the 41,000 feet pressure altitude.
2. Find the appropriate Temperature row (ISA + 10).
3. In that row from the top find the appropriate starting weight (27,000 pounds).
4. Here are the results:
   i. 25 minutes.
   ii. 142 NM.
   iii. 423 pounds of fuel burned.
   iv. 11,850 feet Final Altitude.

Drift Down procedure:

- Set good engine to MCT throttle position.
- Hold drift down speed per weight at engine failure as presented in the table.
- When descent rate of 300 feet-per-minute is reached, hold 300 feet-per-minute descent with the drift down speed.
- When final altitude as presented in the table is reached, set throttle to CRU position and consult single engine cruise tables.

Single Engine Cruise

Before we can determine how far we can cruise on a single engine, we must first know how heavy the aircraft is going to be when it lands. This will be the ZFW plus the fuel reserve. For the purposes of this discussion, we will use the same 4,200 pounds fuel reserve that we used for the flight planning problem (which includes fuel for holding and fuel to the alternate). As in that problem, this is completely arbitrary and you can use more or less fuel.

Also from the flight planning problem we will use the following data:

ZFW	18,975 lb
RES FUEL	4,200 lb
LDG WGT	23,175 lb (this is called the 'Final Weight')

We have already made a couple of calculations; drift down weight and altitude. These are the beginning weight at our drift down altitude and the altitude to use for the single engine cruise condition.

Weight

Subtract the drift down fuel (385 pounds) from the cruise weight (27,000 pounds); the result is 25,615. Rounding up to the nearest figure on the chart, we will use 27,000 pounds. This is called the 'Initial Weight'.

Altitude

The Drift Down table shows that we could maintain an altitude of 11,850 feet. We have single engine cruise tables at 10,000 feet and 15,000 feet (among others) so we will choose 10,000 feet chart for One Engine.

Cruise

The single engine cruise data is obtained from the One Engine Inoperative Cruise charts. There are figures in the charts for three cruise conditions: Long Range Cruise, Normal Cruise Thrust, and Maximum Cruise Thrust. They are also for Anti-Ice OFF. For this example we will use the MCT figures.

These charts are utilized the same way as the two engine cruise charts used in our previous performance problem.

- Find the appropriate weight along the left side (27,000 pounds)
- Move across to find the appropriate temperature (ISA +10)
- Continue across from there to determine the information needed in each of the columns listed

Engine Out and Drift Down

DRIFTDOWN SPEED - KIAS

TEMPERATURE	WEIGHT - LBS 28000	27000	26000	24000	20000
ISA+20°C	211	206	200	189	167
ISA+10°C	198	193	189	178	160
ISA +0°C	196	192	187	178	159
ISA -10°C	179	175	171	165	151

TIME, DISTANCE, FUEL, AND FINAL ALTITUDE — **ANTI-ICE SYSTEMS OFF**

PRESSURE ALTITUDE 47000 FEET, ISA = -57°C = -70°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	—	—	—	30	21
	NM	—	—	—	172	119
	LB	—	—	—	442	268
	FT	—	—	—	29350	35650
ISA +10°C	MIN	—	—	29	26	20
	NM	—	—	165	145	111
	LB	—	—	439	360	244
	FT	—	—	30500	33100	37650
ISA	MIN	—	—	28	25	20
	NM	—	—	158	141	110
	LB	—	—	414	346	238
	FT	—	—	30850	33150	37650
ISA -10°C	MIN	29	28	27	24	20
	NM	154	148	141	127	102
	LB	427	397	369	313	227
	FT	31800	32750	33750	35650	39350

PRESSURE ALTITUDE 45000 FEET, ISA = -57°C = -70°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	—	—	33	29	19
	NM	—	—	189	164	108
	LB	—	—	536	431	242
	FT	—	—	25600	29300	35650
ISA +10°C	MIN	30	28	27	24	18
	NM	171	163	155	134	97
	LB	494	460	425	344	221
	FT	28050	29200	30450	33100	37600
ISA	MIN	28	28	27	24	18
	NM	161	155	148	131	95
	LB	458	431	400	331	214
	FT	28650	29750	30850	33150	37650
ISA -10°C	MIN	27	26	25	22	17
	NM	144	137	130	114	84
	LB	410	379	350	290	192
	FT	31800	32750	33700	35650	39300

PRESSURE ALTITUDE 43000 FEET, ISA = -57°C = -70°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	36	33	32	27	17
	NM	208	190	180	154	95
	LB	662	569	522	417	220
	FT	21600	23800	25600	29250	35600
ISA +10°C	MIN	28	27	26	22	15
	NM	161	153	145	122	80
	LB	480	444	408	323	188
	FT	28000	29200	30450	33050	37600
ISA	MIN	27	26	25	22	15
	NM	151	145	138	118	78
	LB	442	414	383	309	182
	FT	28650	29700	30800	33100	37600
ISA -10°C	MIN	25	24	23	19	12
	NM	132	124	116	98	60
	LB	388	355	324	259	139
	FT	31800	32750	33700	35600	39250

PRESSURE ALTITUDE 41000 FEET, ISA = -57°C = -70°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	35	32	30	26	14
	NM	200	181	171	144	79
	LB	639	555	507	398	190
	FT	21600	23750	25600	29250	35600
ISA +10°C	MIN	27	25	24	20	11
	NM	150	142	133	109	57
	LB	459	423	385	297	137
	FT	28000	29150	30400	33000	37550
ISA	MIN	25	24	23	20	11
	NM	140	134	126	105	55
	LB	422	392	360	283	132
	FT	28600	29700	30800	33100	37550
ISA -10°C	MIN	23	21	20	16	6
	NM	119	110	101	80	30
	LB	359	323	289	217	70
	FT	31750	32700	33650	35550	39150

PRESSURE ALTITUDE 39000 FEET, ISA = -57°C = -70°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	34	30	29	24	11
	NM	191	171	160	131	57
	LB	624	537	487	374	143
	FT	21550	23700	25550	29200	35500
ISA +10°C	MIN	25	23	22	17	5
	NM	138	129	119	91	26
	LB	433	396	354	257	65
	FT	28000	29100	30350	33000	37450
ISA	MIN	23	22	21	17	5
	NM	128	121	112	88	25
	LB	397	365	330	246	61
	FT	28600	29650	30750	33050	37500
ISA -10°C	MIN	20	18	16	11	—
	NM	103	92	82	55	—
	LB	320	280	241	152	—
	FT	31700	32650	33600	35500	—

PRESSURE ALTITUDE 37000 FEET, ISA = -57°C = -70°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	32	29	27	21	5
	NM	180	160	147	116	27
	LB	603	514	460	340	70
	FT	21500	23650	25500	29100	35450
ISA +10°C	MIN	22	21	19	13	—
	NM	124	114	101	68	—
	LB	399	358	312	198	—
	FT	27950	29100	30300	32900	—
ISA	MIN	21	20	18	13	—
	NM	114	105	95	66	—
	LB	363	327	288	189	—
	FT	28550	29600	30700	32950	—
ISA -10°C	MIN	16	14	11	5	—
	NM	82	70	55	25	—
	LB	263	217	167	71	—
	FT	31650	32600	33550	35400	—

PRESSURE ALTITUDE 35000 FEET, ISA = -54°C = -66°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	31	27	24	18	—
	NM	169	147	132	97	—
	LB	577	485	423	291	—
	FT	21400	23600	25450	29000	—
ISA +10°C	MIN	20	17	15	7	—
	NM	106	95	79	38	—
	LB	353	306	249	113	—
	FT	27900	29000	30250	32600	—
ISA	MIN	18	16	14	7	—
	NM	96	85	72	36	—
	LB	316	273	224	105	—
	FT	28500	29550	30650	32900	—
ISA -10°C	MIN	11	8	5	—	—
	NM	55	41	25	—	—
	LB	181	128	76	—	—
	FT	31600	32500	33450	—	—

PRESSURE ALTITUDE 33000 FEET, ISA = -50°C = -59°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	29	24	21	13	—
	NM	156	133	115	70	—
	LB	544	447	375	215	—
	FT	21350	23500	25400	28900	—
ISA +10°C	MIN	16	13	10	1	—
	NM	85	69	51	6	—
	LB	289	230	163	17	—
	FT	27800	28900	30100	32650	—
ISA	MIN	14	11	8	1	—
	NM	74	59	42	4	—
	LB	251	192	134	11	—
	FT	28400	29500	30550	32750	—
ISA -10°C	MIN	5	2	—	—	—
	NM	25	9	—	—	—
	LB	81	30	—	—	—
	FT	31500	32400	—	—	—

PRESSURE ALTITUDE 31000 FEET, ISA = -46°C = -52°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	26	22	17	8	—
	NM	141	116	93	40	—
	LB	505	399	312	124	—
	FT	21250	23400	25300	28700	—
ISA +10°C	MIN	11	7	3	—	—
	NM	57	38	18	—	—
	LB	197	129	58	—	—
	FT	27700	28800	29950	—	—
ISA	MIN	9	5	2	—	—
	NM	46	28	10	—	—
	LB	159	92	32	—	—
	FT	28300	29350	30400	—	—
ISA -10°C	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—

PRESSURE ALTITUDE 29000 FEET, ISA = -42°C = -44°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	23	18	12	2	—
	NM	124	95	65	8	—
	LB	453	335	223	25	—
	FT	21100	23250	25200	28550	—
ISA +10°C	MIN	5	1	—	—	—
	NM	25	5	—	—	—
	LB	88	19	—	—	—
	FT	27550	28700	—	—	—
ISA	MIN	3	—	—	—	—
	NM	14	—	—	—	—
	LB	49	—	—	—	—
	FT	28200	—	—	—	—
ISA -10°C	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—

PRESSURE ALTITUDE 27000 FEET, ISA = -38°C = -37°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	19	13	7	—	—
	NM	101	69	34	—	—
	LB	379	248	116	—	—
	FT	20950	23000	25050	—	—
ISA +10°C	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—
ISA	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—
ISA -10°C	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—

PRESSURE ALTITUDE 25000 FEET, ISA = -35°C = -30°F

	START WEIGHT	28000	27000	26000	24000	20000
ISA +20°C	MIN	14	7	1	—	—
	NM	73	38	3	—	—
	LB	277	140	10	—	—
	FT	20750	22750	24850	—	—
ISA +10°C	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—
ISA	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—
ISA -10°C	MIN	—	—	—	—	—
	NM	—	—	—	—	—
	LB	—	—	—	—	—
	FT	—	—	—	—	—

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WIND EFFECT ON DISTANCE - NM
(SUBTRACT FOR HEADWIND, ADD FOR TAILWIND)

TIME (MIN)	WIND 25KTS	50KTS	100KTS
10	4	8	16
20	8	16	33
30	12	25	50
40	16	33	66
50	20	41	83
60	25	50	100

Cruise 10,000 Feet

ANTI-ICE SYSTEMS OFF **ONE ENGINE**

WT LBS	TEMP	RAT °C		FAN PERCENT RPM	FUEL FLOW LBS/HR	KIAS	IND MACH	KTAS	NAUTICAL MILES / 100 LBS FUEL: HEADWIND 100 KT	HEADWIND 50 KT	HEADWIND 25 KT	ZERO WIND	TAILWIND 25 KT	TAILWIND 50 KT	TAILWIND 100 KT
30000	ISA+20°C	26	(1)	95.0	1720	244	.44	292	11.2	14.1	15.5	17.0	18.4	19.9	22.8
	15°C	25		93.1	1601	232	.420	278	11.1	14.2	15.8	17.4	18.9	20.5	23.6
		25	(2)	91.7	1519	223	.40	268	11.0	14.3	16.0	17.6	19.3	20.9	24.2
	ISA+10°C	17	(1)	95.9	1850	259	.47	304	11.0	13.7	15.1	16.4	17.8	19.1	21.8
	5°C	15		92.4	1619	238	.430	280	11.1	14.2	15.7	17.3	18.6	20.4	23.4
		14	(2)	89.3	1452	218	.40	257	10.8	14.3	16.0	17.7	19.4	21.1	24.6
	ISA+0°C	8	(1)	95.5	1903	267	.48	308	10.9	13.5	14.9	16.2	17.5	18.8	21.4
	-5°C	6		91.7	1637	243	.440	281	11.0	14.1	15.6	17.2	18.7	20.2	23.3
		4	(2)	87.7	1416	218	.39	252	10.7	14.3	16.0	17.8	19.6	21.3	24.9
	ISA-10°C	-1	(1)	96.7	2105	286	.52	323	10.6	13.0	14.1	15.3	16.5	17.7	20.1
	-15°C	-4		91.8	1725	255	.460	288	10.9	13.8	15.3	16.7	18.2	19.6	22.5
		-7	(2)	86.1	1382	218	.39	247	10.7	14.3	16.1	17.9	19.7	21.5	25.1
29000	ISA+20°C	27	(1)	95.0	1720	246	.44	294	11.3	14.2	15.6	17.1	18.5	20.0	22.9
	15°C	25		92.8	1582	232	.420	278	11.2	14.4	16.0	17.6	19.2	20.7	23.9
		24	(2)	89.9	1437	215	.39	258	11.0	14.4	16.2	17.9	19.7	21.4	24.9
	ISA+10°C	18	(1)	95.9	1850	261	.47	306	11.1	13.8	15.2	16.5	17.9	19.2	21.9
	5°C	15		92.1	1601	238	.430	280	11.2	14.3	15.9	17.5	19.0	20.6	23.7
		14	(2)	88.4	1404	215	.39	253	10.9	14.5	16.2	18.0	19.8	21.6	25.1
	ISA+0°C	8	(1)	95.5	1903	269	.48	309	11.0	13.6	14.9	16.2	17.6	18.9	21.5
	-5°C	6		91.4	1620	243	.440	281	11.2	14.2	15.8	17.3	18.9	20.4	23.5
		3	(2)	86.8	1371	215	.39	248	10.8	14.5	16.3	18.1	19.9	21.8	25.4
	ISA-10°C	-1	(1)	96.7	2105	287	.52	324	10.6	13.0	14.2	15.4	16.6	17.8	20.1
	-15°C	-4		90.6	1649	249	.450	282	11.0	14.1	15.6	17.1	18.6	20.1	23.2
		-7	(2)	85.2	1337	215	.39	244	10.7	14.5	16.4	18.2	20.1	22.0	25.7
28000	ISA+20°C	27	(1)	95.0	1720	247	.45	296	11.4	14.3	15.7	17.2	18.6	20.1	23.0
	15°C	25		92.4	1563	232	.420	278	11.4	14.6	16.2	17.8	19.4	21.0	24.2
		24	(2)	88.9	1389	211	.38	254	11.1	14.7	16.5	18.3	20.1	21.9	25.5
	ISA+10°C	18	(1)	95.9	1851	262	.47	307	11.2	13.9	15.2	16.6	18.0	19.3	22.0
	5°C	15		91.8	1583	238	.430	280	11.3	14.5	16.1	17.7	19.2	20.8	24.0
		13	(2)	87.5	1359	212	.38	250	11.0	14.7	16.5	18.4	20.2	22.0	25.7
	ISA+0°C	8	(1)	95.5	1903	270	.49	311	11.1	13.7	15.0	16.3	17.6	18.9	21.6
	-5°C	5		90.1	1556	238	.430	274	11.2	14.4	16.0	17.6	19.2	20.9	24.1
		3	(2)	85.9	1325	211	.38	245	10.9	14.7	16.6	18.5	20.4	22.2	26.0
	ISA-10°C	-1	(1)	96.7	2106	288	.52	325	10.7	13.1	14.2	15.4	16.6	17.8	20.2
	-15°C	-4		90.3	1633	249	.450	282	11.1	14.2	15.7	17.3	18.8	20.3	23.4
		-7	(2)	84.3	1294	212	.38	240	10.8	14.7	16.6	18.6	20.5	22.4	26.3
27000	ISA+20°C	27	(1)	94.9	1720	249	.45	297	11.5	14.4	15.8	17.3	18.7	20.2	23.1
	15°C	25		91.1	1494	226	.410	271	11.5	14.8	16.5	18.2	19.8	21.5	24.8
		23	(2)	88.1	1347	209	.38	251	11.2	14.9	16.8	18.6	20.5	22.3	26.0
	ISA+10°C	18	(1)	95.9	1852	263	.47	309	11.3	14.0	15.3	16.7	18.0	19.4	22.1
	5°C	15		91.5	1566	238	.430	280	11.5	14.7	16.3	17.8	19.4	21.0	24.2
		13	(2)	86.6	1317	209	.38	246	11.1	14.9	16.8	18.7	20.6	22.5	26.3
	ISA+0°C	8	(1)	95.5	1903	271	.49	312	11.1	13.8	15.1	16.4	17.7	19.0	21.6
	-5°C	5		89.8	1540	238	.430	274	11.3	14.6	16.2	17.8	19.5	21.1	24.3
		3	(2)	85.0	1284	209	.38	242	11.0	14.9	16.9	18.8	20.8	22.7	26.6
	ISA-10°C	-1	(1)	96.7	2106	289	.52	326	10.7	13.1	14.3	15.5	16.7	17.8	20.2
	-15°C	-4		90.1	1618	249	.450	282	11.2	14.3	15.9	17.4	19.0	20.5	23.6
		-7	(2)	83.5	1254	209	.38	237	10.9	14.9	16.9	18.9	20.9	22.9	26.9
25000	ISA+20°C	27	(1)	94.9	1721	251	.45	300	11.6	14.6	16.0	17.5	18.9	20.4	23.3
	15°C	25		90.3	1463	226	.410	271	11.7	15.1	16.8	18.5	20.2	22.0	25.4
		23	(2)	86.5	1267	204	.37	245	11.4	15.4	17.3	19.3	21.3	23.3	27.2
	ISA+10°C	18	(1)	95.8	1853	265	.48	311	11.4	14.1	15.5	16.8	18.1	19.5	22.2
	5°C	15		89.8	1487	232	.420	273	11.6	15.0	16.7	18.4	20.0	21.7	25.1
		13	(2)	84.9	1235	203	.37	240	11.3	15.4	17.4	19.4	21.4	23.5	27.5
	ISA+0°C	8	(1)	95.6	1903	273	.49	314	11.2	13.9	15.2	16.6	17.8	19.1	21.7
	-5°C	5		89.3	1506	238	.430	274	11.6	14.9	16.5	18.2	19.9	21.5	24.8
		2	(2)	83.4	1206	203	.37	236	11.2	15.4	17.5	19.5	21.6	23.7	27.8
	ISA-10°C	-1	(1)	96.7	2107	290	.52	328	10.8	13.2	14.4	15.5	16.7	17.9	20.3
	-15°C	-4		89.6	1590	249	.450	282	11.4	14.6	16.2	17.7	19.3	20.9	24.0
		-8	(2)	81.8	1175	203	.37	231	11.1	15.4	17.5	19.6	21.8	23.9	28.2
23000	ISA+20°C	27	(1)	94.9	1721	254	.46	303	11.8	14.7	16.2	17.6	19.1	20.5	23.4
	15°C	25		89.7	1433	226	.410	271	12.0	15.4	17.2	18.9	20.7	22.4	25.9
		23	(2)	84.6	1182	198	.36	237	11.6	15.8	18.0	20.1	22.2	24.3	28.5
	ISA+10°C	18	(1)	95.8	1854	267	.48	314	11.5	14.2	15.6	16.9	18.3	19.6	22.3
	5°C	15		89.2	1456	232	.420	273	11.9	15.3	17.0	18.8	20.5	22.2	25.6
		12	(2)	83.1	1153	197	.36	233	11.5	15.9	18.0	20.2	22.4	24.5	28.9
	ISA+0°C	8	(1)	95.4	1904	275	.50	316	11.3	14.0	15.3	16.6	17.9	19.2	21.9
	-5°C	5		88.7	1480	238	.430	274	11.8	15.2	16.9	18.6	20.2	21.9	25.3
		2	(2)	81.6	1125	197	.36	228	11.4	15.9	18.1	20.3	22.5	24.8	29.2
	ISA-10°C	-1	(1)	96.7	2107	292	.53	329	10.9	13.2	14.4	15.6	16.8	18.0	20.4
	-15°C	-5		88.1	1503	243	.440	276	11.7	15.0	16.7	18.3	20.0	21.7	25.0
		-8	(2)	80.2	1102	198	.36	225	11.3	15.9	18.1	20.4	22.7	24.9	29.5

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(1) MAXIMUM CRUISE THRUST

(2) THRUST FOR MAXIMUM RANGE (APPROXIMATE)

Going back to the data used in our performance problem, we will determine the cruise distance with a 100-knots tailwind and fuel remaining.

To determine fuel remaining, check the fuel gauges or take the cruise weight minus the zero fuel weight and this equals the fuel remaining. Upon completion of the math it is determined that we have 8,000 pounds remaining.

From the chart we determined a 22.1 NM/100 pounds of fuel. Divide 8,000 by 100 and multiply that by 22.1. This yields a distance of 1,768 NM that we can travel single engine.

Taking the distance and dividing by the new groundspeed of 397 knots gives us an endurance of 4 hours and 27 minutes.

Cruise Data

While we have figured the time, distance and fuel what speed schedule do we follow?

As mentioned above, this weight and temperature allows three possibilities: Maximum Cruise, Normal Cruise and Long Range Cruise. Using Maximum Cruise and placing the throttles in the MCT detent allows the FADEC to do the job for us. Otherwise, a constant mach or fan setting would need to be maintained.

Single Engine Enroute
Net Climb Gradient - Percent

FLAPS - 0°

CONDITIONS: ANTI-ICE - ON; LANDING GEAR - UP; AIRSPEED - VENR (180 KIAS); SPEEDBRAKES - RETRACT; INOPERATIVE ENGINE - WINDMILLING; OPERATIVE ENGINE - MAX CONTINUOUS THRUST

ALT FT	TEMP DEG C	WEIGHT - POUNDS 30300					29000					28000					27000					26000				
		WIND KNOTS					WIND KNOTS					WIND KNOTS					WIND KNOTS					WIND KNOTS				
		-10	0	10	20	30	-10	0	10	20	30	-10	0	10	20	30	-10	0	10	20	30	-10	0	10	20	30
0	-54	4.3	4.8	5.0	5.2	5.5	4.8	5.3	5.5	5.8	6.0	5.1	5.7	5.9	6.2	6.4	5.5	6.1	6.4	6.6	6.9	5.9	6.6	6.8	7.1	7.4
	-50	4.3	4.8	5.0	5.2	5.5	4.8	5.3	5.5	5.8	6.0	5.1	5.7	6.0	6.2	6.4	5.5	6.2	6.4	6.6	6.9	5.9	6.6	6.9	7.1	7.4
	-45	4.3	4.9	5.0	5.2	5.5	4.8	5.3	5.5	5.8	6.0	5.2	5.7	6.0	6.2	6.4	5.5	6.2	6.4	6.6	6.9	6.0	6.6	6.9	7.1	7.4
	-40	4.4	4.9	5.0	5.3	5.5	4.8	5.3	5.6	5.8	6.0	5.2	5.7	6.0	6.2	6.4	5.6	6.2	6.4	6.7	6.9	6.0	6.6	6.9	7.1	7.4
	-35	4.4	4.9	5.1	5.3	5.5	4.8	5.4	5.6	5.8	6.0	5.2	5.8	6.0	6.2	6.5	5.6	6.2	6.4	6.7	6.9	6.0	6.6	6.9	7.1	7.4
	-30	4.4	4.9	5.1	5.3	5.5	4.8	5.4	5.6	5.8	6.0	5.2	5.8	6.0	6.2	6.5	5.6	6.2	6.4	6.7	6.9	6.0	6.6	6.9	7.1	7.4
	-25	4.4	4.9	5.1	5.3	5.5	4.8	5.4	5.6	5.8	6.0	5.2	5.8	6.0	6.2	6.5	5.6	6.2	6.4	6.7	6.9	6.0	6.7	6.9	7.2	7.4
	-20	4.4	4.9	5.1	5.3	5.5	4.9	5.4	5.6	5.8	6.0	5.2	5.8	6.0	6.2	6.5	5.6	6.2	6.4	6.7	6.9	6.0	6.7	6.9	7.2	7.4
	-15	4.4	4.9	5.1	5.3	5.5	4.9	5.4	5.6	5.8	6.0	5.2	5.8	6.0	6.2	6.5	5.6	6.2	6.4	6.7	6.9	6.0	6.7	6.9	7.2	7.4
	-10	4.4	4.9	5.1	5.3	5.5	4.9	5.4	5.6	5.8	6.0	5.3	5.8	6.0	6.2	6.5	5.6	6.2	6.5	6.7	6.9	6.1	6.7	6.9	7.2	7.4
	-5	4.4	4.9	5.1	5.3	5.5	4.9	5.4	5.6	5.8	6.0	5.3	5.8	6.0	6.2	6.5	5.7	6.2	6.5	6.7	6.9	6.1	6.7	6.9	7.2	7.4
	0	4.4	4.9	5.0	5.2	5.4	4.8	5.4	5.5	5.8	6.0	5.2	5.8	6.0	6.2	6.4	5.6	6.2	6.4	6.6	6.9	6.0	6.6	6.9	7.1	7.4
	5	3.7	4.1	4.3	4.4	4.6	4.1	4.6	4.7	4.9	5.1	4.5	4.9	5.1	5.3	5.5	4.8	5.3	5.5	5.7	5.9	5.2	5.8	5.9	6.2	6.4
	10	3.0	3.4	3.5	3.6	3.8	3.4	3.8	3.9	4.1	4.2	3.7	4.1	4.3	4.4	4.6	4.0	4.5	4.6	4.8	5.0	4.4	4.9	5.0	5.2	5.4
5000	-54	4.2	4.7	4.8	5.0	5.2	4.6	5.1	5.3	5.5	5.7	5.0	5.5	5.7	6.0	6.2	5.4	6.0	6.2	6.4	6.6	5.8	6.4	6.6	6.9	7.1
	-50	4.2	4.7	4.9	5.0	5.2	4.7	5.2	5.3	5.5	5.8	5.0	5.6	5.7	6.0	6.2	5.4	6.0	6.2	6.4	6.6	5.8	6.4	6.6	6.9	7.1
	-45	4.2	4.7	4.9	5.0	5.2	4.7	5.2	5.4	5.5	5.8	5.0	5.6	5.8	6.0	6.2	5.4	6.0	6.2	6.4	6.6	5.8	6.4	6.6	6.9	7.1
	-40	4.2	4.7	4.9	5.0	5.2	4.7	5.2	5.4	5.6	5.8	5.1	5.6	5.8	6.0	6.2	5.4	6.0	6.2	6.4	6.6	5.8	6.4	6.7	6.9	7.1
	-35	4.3	4.7	4.9	5.1	5.2	4.7	5.2	5.4	5.6	5.8	5.1	5.6	5.8	6.0	6.2	5.5	6.0	6.2	6.4	6.7	5.9	6.5	6.7	6.9	7.1
	-30	4.3	4.7	4.9	5.1	5.3	4.7	5.2	5.4	5.6	5.8	5.1	5.6	5.8	6.0	6.2	5.5	6.0	6.2	6.4	6.7	5.9	6.5	6.7	6.9	7.1
	-25	4.3	4.7	4.9	5.1	5.3	4.7	5.2	5.4	5.6	5.8	5.1	5.6	5.8	6.0	6.2	5.5	6.0	6.2	6.4	6.7	5.9	6.5	6.7	6.9	7.2
	-20	4.3	4.7	4.9	5.1	5.3	4.8	5.2	5.4	5.6	5.8	5.1	5.6	5.8	6.0	6.2	5.5	6.0	6.2	6.5	6.7	5.9	6.5	6.7	6.9	7.2
	-15	4.3	4.8	4.9	5.1	5.3	4.8	5.2	5.4	5.6	5.8	5.1	5.6	5.8	6.0	6.2	5.5	6.1	6.3	6.5	6.7	5.9	6.5	6.7	6.9	7.2
	-10	4.3	4.7	4.9	5.1	5.2	4.8	5.2	5.4	5.6	5.8	5.1	5.6	5.8	6.0	6.2	5.5	6.0	6.2	6.4	6.7	5.9	6.5	6.7	6.9	7.1
	-5	3.7	4.0	4.2	4.3	4.5	4.1	4.5	4.6	4.8	5.0	4.4	4.9	5.0	5.2	5.4	4.8	5.2	5.4	5.6	5.8	5.2	5.7	5.8	6.0	6.2
	0	3.0	3.3	3.4	3.6	3.7	3.4	3.7	3.9	4.0	4.2	3.7	4.1	4.2	4.4	4.5	4.0	4.4	4.6	4.8	4.9	4.4	4.8	5.0	5.2	5.3
	5	2.4	2.7	2.8	2.9	3.0	2.7	3.0	3.2	3.3	3.4	3.0	3.4	3.5	3.6	3.7	3.4	3.7	3.8	4.0	4.1	3.7	4.1	4.2	4.3	4.5
	10	1.8	2.0	2.1	2.2	2.3	2.1	2.4	2.5	2.6	2.7	2.4	2.7	2.8	2.9	3.0	2.7	3.0	3.1	3.2	3.3	3.0	3.3	3.4	3.6	3.7
10000	-54	4.2	4.6	4.8	5.0	5.1	4.7	5.1	5.3	5.5	5.7	5.0	5.5	5.7	5.9	6.1	5.4	5.9	6.1	6.3	6.5	5.8	6.4	6.6	6.8	7.0
	-50	4.2	4.7	4.8	5.0	5.2	4.7	5.1	5.3	5.5	5.7	5.0	5.5	5.7	5.9	6.1	5.4	5.9	6.1	6.3	6.6	5.8	6.4	6.6	6.8	7.0
	-45	4.3	4.7	4.8	5.0	5.2	4.7	5.2	5.3	5.5	5.7	5.1	5.6	5.7	5.9	6.1	5.5	6.0	6.2	6.4	6.6	5.9	6.4	6.6	6.8	7.0
	-40	4.3	4.7	4.9	5.0	5.2	4.7	5.2	5.3	5.5	5.7	5.1	5.6	5.8	5.9	6.1	5.5	6.0	6.2	6.4	6.6	5.9	6.4	6.6	6.8	7.1
	-35	4.3	4.7	4.9	5.0	5.2	4.8	5.2	5.4	5.5	5.7	5.1	5.6	5.8	6.0	6.2	5.5	6.0	6.2	6.4	6.6	5.9	6.5	6.7	6.9	7.1
	-30	4.3	4.7	4.9	5.1	5.2	4.8	5.2	5.4	5.6	5.7	5.1	5.6	5.8	6.0	6.2	5.5	6.0	6.2	6.4	6.6	5.9	6.5	6.7	6.9	7.1
	-25	4.2	4.6	4.8	4.9	5.1	4.7	5.1	5.3	5.4	5.6	5.0	5.5	5.7	5.9	6.0	5.4	5.9	6.1	6.3	6.5	5.8	6.4	6.6	6.8	7.0
	-20	3.7	4.1	4.2	4.4	4.5	4.2	4.6	4.7	4.8	5.0	4.5	4.9	5.1	5.2	5.4	4.9	5.3	5.5	5.6	5.8	5.3	5.7	5.9	6.1	6.3
	-15	3.1	3.4	3.5	3.6	3.8	3.5	3.8	4.0	4.1	4.2	3.8	4.2	4.3	4.4	4.6	4.2	4.5	4.7	4.8	5.0	4.5	4.9	5.1	5.2	5.4
	-10	2.5	2.8	2.8	2.9	3.1	2.9	3.1	3.3	3.4	3.5	3.2	3.5	3.6	3.7	3.8	3.5	3.8	3.9	4.0	4.2	3.8	4.2	4.3	4.4	4.6
	-5	1.9	2.1	2.2	2.3	2.4	2.3	2.5	2.6	2.7	2.8	2.5	2.8	2.9	3.0	3.1	2.8	3.1	3.2	3.3	3.4	3.1	3.4	3.5	3.7	3.8
	0	1.2	1.4	1.4	1.5	1.6	1.5	1.7	1.8	1.8	1.9	1.8	2.0	2.0	2.1	2.2	2.0	2.2	2.3	2.4	2.5	2.3	2.5	2.6	2.7	2.8
	5	0.5	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.0	1.2	1.2	1.3	1.3	1.2	1.4	1.5	1.5	1.6	1.5	1.7	1.7	1.8	1.9
	10	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.7	0.7	0.7	0.7	0.9	0.9	0.9	1.0
15000	-54	3.3	3.6	3.8	3.9	4.0	3.7	4.1	4.2	4.3	4.5	4.0	4.4	4.6	4.7	4.9	4.4	4.8	4.9	5.1	5.3	4.8	5.2	5.3	5.5	5.7
	-50	3.2	3.5	3.6	3.7	3.9	3.6	3.9	4.0	4.2	4.3	3.9	4.3	4.4	4.5	4.7	4.3	4.6	4.8	4.9	5.1	4.6	5.0	5.2	5.3	5.5
	-45	3.0	3.3	3.4	3.5	3.6	3.4	3.7	3.8	3.9	4.0	3.7	4.0	4.1	4.3	4.4	4.0	4.4	4.5	4.6	4.8	4.4	4.7	4.9	5.0	5.2
	-40	2.6	2.9	3.0	3.1	3.2	3.0	3.3	3.4	3.5	3.6	3.3	3.6	3.7	3.9	4.0	3.6	4.0	4.1	4.2	4.3	4.0	4.3	4.5	4.6	4.7
	-35	2.3	2.5	2.6	2.7	2.8	2.6	2.9	3.0	3.1	3.2	2.9	3.2	3.3	3.4	3.5	3.2	3.5	3.6	3.8	3.9	3.6	3.9	4.0	4.1	4.2
	-30	1.9	2.1	2.2	2.3	2.4	2.3	2.5	2.6	2.7	2.8	2.5	2.8	2.9	3.0	3.1	2.8	3.1	3.2	3.3	3.4	3.1	3.4	3.5	3.6	3.8
	-25	1.5	1.7	1.7	1.8	1.9	1.8	2.0	2.1	2.2	2.2	2.1	2.3	2.4	2.4	2.5	2.3	2.6	2.7	2.7	2.8	2.6	2.9	3.0	3.1	3.2
	-20	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.5	1.7	1.7	1.8	1.9	1.8	1.9	2.0	2.1	2.2	2.0	2.2	2.3	2.4	2.5
	-15	0.5	0.6	0.6	0.6	0.7	0.7	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.2	1.3	1.2	1.3	1.4	1.5	1.5	1.4	1.6	1.7	1.7	1.8
	-10	-0.1	0.0	0.0	0.0	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	1.0	1.0	1.1
	-5	-0.6	-0.6	-0.6	-0.6	-0.6	-0.4	-0.4	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3
	0	-1.2	-1.2	-1.2	-1.2	-1.2	-1.0	-1.0	-1.0	-1.0	-1.0	-0.8	-0.8	-0.8	-0.8	-0.8	-0.7	-0.6	-0.6	-0.6	-0.6	-0.5	-0.5	-0.4	-0.4	-0.4
	5	-1.7	-1.8	-1.8	-1.8	-1.8	-1.5	-1.6	-1.6	-1.6	-1.6	-1.4	-1.4	-1.4	-1.4	-1.4	-1.3	-1.3	-1.3	-1.3	-1.3	-1.1	-1.1	-1.1	-1.1	-1.1
	10	-2.1	-2.2	-2.2	-2.2	-2.3	-2.0	-2.0	-2.0	-2.1	-2.1	-1.8	-1.9	-1.9	-1.9	-1.9	-1.7	-1.8	-1.8	-1.8	-1.8	-1.6	-1.6	-1.6	-1.6	-1.6
20000	-54	1.0	1.2	1.2	1.3	1.3	1.3	1.5	1.5	1.6	1.7	1.6	1.7	1.8	1.9	1.9	1.8	2.0	2.1	2.1	2.2	2.1	2.3	2.4	2.4	2.5
	-50	0.9	1.0	1.0	1.1	1.1	1.2	1.3	1.4	1.4	1.5	1.4	1.6	1.6	1.7	1.7	1.6	1.8	1.9	2.0	2.0	1.9	2.1	2.2	2.2	2.3
	-45	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.1	1.3	1.3	1.4	1.4	1.4	1.5	1.6	1.6	1.7	1.6	1.8	1.9	1.9	2.0
	-40	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.8	0.9	1.0	1.0	1.1	1.0	1.2	1.2	1.3	1.3	1.3	1.4	1.5	1.5	1.6
	-35	0.0	0.1	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.1	1.1	1.2
	-30	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7
	-25	-0.8	-0.7	-0.7	-0.7	-0.7	-0.5	-0.5	-0.5	-0.5	-0.5	-0.4	-0.3	-0.3	-0.3	-0.3	-0.2	-0.1	-0.1	-0.1	-0.1	0.0	0.1	0.1	0.1	0.2
	-20	-1.3	-1.3	-1.3	-1.3	-1.3	-1.1	-1.1	-1.1	-1.1	-1.1	-0.9	-0.9	-0.9	-0.9	-0.9	-0.8	-0.7	-0.7	-0.7	-0.7	-0.6	-0.6	-0.5	-0.5	-0.5
	-15	-1.7	-1.8	-1.8	-1.8	-1.8	-1.6	-1.6	-1.6	-1.6	-1.6	-1.4	-1.5	-1.5	-1.5	-1.5	-1.3	-1.3	-1.3	-1.3	-1.3	-1.1	-1.1	-1.1	-1.1	-1.2
	-10	-2.2	-2.3	-2.3	-2.3	-2.4	-2.1	-2.1	-2.1	-2.2	-2.2	-2.0	-2.0	-2.0	-2.0	-2.1	-1.8	-1.9	-1.9	-1.9	-1.9	-1.7	-1.7	-1.7	-1.8	-1.8
	-5	-2.7	-2.8	-2.8	-2.8	-2.9	-2.5	-2.6	-2.7	-2.7	-2.7	-2.4	-2.5	-2.5	-2.6	-2.6	-2.3	-2.4	-2.4	-2.5	-2.5	-2.2	-2.3	-2.3	-2.3	-2.4
	0	-3.0	-3.1	-3.2	-3.2	-3.2	-2.9	-3.0	-3.0	-3.1	-3.1	-2.8	-2.9	-2.9	-3.0	-3.0	-2.7	-2.8	-2.8	-2.9	-2.9	-2.6	-2.7	-2.7	-2.8	-2.8
	5	-3.3	-3.5	-3.5	-3.6	-3.6	-3.2	-3.3	-3.4	-3.4	-3.5	-3.1	-3.3	-3.3	-3.4	-3.4	-3.1	-3.2	-3.2	-3.3	-3.3	-3.0	-3.1	-3.1	-3.2	-3.2
	10	-3.6	-3.8	-3.8	-3.9	-3.9	-3.5	-3.7	-3.7	-3.8	-3.8	-3.5	-3.6	-3.6	-3.7	-3.7	-3.4	-3.5	-3.6	-3.6	-3.7	-3.3	-3.4	-3.5	-3.5	-3.6

68FM-05-00

Single Engine Enroute Climb Gradient

The final chart we will discuss that is in the Citation Sovereign Aircraft Flight Manual is the **Single Engine Enroute Net Climb Gradient – Percent**. This chart is mainly for reference to indicate test data results for enroute climb. It is utilized exactly as the chart for 2nd Segment climb gradient discussed previously in the performance problem.

The following criteria were used to determine the data in the chart:

1. Flaps and Gear – UP.
2. Anti-Ice Systems – OFF or ON (2 sets of charts).
3. Speed Brakes – 0%.
4. Airspeed – V_{ENR} (180 KIAS).
5. Power - Max Continuous Thrust (MCT).

Let's use numbers from one of our earlier examples. We will say that an engine quit at 10,000 feet on climb out from Denver. We will also approximate our weight at this point to be 27,000 pounds, and our anti-ice equipment is ON. To find the climb gradient proceed as follows:

1. Start on the left side of the chart to find the appropriate altitude (10,000 feet).
2. Move to the next column to find the appropriate temperature (-10°C).
3. Continue across to the appropriate weight column (27,000 pounds).
4. Within that column identify the proper wind column (0 knots).
5. This will indicate the net climb gradient at these conditions (3.8%)

Keep in mind that when determining enroute climb gradient, the entire route must be constantly verified to be above the net gradient. Do not substitute second segment net climb gradient data and assume that the aircraft will be able to maintain that gradient throughout an extended enroute climb. The less restrictive approach of only checking the position of the aircraft over the known obstacle or highest altitude can have disastrous results. Ensure that your computations or performance calculator do not follow this less restrictive approach. Consideration must be given to not only flying a specific speed and configuration, but also engine power limitations.

Wet or Contaminated Runways

Cessna has certified the Citation Sovereign with a complete set of charts in the AFM depicting takeoff performance on wet runways. Also included in the Performance section of the AFM (Section IV) is advisory data to assist the crew during operations on contaminated runways.

Wet Runways

Definition

A runway is considered to be wet when there is sufficient moisture on the runway surface to cause it to appear reflective without significant areas of standing water.

Takeoff Distance: Wet Runway

The required takeoff field length from a wet runway or wet runway with reverser(s) is the longer of the wet runway or wet runway with reverser(s) and the dry takeoff field lengths determined with the use of the takeoff performance tables.

Takeoff on Wet Runways

The maximum depth of water for a wet runway is <0.125 inch. Any greater depth is considered contaminated. When operating off wet runways, a separate set of charts for runway length and V_1 are used. Because of the reduced screen height of 15 feet, the wet runway length is occasionally less than the dry runway distance. The wet and dry distances must always be compared and the longer of the two distances used as the minimum runway requirement. In the case of a runway length limited situation, always use the lighter or more restrictive weight.

The takeoff speeds for a wet runway (V_1, V_R, V_2, and V_{ENR}) are always the takeoff speeds associated with the calculated wet runway figures.

Landing on Wet Runways.

The AFM presents data for wet runway landings that is considered the most accurate and practical guidance material available. The information is advisory only and is not FAA approved.

The distances and correction factors presented in the AFM for wet runway landing conditions are approximate, and are to be considered minimums, as actual runway conditions may require distances greater than those determined. Ground handling characteristics, particularly following engine failure, in crosswinds, or when using reverse thrust, may be degraded.

To determine wet runway landing distance, the dry runway landing distance (with any applicable runway gradient adjustment) is applied to the wet runway landing distance table (with or without thrust reversers). Two columns in the table present a comparison in distances between V_{REF} and V_{REF}+10 KIAS. Examples of determining wet runway performance can be found in the AFM.

> ***NOTE:*** The published limiting maximum tailwind component for this airplane is 10 knots, however, landings on wet runways with any tailwind component are not recommended.

Contaminated Runways

Contaminated runway performance charts in the AFM contain advisory takeoff and landing distance data for airport operations on contaminated runways, and are based on analytical guidance material prescribed by the JAA – not flight test data. Flight crews are cautioned that actual conditions (different from those used for establishing the contaminated runway performance) may lead to different performance, and estimating average contamination depth and/or type can be difficult. The charts and data presented are advisory in nature and are not FAA-approved.

Definition

A runway surface is considered contaminated if it is neither dry nor wet. For example, a runway contaminated with standing water has a depth of more than 3mm (0.12 inch) and covers at least 25% of the runway surface area. Definitions for runways contaminated by compacted snow, wet snow, dry snow, slush or ice are contained in AFM Section IV, Contaminated Runway Takeoff and Contaminated Runway Landing sections.

Takeoff Distance: Contaminated Runway

The takeoff field length given for each combination of gross weight, ambient temperature, altitude, wind and runway gradients, is the greatest of the following:

- 115% of the two-engine horizontal takeoff distance from start to a height of 35 feet above runway surface.
- Accelerate-stop distance.
- The engine-out accelerate-go distance to 15 feet.
- The Dry Takeoff Field Length.

No specific identification is made on the charts as to which of these distances governs a specific case.

Takeoff on Contaminated Runways

For takeoffs on precipitation covered runways other than those considered wet runways, tables and correction factors are included in AFM Section IV, Performance. The performance information assumes that the runway contaminant is of uniform depth and density over the entire runway surface. The impingement drag is based on testing performed on a Cessna Citation Sovereign.

The distances and correction factors for contaminated runway conditions are approximate, and are to be considered minimums, as actual runway conditions may require distances greater than those determined. Where possible, every effort should be made to ensure that the runway surface is cleared of any significant contamination. Ground handling characteristics, particularly following engine failure, in crosswinds, or when using reverse thrust, may be degraded.

To determine contaminated runway takeoff distance, the wet runway landing distance with reversers (and any applicable runway gradient adjustment) is applied to the contaminated runway takeoff distance tables. The columns on the table present different types of precipitation and depth. Examples for determining adverse runway performance can be found in the AFM.

Landing on Contaminated Runways

As with takeoff, landing operations on contaminated runways require longer distances than on dry or wet runways. These longer distances result primarily from reduced braking effectiveness. Due to the difficulty of accurately measuring contaminant depth, actual runway conditions may require distances greater than those determined.

To determine contaminated runway landing distance, the dry runway landing distance (without thrust reversers, along with any applicable runway gradient adjustment) is applied to the contaminated runway landing distance tables. Tables are provided for a comparison of approach speeds at V_{REF} and V_{REF}+10 KIAS. The columns on the table present different types of precipitation and depth. Examples are provided to aid in the use of the tables.

> ***NOTE:*** The guidance material does not address multiple contaminant types such as loose snow covering compacted snow or slush (or standing water or loose snow covering an icy runway). Pilots should be especially cautious about conducting takeoff and landing operations when multiple contaminant types are present.

> ***NOTE:*** The published limiting maximum tailwind component for this airplane is 10 knots, however, landings on precipitation covered runways with any tailwind component are not recommended.

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Systems

Several chapters contain multiple systems to facilitate a more coherent presentation of information. The systems covered are listed below in alphabetical order opposite the chapter in which they are located. ATA codes are noted in parentheses.

SYSTEM (ATA Code)	CHAPTER
Air Conditioning (21)	PRESSURIZATION/ENVIRONMENTAL
Aircraft Structure (51)	AIRCRAFT OVERVIEW
APU (49)	AUXILIARY POWER UNIT
Autopilot (22)	AVIONICS AND AUTOPILOT
Brakes (32)	LANDING GEAR AND BRAKES
Communications (23)	AVIONICS AND AUTOPILOT
Dimensions and Areas (6)	AIRCRAFT OVERVIEW
Doors (52)	AIRCRAFT OVERVIEW
Electrical (24)	ELECTRICAL AND LIGHTING
Engine (71)	POWERPLANT AND THRUST REVERSERS
Engine Controls (76)	POWERPLANT AND THRUST REVERSERS
Engine Fuel and Control (73)	POWERPLANT AND THRUST REVERSERS
Engine Indicating (77)	POWERPLANT AND THRUST REVERSERS
Equipment/Furnishings (25)	AIRCRAFT OVERVIEW
Fire Protection (26)	FIRE PROTECTION
Flight Controls (27)	FLIGHT CONTROLS
Fuel (28)	FUEL SYSTEM
Fuselage (53)	AIRCRAFT OVERVIEW
Hydraulics (29)	HYDRAULICS
Ice and Rain Protection (30)	ICE AND RAIN PROTECTION
Ignition (74)	POWERPLANT AND THRUST REVERSERS
Landing Gear (32)	LANDING GEAR AND BRAKES
Lighting (33)	ELECTRICAL AND LIGHTING
Navigation (34)	AVIONICS AND AUTOPILOT
Oil (79)	POWERPLANT AND THRUST REVERSERS
Oxygen (35)	OXYGEN SYSTEM
Pitot/Static (34)	AVIONICS AND AUTOPILOT
Pneumatic (36)	PRESSURIZATION/ENVIRONMENTAL
Pressurization (21)	PRESSURIZATION/ENVIRONMENTAL
Stabilizers (55)	AIRCRAFT OVERVIEW

9

Aircraft Overview

Contents

Publications

Service Bulletins and Letters

Aircraft Overview

General

This section presents an overview of the Citation Sovereign aircraft. It includes major features, airframe structures, dimensions, and danger areas, as well as a list of service bulletins referenced in this manual.

This manual references the manufacturer's unit numbers and, where system differences warrant, it publishes separate data and schematics.

Unit numbers are assigned consecutively as construction begins; each number remains with its aircraft regardless of the model serial number later assigned.

The serial and unit number are stamped into the aircraft identification plate.

For details of the aircraft features, refer to Figure 9-1: Aircraft Features on page 9-4.

Aircraft Features

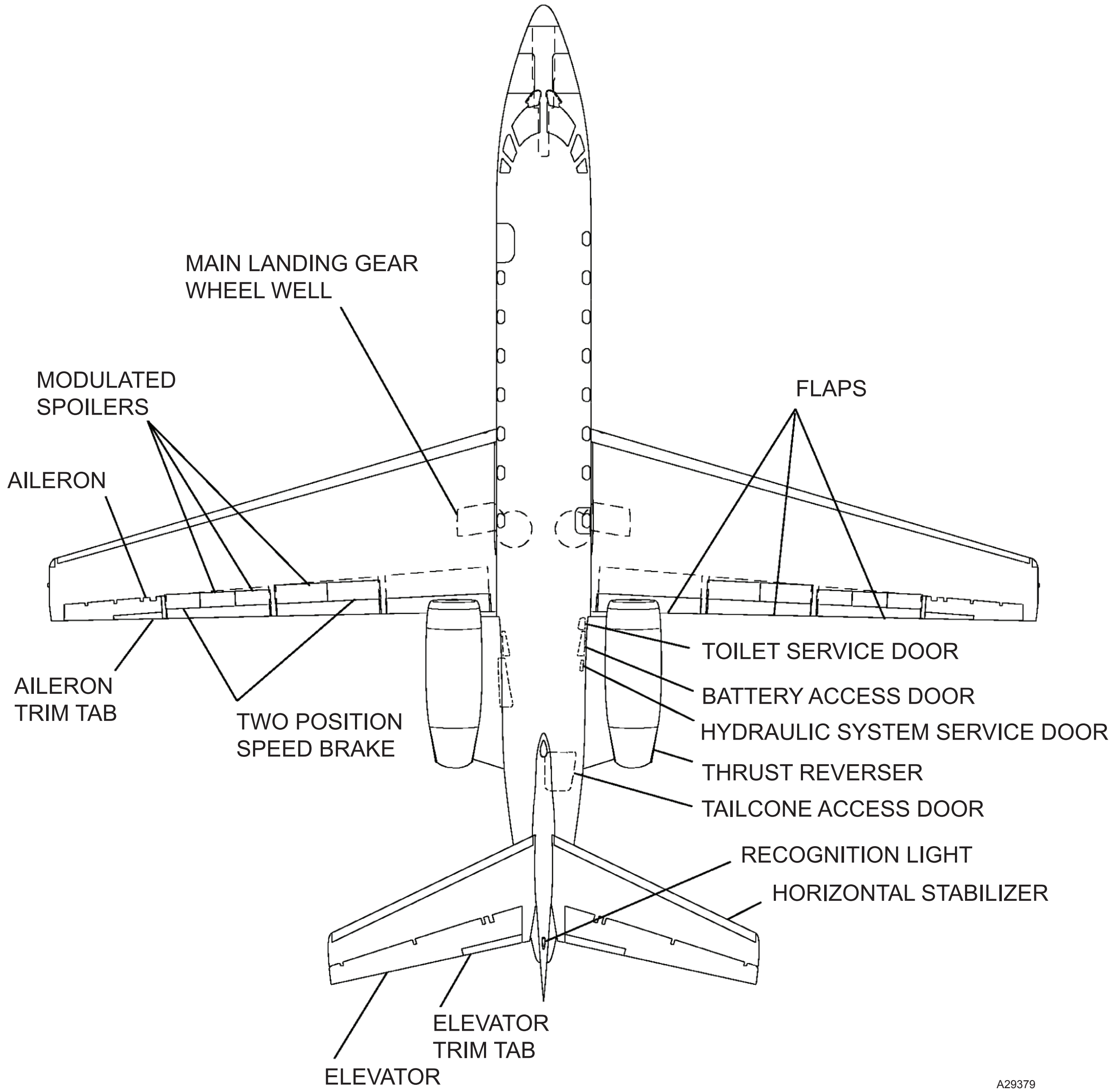

Figure 9-1: Aircraft Features

Airframe Description

General

The Citation Sovereign is a low-wing, twin turbofan, pressurized transport category airplane, specifically designed for all-weather operations and certified to fly at altitudes up to 47,000 feet. The minimum crew required is a pilot and copilot.

The aircraft is certified in accordance with FAR Part 25 and JAR-25 airworthiness standards and utilizes the fail-safe and damage tolerant construction concept. It combines systems simplicity with ease of access to reduce maintenance requirements. Low takeoff and landing speeds permit operation at small and unimproved airports. Front fan type turbofan engines contribute to overall operating efficiency and performance.

The aircraft is certified for the following types of operations: Day, night, VFR, IFR, flight into known icing, and Category I approach operations. Category II certification is available as an option.

Flight Controls

Primary flight control is accomplished through conventional cable-operated surfaces with the exception of roll spoilers, which are driven by hydraulics. The aileron system has automatic, electrically controlled, variable gearing to optimize handling qualities in various flight conditions. Pilot controlled trimming is provided by electrically driven aileron and rudder tabs, and by a moveable horizontal stabilizer. The elevator tabs are geared to the horizontal stabilizer and are equipped with an automatic pitch trim system to optimize high-speed stability. The horizontal stabilizer trim and the trailing edge flaps are electrically actuated. Hydraulically operated speed brakes are installed on the upper surface of both wings. The rudder pedals and nosewheel steering tiller provide mechanical control of the hydraulically powered nosewheel steering. The rudder system is equipped with a pneumatic rudder bias system that assists during single-engine operations.

Engines

Two Pratt & Whitney Canada Inc. PW306C turbofans installed on the rear fuselage produce 5770 pounds of thrust each for takeoff. The engines are controlled by dual channel, Full Authority Digital Engine Controls (FADEC). Each engine incorporates ice protection, fire detection and fire protection systems. Target-type thrust reversers are individually operated by "piggy back" controls mounted on the throttles.

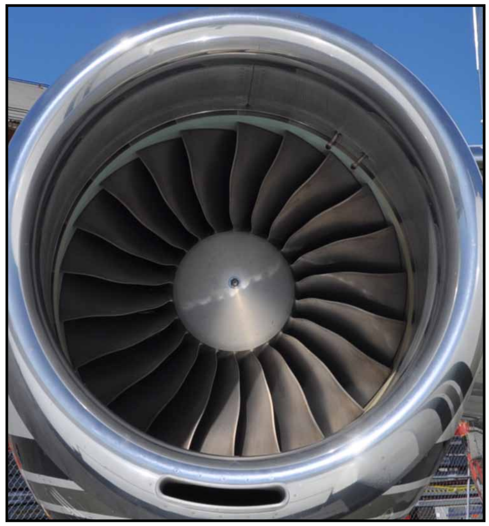

Figure 9-2: Engine

Fuselage

The fuselage is an all metal, semi-monocoque structure consisting of a nose section, pressurized compartment, and tailcone.

Figure 9-3: Fuselage

Nose Section

The nose section of the fuselage is unpressurized. The nose compartment is sized to provide space for avionics equipment and the nose wheel well. Access to the avionics equipment is provided by doors on the left and right side of the nose. The lower part of the right nose avionics compartment houses a fire bottle for use in the aft baggage compartment. The radome is removable to provide access to the radar antenna and other components. The nose gear retracts forward.

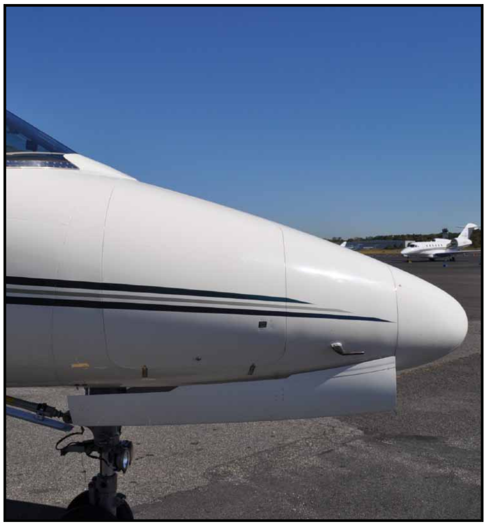

Figure 9-4: Nose Section

Pressurized Section

The Citation Sovereign pressurized cabin length is approximately 30 feet from the forward pressure bulkhead to aft pressure bulkhead. It accommodates eight passengers in the typical configuration and a crew of two. As many as twelve passengers may be accommodated in the high density seating option.

The cockpit seats can be moved vertically, horizontally, and tilted. The passenger seats can be reclined and swiveled.

An air outlet, light, and oxygen mask are provided in the cabin section for each passenger. An aft compartment houses a toilet with doors for privacy.

Cockpit

The cockpit contains flight, engine and miscellaneous instruments and pressurization controls. The Electronic Flight Instrument System (EFIS) consists of a Primary Flight Display (PFD) and Multi-Function Display (MFD) on both the pilot and copilot sides.

The standby instruments are located on the center of the panel. A pedestal between the crew seats contains the throttles, trim switches, flap and speed brake control handle and the Multi-Function Control Display Units (MCDU) for entering navigation, performance, radio tuning and other flight data.

Crew Seats

The crew seats have a five-point restraint system and are adjustable forward, aft, vertically and tilted. Three control handles are provided for the adjustments. Adjustable arm rests are also available for the flight crew seats.

Figure 9-5: Cockpit

Cockpit Windows

The cockpit windows (Figure 9-6) include the electrically heated glass windshield and forward side windows. Also included are the aft crew compartment side windows that open. The windshields and the forward flight compartment side windows are of laminated glass construction, with a laminated film heating element and bonded fiberglass edge attachments. The aft crew compartment side windows are made of laminated stretched acrylic construction.

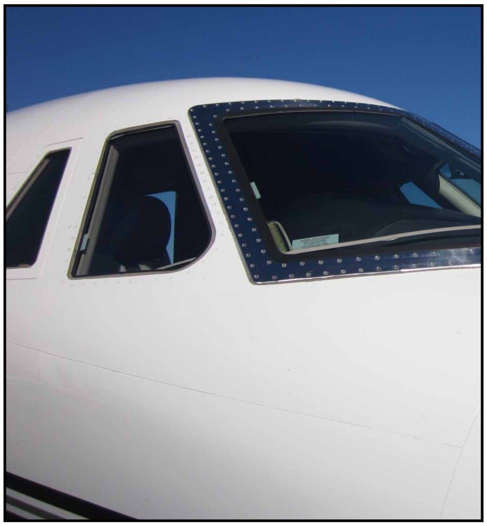

Figure 9-6: Cockpit Windows

Entry Door

The manually operated cabin door (Figure 9-7) is located on the left side of the fuselage at the forward end of the passenger compartment. A rubber seal around the door opening provides passive pressure sealing. A second pressurized seal provides noise reduction. The door can be opened from either the inside or the outside of the aircraft. The entry door, when opened, serves as steps into the interior of the aircraft.

Figure 9-7: Cabin Door

Emergency Exit Door

A removable emergency exit door (Figure 9-8) is located on the right side of the fuselage at the aft end of the passenger compartment. The door is of the plug type, and is installed from inside the aircraft. It can be removed from either inside or outside of the aircraft. This exit is an alternate to the cabin door in the event of a crash landing and is the primary exit in a ditching situation.

During emergency evacuation, the emergency exit door should be completely removed and thrown outside the aircraft through its own open exit, to keep the escape route clear inside the cabin.

Figure 9-8: Emergency Exit Door

Passenger Compartment

The passenger compartment (Figure 9-9) provides seating, an air outlet, a light and an oxygen mask for each occupant. The rear seats may be moved laterally away from the sidewall, tracked fore and aft, or reclined.

Figure 9-9: Passenger Compartment Seats

Passenger Cabin Windows

Eight windows are located on the right side of the cabin and seven are located on the left side (including the window in the emergency exit door), and are identical in construction. The windows are of laminated stretched acrylic/polyvinyl butyral construction, incorporating a frost pane on the interior side.

Figure 9-10: Cabin Windows

Toilet Compartment

Toilet Compartment Limitation

The lavatory doors must be latched open for takeoff and landing.

An externally serviceable flush toilet is installed between the aft vanity bulkhead closet and the aft divider. Although designed for permanent installation, the toilet assembly is removable for maintenance. Service is accomplished at the service panel, located on the right side of the aircraft behind the wing. The service panel door is not monitored and is closed with two mechanical latches. The waste drain line is insulated, and the waste drain valve is electrically heated to prevent line freezing. Power must be available to service the toilet.

Hydraulic Compartment

A hydraulic service area is accessed through a door aft of the right battery access door. The door is not monitored and is closed with two mechanical latches. The service area indicators and connections for a hydraulic service cart.

External Power Compartment

A ground power unit (DC power) receptacle is located aft of the right wing, forward of the right battery compartment. The door is not monitored and is secured by a single mechanical latch.

Baggage Compartment

A heated, non-pressurized baggage compartment is located aft of the rear pressure bulkhead. It includes a forward and aft section, as well as a coat rod. Access is provided on the left side of the aircraft behind the wing. The compartment is equipped with a smoke detection and fire suppression system. Maximum allowable weight is 1,000 pounds (453 kg). The maximum floor loading of the baggage compartment is 150 pounds per square foot.

Baggage Compartment Limitation

Baggage compartment smoke detection and extinguishing systems must be operational if baggage is to be carried in the compartment.

Figure 9-11: Baggage Compartment

Tailcone

Tailcone Compartment

The tailcone is an unpressurized area aft of the baggage compartment containing various system components. An Auxiliary Power Unit (APU) is located in the stinger, which is utilized to provide DC electrical power and environmental system support for the aircraft. Access to the tailcone is provided by a hinged door located on the bottom of the tailcone. The stinger area has three access panel/doors to provide access to the APU.

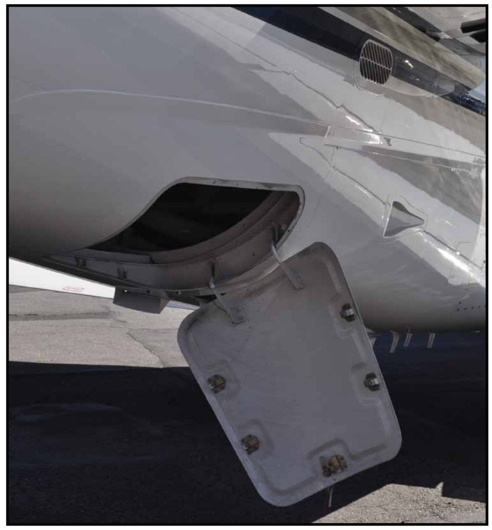

Figure 9-12: Tailcone Compartment

Battery Compartment

There are two 44 amp-hour batteries, left and right, which provide aircraft battery power. Power from the batteries is made available to the aircraft by use of the L or R BATT buttons located on the main electrical panel.

The batteries are located on each side of the fuselage just aft of the wing. Access panels allow for battery maintenance and disconnecting. The left battery access panel is forward of the tailcone baggage door. The right battery access panel is aft of the external power access door.

Figure 9-13: Battery Compartment

Door Unlocked Warning System

An amber **CABIN DOOR OPEN** CAS message will illuminate any time the cabin door switches indicate the cabin door is in the open position, the inner handle is not secured, the locks are not engaged, or the monitor system operation has not been verified correct.

The cabin door is secured with an over-center main bellcrank, which in turn drives rotating cam locks positioned on the door frame. Inspection windows near each cam lock allow for visual inspection of the locking mechanisms. The door is electrically monitored by microswitches, and must be closed with main DC power selected on.

If the door is not properly closed, the inner handle is not secured, the locks are not engaged, or the monitor system has not been verified correct, an amber **CABIN DOOR OPEN** message illuminates on the CAS portion of the EICAS display. If the cabin door is closed prior to turning the batteries on or if power to the left main electrical bus is interrupted after closing the door, the amber **CABIN DOOR OPEN** message will be displayed and the door must be cycled to clear the CAS message.

Above 80 knots ground speed, a locking solenoid engages the inner door handle to prevent it from inadvertently being moved during flight.

The baggage compartment door has four pins and latches which secure the door closed. The door is monitored electrically and will display an amber **BAGGAGE DOOR OPEN** CAS message when any baggage door sensor indicates the door is not fully closed, any of the four clasps are unlatched, or any one or more of the sensors are faulted.

In addition to the main cabin door and baggage door warning systems, the following amber annunciations will appear if the respective door is not properly closed at the mechanical latches:

- **EMERGENCY EXIT OPEN**
- **LAVATORY DOOR**
- **NOSE DOOR OPEN L** and/or **R**
- **TAILCONE DOOR OPEN**

Both MASTER CAUTION buttons will also illuminate with any of the amber door warning messages.

Wing

The wing is a moderately super-critical design in order to achieve low aerodynamic drag, high internal fuel volume, and favorable approach and landing qualities. The center wing assembly components together make up a one-piece wing with three carry-through spars that extend from wing tip-to-wing tip. The wing attach fittings are connected to the fuselage attach fittings with the use of six wing attach links. Wing leading edges are anti-iced by engine bleed air.

Figure 9-14: Wing

Empennage

The horizontal stabilizer is an adjustable airfoil with 138.54 square ft (12.87 m^2) of surface area. It has a sweepback angle of 25.4° along the leading edge and 0.0° of dihedral. The horizontal stabilizer is installed in the middle of the vertical stabilizer and can move to increase or decrease the angle of attack to change the pitch trim of the aircraft. The leading edge is heated with the use of bleed air for anti-ice protection. The elevators are attached to the trailing edge. The trim tabs are operated mechanically when the horizontal stabilizer is moved. A Mach trim actuator is attached to the trim tabs.

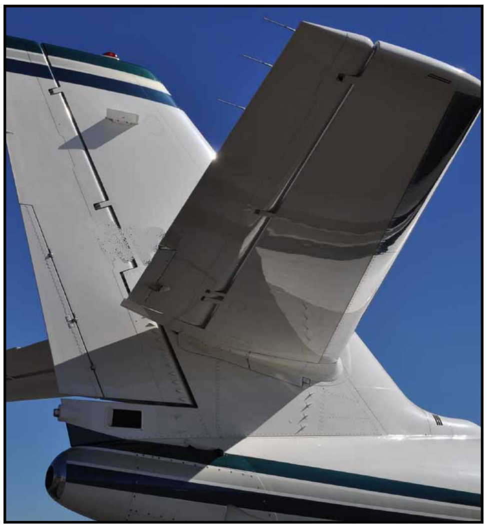

Figure 9-15: Empennage

Aircraft Dimensions

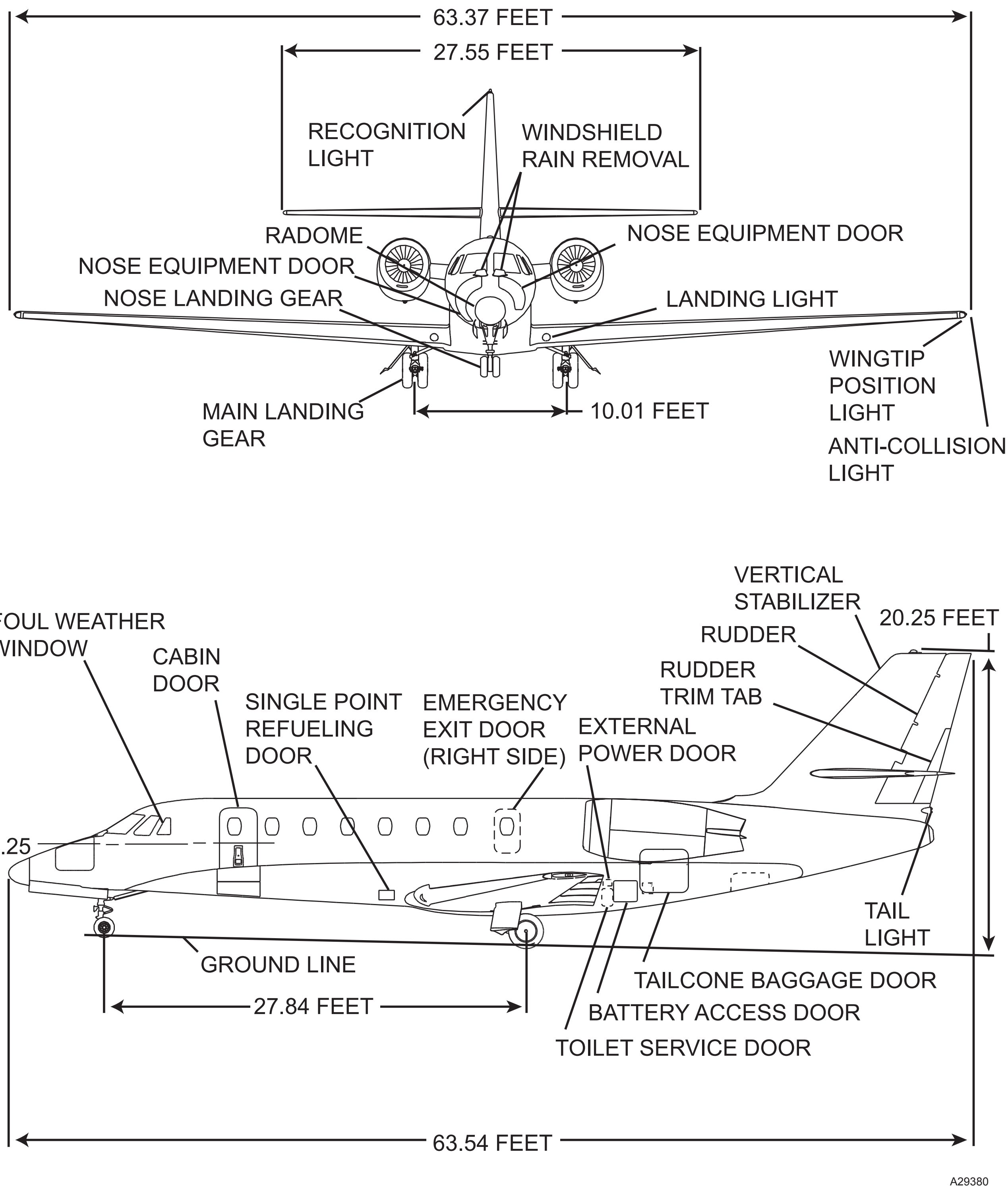

Figure 9-16: Aircraft Dimensions

Aircraft Dimensions

Exterior

Length . . . . 63.54 feet
Height . . . . 19.94 feet
Wingspan. . . . . 63.13 feet
Horizontal Stabilizer Span . . . . 27.55 feet
Wheelbase (MLG to NLG). . . . . 27.84 feet
Stance (Distance Between MLG) . . . . 10.01 feet

Interior

Length (Pressure Vessel) . . . . 30.80 feet
Height . . . . 5.75 feet
Width . . . . 5.71 feet

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Hazard Areas

The primary dangers around the aircraft are weather radar emissions from the radome, the engine inlet air draw, and the exhaust plume (Hazard Areas).

Radar

The area within the scan area (±135° of the nose) and within 30 feet of the Primus 880 weather radar system during operation constitutes a hazardous area. Do not operate the radar system within 15 feet of personnel or flammable or explosive material or during fueling operations.

For ground operation of a radar system, position the aircraft facing away from buildings or large metal structures that are likely to reflect radar energy back to the aircraft.

Engine Inlet Air Draw

The engine inlet air draw is hazardous up to 37 feet in front of the engine nacelle. The draw increases close to the nacelle. Ingestion of small articles (e.g., keys and pebbles) can cause considerable damage to the engine.

Engine Exhaust Plume

The engine exhaust danger area extends up to 270 feet from the rear of the engine. The engine exhaust hazards lie in plume temperature and velocity.

At maximum takeoff thrust, exhaust gases immediately exiting the nacelle average 537°C (1,000°F) at 600 knots. This decreases to 29°C (84°F) and 40 knots at a distance of 200 feet.

Advise ground personnel of imminent engine starts. Do not start an engine without verifying that the immediate area behind and in front of the aircraft is clear of ground personnel, small articles, and sensitive equipment.

Refer to Figure 9-17: Hazard Areas on page 9-22.

Hazard Areas - Citation Sovereign

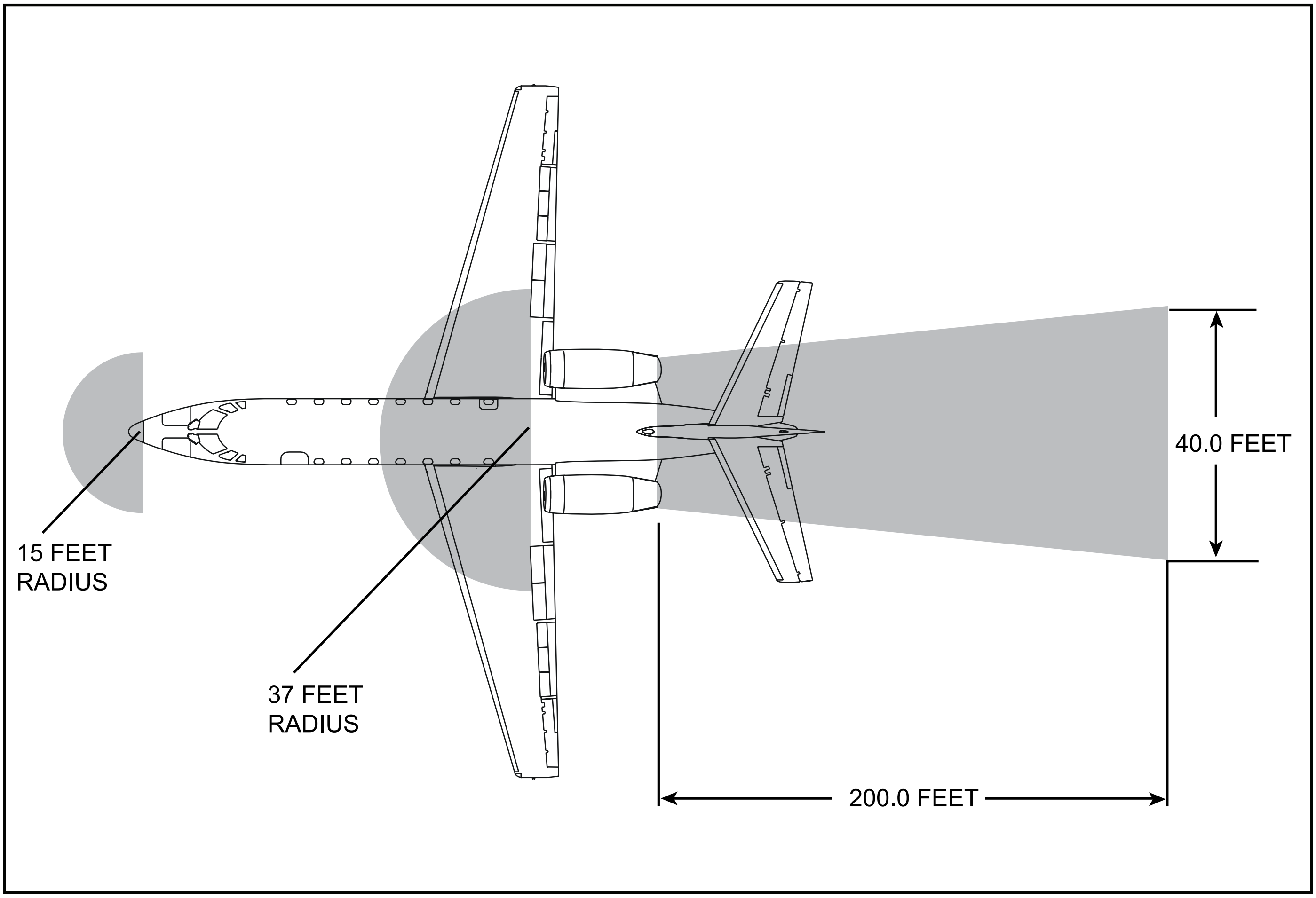

Figure 9-17: Hazard Areas

Publications

The following publications must be immediately available to the flight crew:

- FAA-Approved Airplane Flight Manual
- Honeywell Primus EPIC Integrated Avionics System Pilot's Guide
- Honeywell Primus EPIC Flight Management System Pilot's Guide

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Service Bulletins and Letters

The following is a list of Service Bulletins (SB) and Service Letters (SL) that are applicable to the operation of the aircraft, and have been incorporated into this manual. This list contains only those Service Bulletins that are currently active. A complete list of Service Bulletins and Service Letters is available online at the Cessna Customer Support website.

Number	Title	Aircraft Serial Effectivity
SB680-27-02	Flight Controls - Right Aileron Trim Actuator Installation	680-0001 thru -0049
SB680-49-02	Auxiliary Power Unit - APU Starter Generator Cooling	680-0002 thru -0072
SL680-78-01	Exhaust - Replacement of Thrust Reverser Door Seals	680-0001 thru -0035
SB680-34-09	Navigation - Category II Operations	680-0001 and On
SB680-49-05	Auxiliary Power - APU ADD OIL Light Removal	680-0001 thru -0084
SB680-34-20	Navigation - EPIC Phase 5 Software Upgrade	680-0001 thru -0290
SB680-34-23	Navigation - EPIC Phase 4.2 Software Upgrade	680-0001 thru -0213
SL680-30-03	Ice and Rain Protection - Approved Deicing Program Updates	680-0001 and On

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10

Auxiliary Power Unit

Contents

Auxiliary Power System

Introduction

The Auxiliary Power Unit (APU) is a turbine engine composed of one compressor stage and one turbine stage with accessory mountings for a starter-generator and a bleed air control valve that provides compressor pressurized air for the aircraft pneumatic system bleed air supply manifold. The APU allows the aircraft to operate independently without requiring a ground DC power cart to supplement battery power for operating aircraft systems or starting engines. The APU also provides the ability to operate the air conditioning pack to cool or heat the aircraft interior without the necessity of starting the engines while preparing for departure. During flight, the APU can be used as a backup electrical power supply if a malfunction renders one or both aircraft engine generators inoperative. The APU operating envelope extends up to thirty thousand feet (30,000 ft) if the APU is started at a lower altitude. The APU will start at altitudes up to twenty thousand feet (20,000 ft).

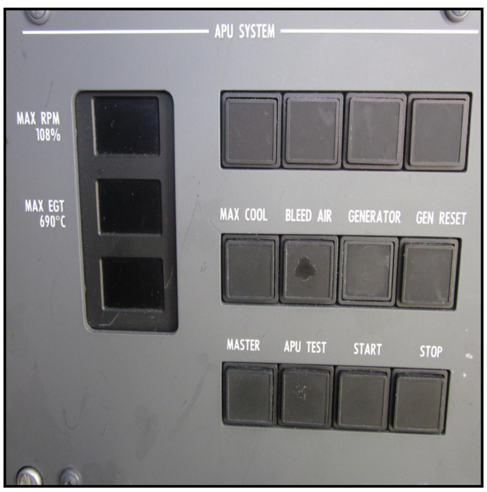

Figure 10-1: APU System Control Panel

Description

General

The Honeywell RE100 APU is designed for fully automatic operation. It consists of a single-stage centrifugal compressor, reverse-flow annular combustor, and a single-stage radial inflow turbine. A gearbox driven by the power section reduces the power RPM to drive a DC starter-generator, oil pump and fuel control unit.

APU Installation

The APU is installed in the tailcone stinger below the vertical stabilizer. Electrical components necessary for operation of the APU system include the control panel on the copilot's side console in the cockpit, an APU Electronic Control Unit (ECU) in the tailcone, a maintenance control panel in the tailcone, and an APU Printed Circuit Board (PCB). System operation is controlled from the cockpit via the APU System Control Panel.

APU Fire Protection

An APU fire extinguishing system is installed to deploy extinguishing agent into the APU fire containment box in the event a fire is detected by the associated fire detection system. The containment box is made of titanium and stainless steel and completely encloses the APU. More information pertaining to the APU fire detection and extinguishing systems can be found in the Fire Protection chapter of this manual.

APU Inlet and Exhaust

The APU air inlet is in the rudder fairing on the copilot's side of the airplane. Air travels through the inlet, forward to an acoustic chamber, and down into the APU. The APU exhaust goes out through the aft end of the tailcone stinger. An APU exhaust system bellmouth operates as an eductor for the APU exhaust. As the exhaust air goes into the bellmouth and exhaust duct, it pulls cooling air into the stinger through two NACA openings on each side of the stinger.

Figure 10-3: APU Compartment

Figure 10-2: APU Exhaust

Components and Operation

Oil Reservoir

The APU gearbox also functions as an oil reservoir that uses the same type of oil as the engines. Oil is sprayed on the compressor shaft by an oil pump and returned to the reservoir by scavenge pumps. The ECU monitors the oil temperature and pressure. If the oil temperature becomes excessive or the oil pressure becomes too low, the ECU shuts down the APU. Oil bypass and chip collection are checked during inspections by maintenance. APU oil quantity is checked using the service panel located in the tail compartment. Servicing of the oil is accomplished through an access door on the left side of the tail stinger.

Electronic Control Unit (ECU)

The Electronic Control Unit (ECU) is a microprocessor that provides independent control and operational monitoring of the APU through direct wire connections to the mechanical components of the APU and ARINC-429 bus connections to Modular Avionics Units for aircraft sensor data. The ECU controls the APU start sequence, including providing voltage to the APU starter and initiating fuel flow to the combustion chamber when RPM is sufficient and powering the igniters. Once the APU has been started, the APU monitors performance and adjusts operating temperature and RPM by commands to the fuel control, controls and monitors the loading of the DC generator and provides bleed air to the pneumatic system, if selected, by varying the position of the Bleed Control Valve (BCV). The ECU also records the cumulative operating time of the APU whenever RPM reaches the normal range though an hour meter function. The electronically stored record of APU operation is used to schedule periodic maintenance and inspection of the APU. The ECU receives power from the emergency bus system.

The ECU provides operational protection for the APU by shutting down the unit if operating parameters are exceeded or if a fire is detected within the APU housing.

Starter-Generator

The APU starter-generator is on the accessory gearbox and is air-cooled. The starter-generator is interchangeable with the engine generator. The generator is rated at 28 VDC, limited to 275 amps. The generator can temporarily exceed the continuous rating and provide up to 450 amps when assisting an engine start. The APU generator is controlled with the GENERATOR and GEN RESET buttons on the APU SYSTEM control panel. The starter-generator has an internal fan that circulates air for cooling on the ground. The internal fan and ram air provide cooling in flight.

Maximum Altitude Limitation

Maximum operating altitude for the APU is FL300.

The APU is used in assisting the batteries for engine starts and is capable of supplying electrical power to the entire electrical system. Amperage is limited to 275 amps, but transients over 275 amps are allowed during engine starts and up to 2 minutes after engine starts to allow for recharging of the batteries.

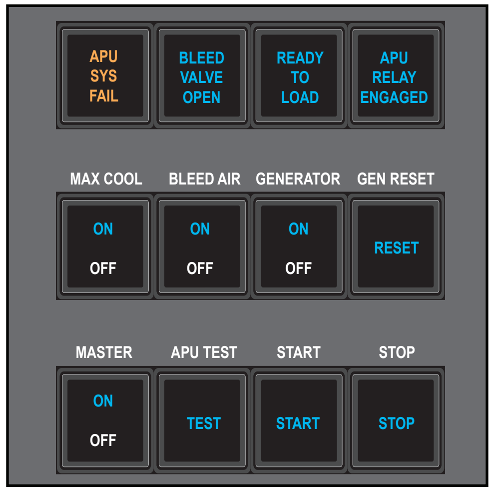

Figure 10-4: APU Generator Controls

Fuel Supply and Control

Fuel is supplied to the APU from the right wing fuel tank via the electric fuel boost pump. If motive flow is available (RH engine running), the electric fuel boost pump is not required. Crossfeed from the opposite tank is possible with normal crossfeed operations.

A DC-powered electric motor valve opens when the APU MASTER button is selected ON. This allows fuel from the wing tank to pass through the APU firewall to the APU. The valve closes when the MASTER button is selected OFF, the EMERGENCY SHUTOFF button in the tailcone compartment is pressed, or the ECU commands it closed.

The Fuel Control Unit (FCU) attached to the APU filters the fuel, boosts the pressure, and regulates it through a torque motor metering valve. Any change in RPM is sensed by the ECU and sends a signal to the torque metering valve to increase or decrease the fuel flow to maintain RPM at 100%.

APU Fuel Shutoff Solenoid Valve

Fuel exiting the FCU passes through the APU fuel shutoff solenoid valve before reaching the primary and secondary fuel manifolds (and six fuel nozzles) for combustion. The fuel shutoff solenoid opens during start at 5% RPM and remains open until the ECU closes it during normal or abnormal shutdown.

Bleed Air Control Valve

Bleed air from the APU is extracted from the compressor section and is routed to the service air manifold and the Bleed Control Valve (BCV). APU air is available for environmental, pressurization, and service bleed systems only. The BCV is regulated by a printed circuit board which will automatically close the BCV to an intermediate position if a low RPM or high EGT condition exists. APU electrical output has priority over the bleed air in that the system will maintain a continuous generator demand while reducing bleed air load if the APU EGT is too high.

APU Starting

Pushing the START button on the APU SYSTEM panel transmits two start signals from the APU CNTL PCB. One signal goes to the GCU and one signal goes to the ECU. After the APU CNTL PCB receives the start signals, it transmits a signal to the AUX DIST PCB to close the APU relay, which will supply current to the APU starter-generator, and also transmits a signal to the RH FUEL PCB to open the APU fuel valve and start the right boost pump. When the APU is at 5% RPM, the ECU transmits a signal to open the APU-mounted fuel shutoff valve and also energize the ignition unit. The GCU will continue to supply power to the starter-generator through the APU relay until the APU is at 50% RPM.

Maximum Altitude and Airspeed Limitation

Maximum altitude for APU starting is FL200. Maximum airspeed for APU starting is 250 KIAS.

If the APU does not start (no flame) within 4 seconds, which the ECU senses as a 38°C (100°F) rise in EGT, the ECU will transmit a signal to the GCU to disengage the starter-generator. As APU speed rolls back to less than 10% RPM, the ECU will transmit a signal to the GCU to engage the starter-generator again. This automatic sequence (restart attempt) will occur not more than three times.

The ignition unit is de-energized at 99% RPM. If the speed decreases uncommanded to less than 94% RPM, the ignition unit will energize again. When the APU is at 95% RPM for more than 4 seconds, the READY TO LOAD annunciator switch on the APU SYSTEM panel will come on, which shows that bleed air and/or electrical power is available.

The start sequence will stop manually when the STOP annunciator switch on the APU SYSTEM panel is pushed, or automatically commanded by the ECU or APU CNTL PCB.

Operation

The APU may be operated on the ground or up to FL300 at any speed within the aircraft's normal operating envelope. APU starting is limited to FL200 or below, and a maximum airspeed of 250 KIAS. Approximate fuel burn at sea level is 110 pounds per hour unloaded, 125 pounds per hour loaded.

For aircraft with SB 680-49-02, the APU may be used as an alternate source of electrical power in flight, if desired. Refer to normal checklist procedures for detailed information.

APU Shutdown

The APU can be shut down with all systems operating. To stop the APU, momentarily press the STOP button. RPMs begin decreasing until they become zero.

The APU will automatically shut down as commanded by the ECU if a fire is detected in the APU enclosure, as well as for system failures such as an overspeed condition. All faults are logged by the ECU for maintenance tracking purposes.

> ***NOTE:*** The APU must not be restarted after shutdown until 30 seconds after the RPM indicator reads 0%.

Controls and Indications

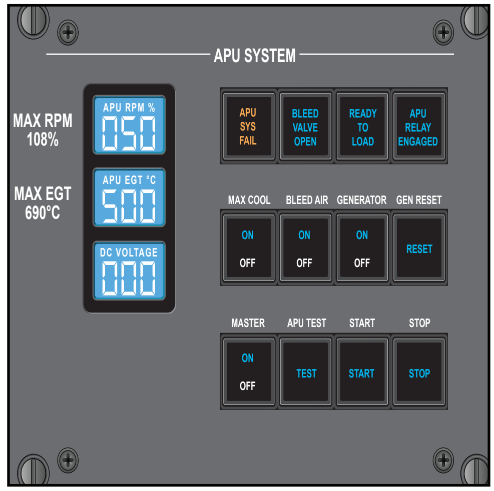

Figure 10-5: APU Control Panel

APU Control Panel

The left side of the APU SYSTEM control panel provides the following digital information:

- APU RPM: Provided by the ECU for display.
- APU EGT: Provided by a thermocouple extending into the exhaust gas stream. The ECU uses this temperature for fuel scheduling, controlling the bleed-air control valve, and automatic shutdown due to overtemperature.
- DC VOLTAGE: Indicated when the APU is operating, even if the generator is selected OFF. The number represents voltage available for use.

Circuit Breakers

Three circuit breakers control APU operation:

- APU FIRE DETECT: Right CB panel. Emergency bus power dedicated to the fire detection system.
- APU MASTER: Right CB panel. Emergency bus power and protection for the APU electrical system.
- APU ECU: Aft J-box CB panel. Dedicated to the ECU.

Circuit breakers are placed on the emergency bus for engineering purposes. Although the circuit breakers receive emergency bus power, the APU will not operate with a loss of main DC bus power.

Annunciators

APU SYS FAIL

The amber APU SYS FAIL annunciator indicates a system malfunction, and that the APU will not start. The APU has failed its self-test or has automatically shut down.

BLEED VALVE OPEN

The cyan BLEED VALVE OPEN annunciator indicates that the APU bleed control valve is open. Illumination of this light is normal if the BLEED AIR button is selected ON.

READY TO LOAD

The cyan READY TO LOAD annunciator indicates that the APU has reached operating speed (RPM 95% + 4 seconds). Electrical and bleed air loads are available and may be selected ON. The annunciator remains illuminated during operation.

APU RELAY ENGAGED

The cyan APU RELAY ENGAGED annunciator illuminates during APU start when the starter-generator is receiving start power through its APU relay. The annunciator extinguishes at starter cutoff (approximately 50% RPM). The annunciator illuminates again when the APU relay closes. If the generator button is ON during start, it is important to note the extinguishing of this annunciator when the start sequence terminates.

Buttons

MAX COOL

MAX COOL can only be selected ON if the bleed air is ON. Selecting MAX COOL ON opens the bleed air load control valve to its maximum open position for environmental cooling. Selecting MAX COOL OFF repositions the BCV to its normal bleed-air open position.

NOTE: Operating the cockpit and cabin temperature controls in MANUAL is prohibited while APU MAX COOL is selected ON.

BLEED AIR

Selecting bleed air ON opens the BCV to an intermediate position, approximately half open. The cyan BLEED VALVE OPEN annunciator on the APU panel illuminates when the BCV is open and remains illuminated until the valve fully closes.

The BCV is closed during APU start, even if the button is selected ON, and automatically opens when the READY TO LOAD annunciator illuminates. Manual selection to ON should be made after the READY TO LOAD annunciator illuminates. Selecting OFF closes the BCV completely.

GENERATOR

Selecting the GENERATOR button to the ON position closes the APU generator relay to power the left emergency bus. Selecting the OFF position commands the GCU to open the APU relay and place the generator off line.

APU Operation Limitation

Unattended operation of the APU is prohibited.

Depending on aircraft configuration, the generator may be used in flight. Configuration AF (SB-680-49-02) installs a dedicated air-cooling exhaust pipe to increase the amount of airflow across the generator for cooling. Only aircraft with this modification may operate the APU generator in flight. One APU start attempt is permitted following a dual generator failure.

GEN RESET

The GEN RESET button is a momentary contact switch used for attempting to regain generator power after an uncommanded failure. Refer to the AFM for more information.

MASTER

The APU master switch, when selected ON, provides power to the APU system. It initiates an internal self-test and allows full control of the APU panel. In the OFF position, all power is removed from the APU.

APU TEST

The APU TEST button checks the proper illumination of buttons, annunciators, and digits on the APU panel. The APU TEST switch also checks for proper APU fire indications and aural warnings.

APU FIRE Button

Illumination of the APU FIRE PUSH button indicates that a high temperature has been detected around the APU. Pressing the momentary contact button activates the fire suppression system.

DC AMPS Gauge

The DC AMPS gauge is on the right instrument panel. The scale ranges from 0 to 400 amps, with a red line amperage limitation.

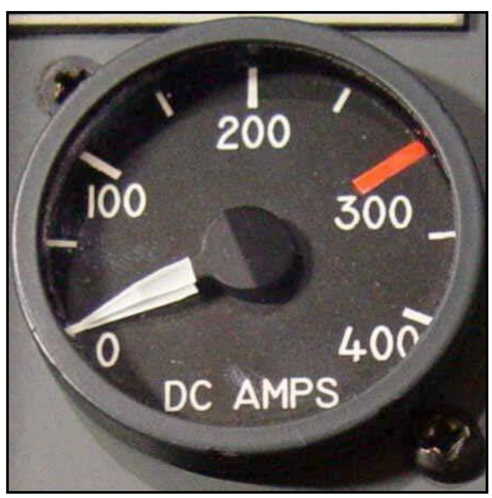

Figure 10-6: DC Amps Gauge

APU Cycle Counting

APU hours and start cycles are recorded in the ECU. A start cycle is counted when the APU READY TO LOAD annunciator on the APU panel illuminates. Hours are recorded when the MASTER button on the APU panel is selected ON. The total APU HOURS and CYCLES can be accessed in either Multifunction Control Display Unit (MCDU).

Figure 10-7: APU Hours Meter

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Servicing and Procedures

Servicing Panel

An APU service panel in the tailcone allows for APU preflight and emergency shutdown. Functions on the panel include an oil check switch and an emergency shutdown button.

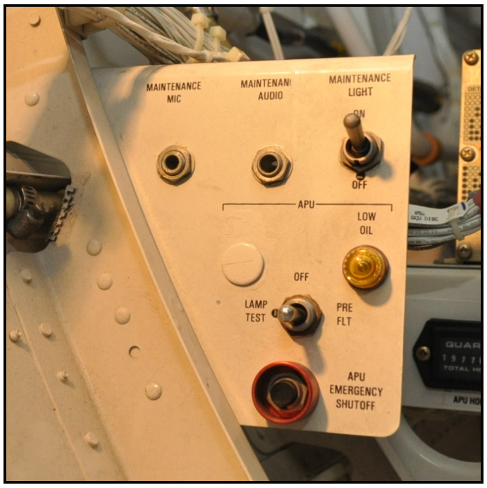

Figure 10-8: APU Service Panel

Preflight

The oil level in the reservoir is checked on the APU service panel. For accurate readings, oil quantity should be checked after the APU has been shut down for at least 10 minutes.

To conduct a preflight check of the APU:

1. Push the switch to the LAMP TEST position. The amber LOW OIL indicator should illuminate.
2. Release the switch and push it to the OIL CHECK (or PRE FLT) position:
    a. If the amber light does not illuminate, the oil is adequate.
    b. If the amber LOW OIL light illuminates, the oil level should be checked with the dipstick and properly serviced. If no services are available, the APU may be operated up to 20 hours.

The limitations section of the AFM states that the APU must be tested with the APU TEST button on the APU SYSTEM panel.

A successful test of the APU is indicated by illumination of the following lights:

- Amber APU SYS FAIL indicator
- Cyan BLEED VALVE OPEN indicator
- Cyan READY TO LOAD indicator
- Cyan APU RELAY ENGAGED indicator
- MAX COOL button (both ON and OFF lights)

- MASTER button
- APU TEST button
- START button
- STOP button
- BLEED AIR button
- GENERATOR button

> ***NOTE:*** The BLEED AIR button and GENERATOR button remain unchanged in whichever state they are each selected.

Starting and Shutdown

The APU can be started on the ground with battery power, a ground power unit, or engine generator power. If battery power is used, the minimum voltage for start is 24 VDC. In flight APU starts require the crew to place the BUS TIE button in the CLOSED position. This allows both batteries to participate in the APU start. The bus tie must be opened following start completion.

To start the APU, the main battery buttons must be on. A minimum of 24 VDC is required to start the APU. Press the APU MASTER button to the ON position. This illuminates the APU panel and initiates an internal self-test. Press and hold the TEST button until all the proper indications have been checked.

The GENERATOR and/or BLEED AIR buttons may be selected ON or OFF for start. PCB logic prevents their operation until the APU has successfully completed the start cycle. Momentarily press the START button. The APU RELAY ENGAGED annunciator illuminates and the RPM begins to increase. Following ignition, the EGT begins to rise. Monitor the start and, at approximately 50%, the APU START RELAY annunciator extinguishes.

At completion of the start cycle, the READY TO LOAD annunciator illuminates, indicating that the APU is ready. The GENERATOR and/or BLEED AIR buttons may be selected ON. If the GENERATOR and/or BLEED AIR buttons were in the ON position, the respective system operation will automatically be commanded on by the ECU (MAX COOL is OFF for APU starts). Operation of the generator can be verified by the ammeter on the right side of the instrument panel, and bleed-air operation can be verified by the increase of air noise in the cockpit/cabin. Both electrical loading and bleed-air use can also be verified by an increase in EGT.

The APU can be shut down with all systems operating. To stop the APU, momentarily press the STOP button. RPMs begin decreasing until they become zero.

> ***NOTE:*** The APU starting limit is three APU start cycles per 30 minutes. Three cycles with a 90-second rest period between cycles is permitted.

Operational Considerations

If the airplane is to be secured and stored in a “flight ready” condition, it is generally recommended that at intervals of every three (3) to seven (7) days the APU be operated (at no load) for a minimum of five (5) minutes in order to preclude the possibility of APU engine compressor shroud corrosion. This practice is strongly recommended at intervals of three (3) days when the airplane is located in climates with consistently high levels of humidity and salinity, such as coastal areas.

Abnormal and Emergency Procedures

The following is a discussion of abnormal and emergency procedures pertaining to the APU. For a detailed checklist, refer to the CAE SimuFlite Operating Handbook.

APU System Failure

An amber APU SYS FAIL annunciator illuminated on the APU control panel indicates a failure of the APU self-test, or that an automatic shutdown of the APU has been initiated by the ECU. On the ground, cycling the APU MASTER button OFF to reset may clear the failure message. In flight, do not attempt to restart the APU.

APU Inflight Operation - Alternate Electrical Power Source

If the left engine generator has failed, or if both generators have failed, the APU may be used as an alternate source of electrical power if the power loss is not associated with an over-current condition. The normal APU start checklist is used in conjunction with the appropriate abnormal (single generator failure) or emergency (dual generator failure) checklist. Monitor electrical loads and decrease as required. Land as soon as practical.

APU Fire Detection Failure

If the APU fire detection system is inoperative, the APU will not start and will automatically shut down if it is running. Confirm that the APU is shut down using normal procedures.

APU Fire

A red APU FIRE button is on the right side of the instrument panel. If an excessively high temperature is sensed by the fire-detection system in the APU compartment, the light illuminates and the APU automatically shuts down. When this occurs, pressing the APU FIRE button discharges the shared baggage/APU fire bottle in the tailcone into the APU compartment.

If the button is not pressed within 8 seconds after illumination, the baggage/APU fire bottle is discharged automatically. Following discharge of the fire bottle, a cyan CAS message **FIRE BOTTLE LOW BAG-APU** appears on the EICAS. The APU and baggage heat cannot operate when this message is displayed.

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EICAS System Displays

Information regarding the APU system is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit.

Messages are displayed in cyan, amber or red, according to their urgency. The following are possible messages displayed that relate to the APU system.

Cyan Messages	Description
APU ON	This message is displayed when the APU is running and altitude is less than or equal to FL300.
Amber Messages	**Description**
APU ON	This message is displayed when the APU is running and altitude is greater than FL300.
APU FIRE DETECT FAIL	This message is displayed when the APU SYSTEM MASTER button is selected ON and the APU fire detection system is inoperative.
APU SYS FAIL	This message indicates a failure of the APU self-test, or that the ECU has initiated an automatic shutdown of the APU.
Red Messages	**Description**
APU FIRE	This message is displayed when a fire is detected in the APU.

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11

Avionics

Contents

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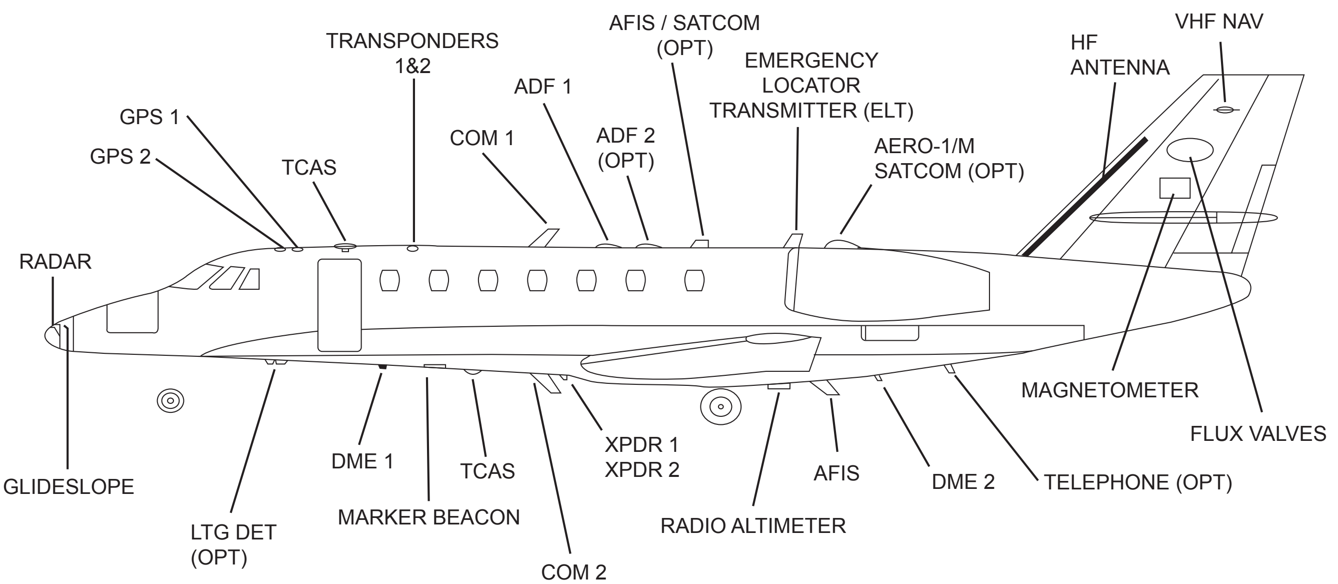
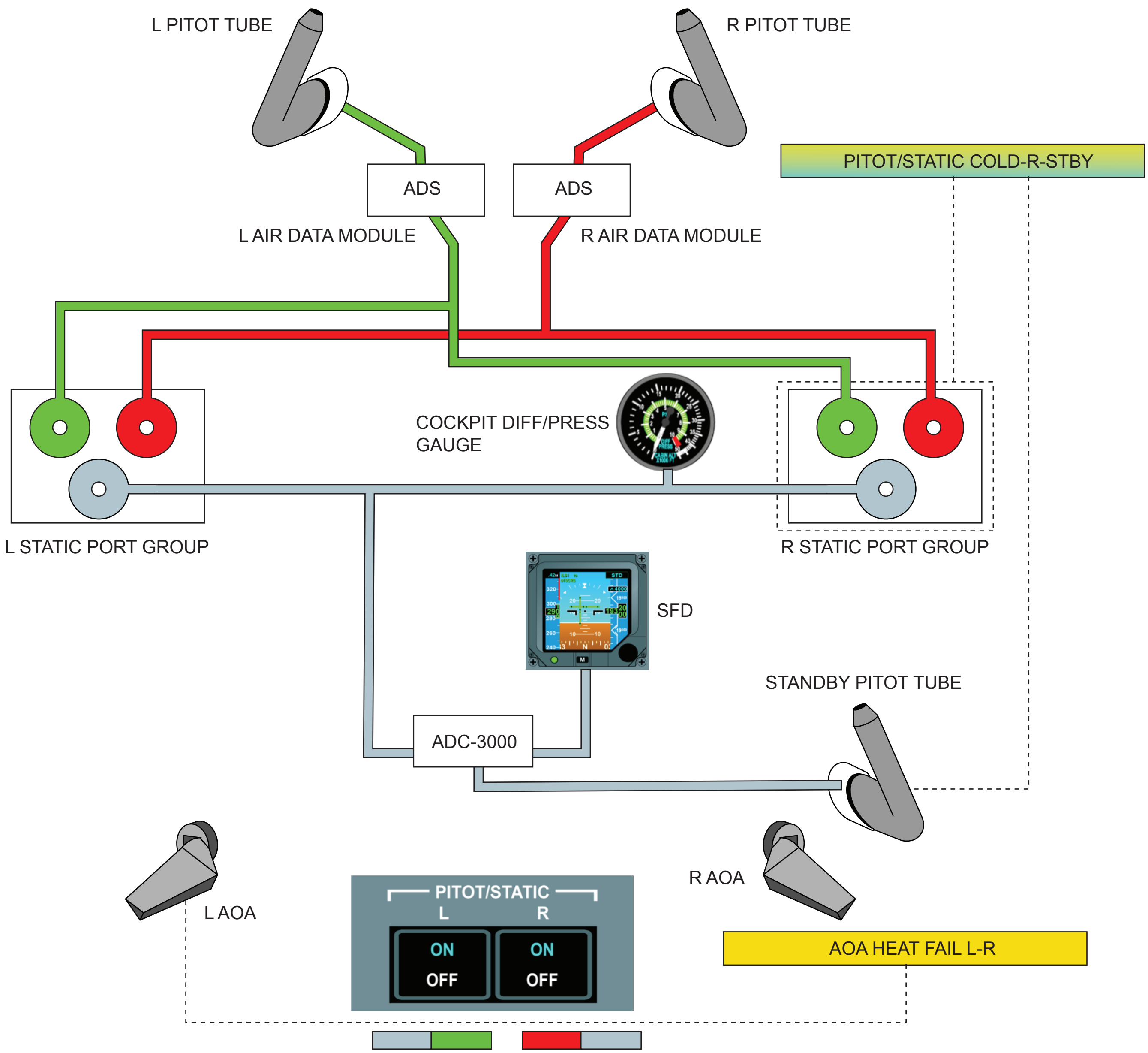
Citation Sovereign Cockpit

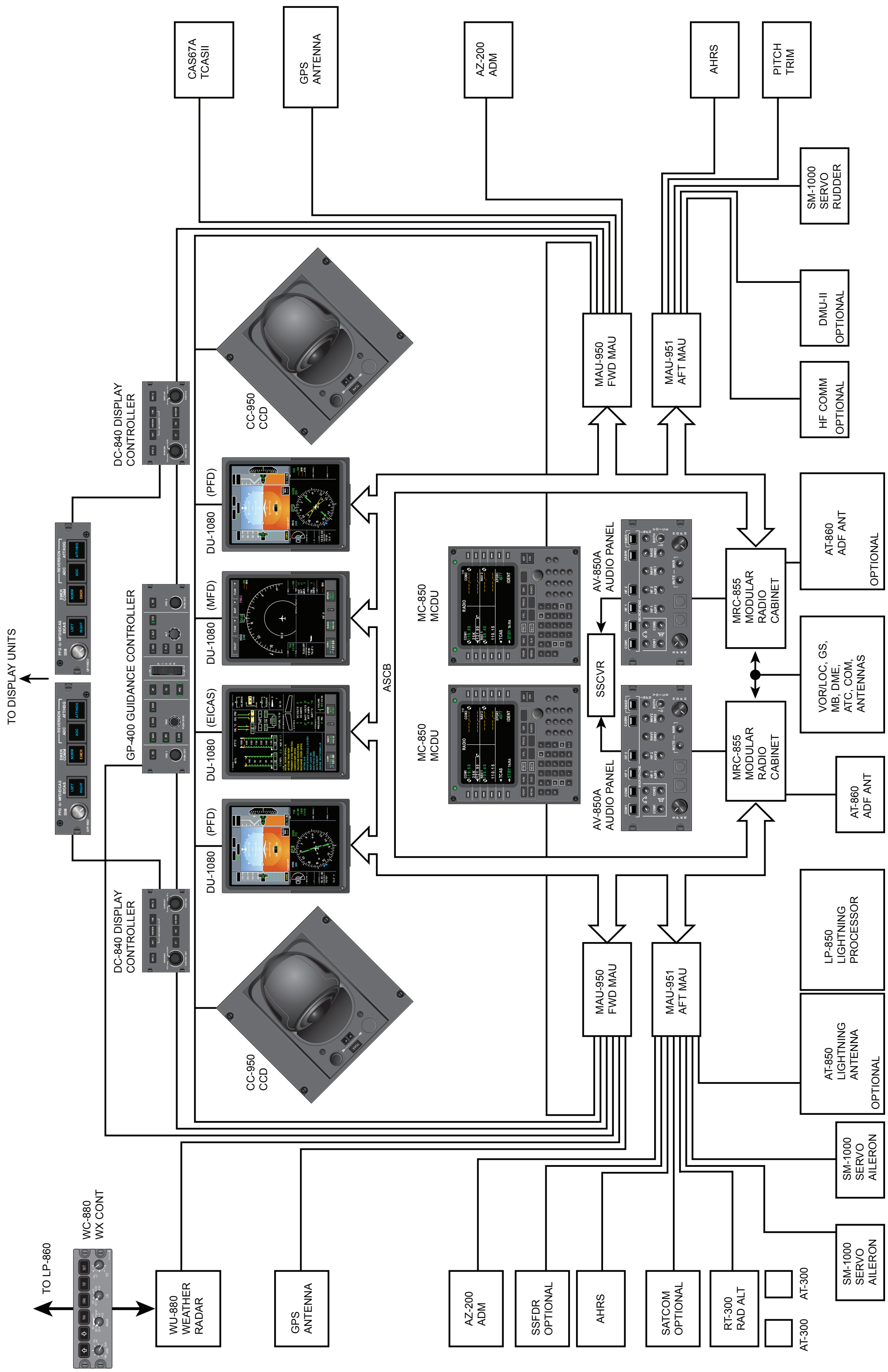
Aircraft Antennas



Pitot Static System



Primus Epic System



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Introduction

This chapter describes the operation, components, typical flight application, and operating procedures for the Honeywell Primus Epic system installed in Citation Sovereign aircraft. Subsystems covered in this chapter include the following:

- Electronic Display System (EDS)
- Modular Avionics Unit (MAU)
- Air Data System (ADS)
- Communications System
- Weather Radar System
- Radio Altimeter System
- Flight Management System (FMS)
- Flight Guidance System
- Enhanced Ground Proximity Warning System (EGPWS)
- Traffic Alert and Collision Avoidance System (TCAS)
- Lightning Sensor System (LSS) (optional)

The chapter is divided into four subsections: Instruments, Communications, Navigation and Autopilot. Although discussed individually, these systems interface through the Primus Epic system. Additional information pertaining to these systems can be found in the Cessna Citation Sovereign Pilot's Guides for the Primus Epic System (part numbers A28-1146-168 and A28-1146-183), which are required to be carried on board the aircraft. The material contained in this chapter is provided as a general overview of system components and operation.

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Acronyms and Abbreviations

TERM	DEFINITION
ABV	Above
ACL	Accel
ACM	Air Cycle Machine
ACMF	Aircraft Condition Monitoring Function
ACP	Audio Control Panel
ACT	Altitude Compensated Tilt
ADC	Air Data Computer
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
ADJ	Adjustment
ADM	Air Data Module
ADMS	Aircraft Diagnostic And Maintenance System
ADS	Air Data System
ADS-B	Automatic Dependent Surveillance -- Broadcast
ADS-C	Automatic Dependent Surveillance -- Contract
AFCS	Automatic Flight Control System
AFE	Above Field Elevation
AFIS	Airborne Flight Information System
AFN	ATC Facilities Notification
AFTN	Aeronautical Fixed Telecommunication Network
AGB	Accessory Gearbox
AGL	Above Ground Level
AHRS	Attitude Heading Reference System
AIU	Audio Interface Unit
ALRT	Alert
ALT	Altitude Hold
ALTN	Alternate
AMLCD	Active Matrix Liquid Crystal Display
ANG	Angle
ANT	Antenna
AOA	Angle-Of-Attack
AP	Autopilot
APC	Audio Processing Card
APM	Aircraft Personality Module
APPR	Approach
ARINC	Aeronautical Radio Incorporated
ARP	Airport Reference Point
ARR	Arrival
ASCB	Avionics Standard Communications Bus

TERM	DEFINITION
ASCB-D	Avionics Standard Communications Bus-Digital
ASEL	Altitude Select
ATA	Actual Time Of Arrival
ATS	Air Traffic Services
ATT	Attitude
AVAIL	Available
AZ	Azimuth
BAC	Back Course
BARO	Barometric
BC	Back Course
BCV	Bleed Control Valve
BFI	Bus Fail Inhibit
BFL	Balanced Field Length
BFO	Beat Frequency Oscillator
BIT	Built-In Test
BITE	Built-In Test Equipment
BKUP	Backup
BLE	Boundary Layer Energizer
BLW	Below
BOD	Bottom Of Descent
BOSC	Bottom Of Step Climb
BOV	Bleed Off Valve
BOW	Basic Operating Weight
BRG	Bearing
BRT	Brightness
CAN	Controlled Area Network
CAP	Capture
CAS	Crew Alerting System
CAT	Category
CAUT	Caution
CCA	Circuit Card Assembly
CCD	Cursor Control Device
CCW	Counterclockwise
CDB	Custom Database
CDI	Course Deviation Indicator
CDU	Control Display Unit
CER	Cascade Effect Removal
CERT	Certified
CFIT	Controlled Flight Into Terrain
CHG	Change
CHKLST	Checklist
CIO	Control Input/Output
CLB	Climb

TERM	DEFINITION
CLR	Clear
CM	Control Module
CMD	Command
CMF	Communications Management Function
CMS	Central Maintenance System
COM	Communication
COMP	Compass
CONFIG	Configuration
CONT	Control
CONUS	Continental United States
CP	Crosspointer
CPC	Cabin Pressure Controller
CPCS	Cabin Pressure Control System
CPDLC	Controller Pilot Data Link Communications
CPL	Couple
CPU	Central Processing Unit
CRS	Course
CRT	Cathode Ray Tube
CRU	Cruise
CSMU	Crash Survivable Memory Unit
CTR	Center
CTRL	Control
CVR	Cockpit Voice Recorder
CW	Continuous Wave
DA	Decision Altitude
DAB	Digital Audio Bus
DADC	Digital Air Data Computer
DAFCS	Digital Automatic Flight Control System
DAU	Data Acquisition Unit
DB	Database
DBM	Database Module
DC	Display Controller
DDU	Display Driver Unit
DEL	Delete
DEM	Digital Elevation Model
DEOS	Digital Engine Operating System
DEP	Departure
DES	Descent
DEST	Destination
DEV	Deviation
DG	Directional Gyro
DGIO	Dual Generic Input/Output
DGPS	Differential Global Positioning System
DGRAD	Degraded

TERM	DEFINITION
DH	Decision Height
DIM	Dimming
DIR	Direct
DISA	International Standard Atmosphere Deviation
DISC	Disconnect
DISENG	Disengage
DIST	Distance
DLK	Datalink
DLS	Data Loading System
DME	Distance Measuring Equipment
DMU	Data Management Unit
DN	Down
DR	Dead Reckoning
DSP	Digital Signal Processor
DST	Distance
DTG	Distance To Go
DTMF	Dual Tone Multi-Frequency
DTRK	Desired Track
DU	Display Unit
DV	Digital Voice
EBDBDB	That's All Folks
ECS	Environmental Control System
ECU	Electronic Control Unit
EDM	Emergency Decent Mode
EDS	Electronic Display System
EDU	Engine Diagnostic Unit
EEC	Electronic Engine Control
EFIS	Electronic Flight Instrument System
EGNOS	European Geostationary Navigation Overlay Service
EGPWM	Enhanced Ground Proximity Warning Module
EGPWS	Enhanced Ground Proximity Warning System
EGT	Exhaust Gas Temperature
EHSI	Electronic Horizontal Situation Indicator
EICAS	Engine Instruments And Crew Alerting System
EL	Electrolumincescent
ELEV	Elevation
ELT	Emergency Locator Transmitter
EMER	Emergency
END	Endurance
ENG	Engage
ENGR	Engineer
EPU	Estimated Position Uncertainty
ERL	Effective Runway Length

TERM	DEFINITION
ESDI	Engine Shutdown Inhibit
ESS	Essential
ET	Elapsed Time
ETA	Estimated Time Of Arrival
ETD	Estimated Time Of Departure
ETE	Estimated Time Enroute
ETP	Equal Time Point
ETTS	Electronic Thrust Trim System
EXT	External
FACS	Final Approach Course Fix
FADEC	Full Authority Digital Engine Control
FAF	Final Approach Fix
FANS	Future Air Navigation System
FAS	Final Approach Segment
FCSOV	Flow Control Shutoff Valve
FCU	Fuel Control Unit
FD	Flight Director
FDE	Fault Detection And Exclusion
FDR	Flight Data Recorder
FF	Fuel Flow
FGC	Flight Guidance Computer
FGCS	Flight Guidance Control System
FGS	Flight Guidance System
FIDB	Flexible Input Database
FIR	Flight Information Region
FL	Flight Level
FLC	Flight Level Change
FLD	Field
FLEX	Flexible
FLT	Flight
FMS	Flight Management System
FN	Function
FOM	Figure Of Merit
FOHE	Fuel Oil Heat Exchanger
FPL	Flight Plan
FPA	Flight Path Angle
FPD	Flat Panel Display
FPM	Flight Path Marker
FPV	Flight Path Vector
FQ	Fuel Quantity
FQMS	Fuel Quantity Measuring System
FQSC	Fuel Quantity Signal Conditioner
FSBY	Forced Standby
FSOV	Firewall Shutoff Valve

TERM	DEFINITION
FWC	Fault Warning Computer
FWD	Forward
GA	Go-Around
GBATC	Ground-Based Air Traffic Control
GCR	Ground Clutter Reduction
GCU	Generator Control Unit
GDC	Global Data Center
GEN	Generator
GEOREF	Geo-Referenced
GES	Ground Earth Station
GFP	Graphical Flight Planning
GGF	Graphic Generation Function
GMAP	Ground Mapping
GND	Ground
GNSS	Global Navigation Satellite System
GNSSU	Global Navigation Sensor System Unit
GP	Glidepath
GPS	Global Positioning System
GPU	Ground Power Unit
GPWS	Ground Proximity Warning System
GRAD	Gradient
GRD	Ground (FMS)
GS	Groundspeed Or Glideslope
GS CAP	Glideslope Capture
GSP	Ground Service Panel
GSPD	Groundspeed
GTE	Gas Turbine Engine
GUI	Graphical User Interface
HA	High Altitude
HDG	Heading
HDOP	Horizontal Dilution Of Precision
HDPH	Headphone
HF	High Frequency
HFCU	Hydromechanical Fuel Control Unit
HFOM	Horizontal Figure Of Merit
Hg	Mercury
HGA	High Power Gain Antenna
HGI	Honeywell-Generated Information
HIL	Horizontal Integrity Limits
HINT	Horizontal Integrity
HLD	Hold
HMIC	Headphone Mic
HMU	Hydromechanical Metering Unit
HP	High Pressure

TERM	DEFINITION
HPA	High Power Amplifier
HPa	Hectopascals
HSI	Horizontal Situation Indicator
HYD	Hydraulic
I/O	Input/Output
IAF	Initial Approach Fix
IAP	Instrument Approach Procedure
IAS	Indicated Airspeed
IBIT	Initiated Bit
ICAO	International Civil Aviation Organization
ICS	Intercom System
ID	Identification
IF	Intermediate Fix
IGN	Ignition
IGRF	International Geometric Reference Field
IGS	Instrument Guidance System
IHBT	Inhibit
ILS	Instrument Landing System
IN	Inches Of Mercury
INIT	Initialization
INMARSAT	International Maritime Satellite Organization
INT	Internal
INTERSCTN	Intersection
INV	Inverter
IOP	Input/Output Processor
IOR	Indian Ocean Region
IR	Inertial Reference
IRS	Inertial Reference System
IRU	Inertial Reference Unit
ISA	International Standard Atmosphere
ITT	Inter-Turbine Temperature
ITU	International Telecommunications Union
IVS	Inertial Vertical Speed
JAA	Joint Air Worthiness Authority
JIT	Jeppesen Integration Toolkit
KIS	Keep It Simple
LAA	Low Altitude Awareness
LAN	Local Area Network
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LND	Landing
LAT	Latitude
LAV	Lavatory
LBS	Lateral Beam Sensor

TERM	DEFINITION
LCD	Liquid Crystal Display
LCV	Load Control Valve
LD	Landing
LDA	Landing Directional Aid
LDG	Landing
LDI	Loadable Diagnostic Information
LED	Leading Edge Down
LEU	Leading Edge Up
LIM	Limit
LN	Length
LNAV	Lateral Navigation
LOC	Localizer
LOC CAP	Localizer Capture
LON	Longitude
LOPI	Landing Operations Phase Inhibit
LP	Low Pressure
LPV	Localizer Performance With Vertical Guidance
LRC	Long Range Cruise
LRM	Line Replaceable Module
LRN	Long Range Navigation
LRU	Line Replaceable Unit
LSA	Low Speed Awareness
LSK	Line Select Key
LSS	Lightning Sensor System
LV	Lower Sideband Voice
LVDT	Linear Voltage Differential Transducer
LX	Lightning
MAG	Magnetic
MAF	Missed Approach Fix
MAGVAR	Magnetic Variation
MAINT	Maintenance
MAP	Missed Approach Point
MAU	Modular Avionics Unit
MAX	Maximum
MCDU	Multi-Function Control Display Unit
MCT	Maximum Continuous Thrust
MDA	Minimum Descent Altitude
MED	Medium
MFD	Multi-function Display
MFK	Multi-function Knob
MGT	Management
MHz	Megahertz
MIC	Microphone
MICSTK	Microphone Stuck

TERM	DEFINITION
MIN	Minimum
MKR	Marker
MLS	Microwave Landing System
MMO	Maximum Operating Mach
MN	Main
MNPS	Minimum Navigation Performance Specifications
MPEL	Maximum Permissible Exposure Level
MRC	Modular Radio Cabinet
MSG	Message
MT	Mach Trim
MTC	Minimum Terrain Clearance
MWF	Monitor Warning Function
MWS	Monitoring Warning System
MXR	Maximum Range
N/A	Not Applicable
NAT	North Atlantic
NAV	Navigation
NAVAID	Navigational Aid
NAVSTAR	Navigation System With Time And Ranging
NBAA	National Business Aircraft Association
NCD	No Computed Data
ND	Navigation Display
NDB	Navigation Database
NIC	Network Interface Controller
NIM	Network Interface Module
NM	Nautical Miles
NOAA	National Oceanic And Atmospheric Administration
NOC	Navigation On Course
NORM	Normal
NT	Navaid Tuning
NWS	Nose Wheel Steering
O	Outer
OAS	Own Aircraft Symbol
OAT	Outside Air Temperature
OBST	Obstacle
OCA	Oceanic Control Area
OEM	Original Equipment Manufacturer
OHU	Overhead Unit
ORCA	Oceanic Route Clearance Authorization
ORG	Origin
ORT	Owner Requirements Table
OS	Over Station
OSS	Over Station Sensor

TERM	DEFINITION
OUTBD	Outbound
OVRD	Override
OVSPD	Overspeed
P/B/D	Place/Bearing/Distance
P/B/P/B	Place/Bearing/Place/Bearing
PA	Passenger Address
PAST	Pilot-Activated Self-Test
PBX	Private Branch Exchange
PCB	Printed Circuit Board
PCDR	Procedure
PCM	Programmable CAS Messages
PCU	Power Control Unit
PDB	Power Distribution Board
PDC	Pre-Departure Clearance
PDU	Power Drive Unit
PERF	Performance
PFD	Primary Flight Display
PIT	Pitch
PLI	Pitch Limit Indicator
PLN	Plan
PMA	Permanent Magnetic Alternator
PNL	Panel
PNR	Point Of No Return
POR	Pacific Ocean Region
POS	Position
POST	Power On System Test
PPH	Pounds Per Hour
PPOS	Present Position
PRED	Predictive
PRESS	Pressure
PREV	Previous
PRI	Primary
PRN	Pseudo-Random Noise
PROC	Processor
PROG	Progress
PROX	Proximity
PRSOV	Pressure Regulating Shutoff Valve
PS	Power Supply
PSU	Power Supply Unit
PT	Procedure Turn
PTS	Points
PTT	Push To Talk
PWM	Pulse-Width-Modulated
PWR	Power

TERM	DEFINITION
QFE	Queen’s Field Elevation
QNH	Sea Level Pressure
QTY	Quantity
QUAD	Quadrant
R/T	Radio/Transmitter
RA	Radio Altitude
RAD	Radio Altitude
RAAS	Runway Awareness Advisory System
RAD	Radial
RAD ALT	Radio Altimeter
RAIM	Receiver Autonomous Integrity Monitor
RCT	Rain Echo Attenuation Compensation Technique
REACT	Rain Echo Attenuation Compensation Technique
REF	Reference
REM	Remaining
REQ	Required
REV	Thrust Reverser
RF	Radio Frequency
RFCF	Runway Field Clearance Floor
RIB	Remote Image Bus
RMU	Radio Management Unit
RNAV	Random Area Navigation
RNP	Required Navigation Performance
ROL	Roll
RPM	Revolution Per Minute
RQST	Request
RT	Receiver Transmitter
RTA	Receiver Transmitter Antenna
RTE	Route
RTU	Radio Tuning Unit
RVSM	Reduced Vertical Separation Minimum
RW	Runway
RW POS	Runway Position
SA	Selective Availability
SAAAR	Special Aircraft And Aircrew Authorization Required
SAT	Static Air Temperature
SATCOM	Satellite Communications
SBAS	Space-Based Augmentation System
SC	Single Cue
SDCS	Satellite Data Communication System
SDF	Simplified Directional Facility
SDI	Source/Destination Identifier

TERM	DEFINITION
SDU	Satellite Data Unit
SEC	Second
SEI	Standby Engine Indicator
SEL	Select
SELCAL	Selective Call
SERV	Service
SFD	Standby Flight Display
SID	Standard Instrument Departure
SIGMET	Significant Meteorological Advisory
SM	Single Mode
SMARTPERF	Smart Performance
SOP	Standard Operating Procedures
SOV	Shutoff Valve
SP	Space
SPD	Speed
SPKR	Speaker
SPR	Single-Point Refueling
SQ	Squelch
SQNO	Squelch Noise
SRN	Short Range Navigation
SSEC	Static Source Error Correction
SSM	Sign Status Matrix
ST	Sidetone
STAB	Stabilization
STAR	Standard Terminal Arrival Route
STBY	Standby
STD	Standard
STK MIC	Stuck Microphone
SVC	Service
SVN	Satellite Vehicle Number
SW	Switch
SWAAT	Stall Warning Angle-Of-Attack Transducer
SWC	Stall Warning Computer
SWPS	Stall Warning And Protection System
SYM	System
SYNC	Synchronization
SYS	System
T	Terminal
TA	Traffic Advisory
TAD	Terrain Awareness Display
TACAN	Tactical Air Navigation
TAP	Terminal Area Procedure
TAS	True Airspeed
TAT	True Air Temperature

TERM	DEFINITION
TAWS	Terrain Awareness And Warning System
TCAS	Traffic Alert And Collision Avoidance System
TCF	Terrain Clearance Floor
TCMV	Temperature Control Modulating Valve
TCN	Tactical Air Navigation
TCS	Touch Control Steering
TCV	Temperature Control Valve
TDOP	Time Dilution Of Precision
TED	Trailing Edge Down
TEU	Trailing Edge Up
TEMP	Temperature
TERM	Terminal
TERR	Terrain
TFL	Takeoff Field Length
THRESH	Threshold
TLA	Throttle Lever Angle
TLD	Time Limited Dispatch
TO	Takeoff
TOC	Top Of Climb
TOD	Top Of Descent
TOGA	Takeoff/Go-Around
TOLD	Takeoff And Landing Data
TOPI	Takeoff Phase Inhibit
TOSC	Top Of Step Climb
TQA	Throttle Quadrant Angle
TR	Thrust Reverser
TRA	Throttle Resolver Angle
TRANS	Transition
TRK CHG	Track Change
TST	Test
TT0	Total Temperature Probe
TTFF	Time-To-First-Fix
TWIP	Terminal Weather Information For Pilots
TX	Transmitting
UD	Upper Sideband Data
UDMH	Unsymmetrical Dimethylhydrazine
UHF	Ultra High Frequency
UIR	Upper Flight Information Region
ULB	Underwater Locator Beacon
UNAVAIL	Unavailable
UR	Unrestricted
UTC	Universal Time Coordinate
UV	Upper Sideband Voice
V/S	Vertical Speed

TERM	DEFINITION
VALT	VNAV Altitude Hold
VAR	Variable
VASEL	Vertical Altitude Select
VNAV	Altitude Preselect
VBS	Vertical Beam Sensor
VCT	Vector
VDOP	Vertical Dilution Of Precision
VDR	VHF Data Radio
VERT	Vertical
VFOM	Vertical Figure Of Merit
VGP	Vertical Glidepath
VHF	Very High Frequency
VIL	Vertical Integrity Limit
VINT	Vertical Integrity
VIP	Very Important Person
VNAV	Vertical Navigation
VORAP	VOR Approach
VPATH	Vertical Path
VS	Vertical Speed
VTA	Vertical Track Alert
W/T	Wind/Temperature
WAAS	Wide Area Augmentation System
WARN	Warning
WPT	Waypoint
WGS	World Geodetic System
WND	Wind
WNDSHR	Windshear
WOW	Weight-On-Wheels
WT	Weight
WX	Weather
XFER	Transfer
XMIT	Transmit
XPDR	Transponder
XTK	Cross Track
YD	Yaw Damper

Instruments

General

The Citation Sovereign is equipped with the Honeywell Primus Epic advanced Digital Automatic Flight Control System (DAFCS). Four Honeywell DU-1080 Active Matrix Liquid Crystal Display (AMLCD) panels provide the flight crew with critical flight and system operations information. The Primus Epic system is a fully integrated electronic flight information system. Integrated within the system are communication functions, Electronic Flight Instrument System (EFIS), GPS and VHF navigation information, the airplane Intercom System, Weather Radar, Engine Instrument and Crew Alerting System (EICAS), aural warnings, Enhanced Ground Proximity Warning Module, and the AHS-3000 Altitude Heading and Reference System. Additional integrated systems and associated descriptions of all integrated systems are discussed later in this section.

Modular Avionics Units (MAUs) are the heart of the Primus Epic system. The MAUs process information from the Air Data Modules (ADMs), Attitude and Heading Reference System (AHRS) Modular Radio Cabinets (MRCs), Traffic Collision and Avoidance System (TCAS II), and the Primus WX-880 Weather Radar System. Control of the system is provided to the crew by two Multi-Function Control Display Units (MCDUs), two Cursor Control Devices (CCDs), two Display Controllers, a Flight Guidance Panel, and other individual control panels.

Figure 11-1: Cockpit

Modular Avionics Units

Four Modular Avionics Units (MAUs) are installed in the Citation Sovereign. MAUs 1 and 2 are located in the nose avionics compartment and MAUs 3 and 4 are located in the tailcone. Due to the nature of the computer processing, one unit is now used to perform the tasks that required individual processors in the past.

Each MAU is a hardware cabinet that has a backplane interface, multiple module mounting locations, cooling fans, and conditioned power (through the power supply modules) for the plug-in modules. These modules are field-replaceable and represent building blocks of the avionics system. The modules themselves are linked to the ASCB-D data bus through the network interface controller (NIC) module. ARINC 429 inputs and outputs handle communications and interface with non-ASCB components.

Figure 11-2: MAU in Nose Compartment

Pitot-Static System

The aircraft pitot-static system provides altitude and airspeed information to the flight crew. Cabin pressure reference to determine differential pressure is also provided by the system.

Three redundant and independent systems comprise the pitot-static system. This redundancy ensures that a clear representation of pitot static information is displayed on the PFDs, preventing possible confusion of the flight crew in the event of system failure. Each of the three systems consists of a pitot probe and two static ports.

Pitot probes are located at the airplane nose and the static ports are installed in an array of three on each side of the outer cockpit fuselage section. The top forward static port on each side is tied to the pilot's pitot-static system, bottom forward static port to the copilot’s, and the aft port to the standby system.

The total and static air pressure from system components is fed directly to Air Data Modules. The Air Data Modules (ADMs) for the pilot and copilot pitot-static systems are located in the nose of the airplane. Each pilot's pitot-static system sends pitot-static pressure information to the respective ADM. The ADM then converts the pitot-static pressure to a raw electrical signal, transferring the signal to a Modular Avionics Unit (MAU). The MAU then calculates the air density, airplane altitude, dynamic pressure, and airspeed. The information is then presented on the cockpit displays.

To prevent a possible system failure from an ice buildup on the probes or static ports, the system is electrically anti-iced. Pitot-static anti-ice failure information is conveyed through the EICAS system by sensors located in-line with each probe and port anti-ice power source. Once the system is in operation, the sensors detect the amount of current being sent to each heater and send a corresponding signal to the Master Warning System (MWS).

Air Data System

The Air Data System (ADS) receives pitot-static pressures and air temperature inputs that it uses to compute the standard air data functions (airspeed, altitude, vertical speed). The ADS computes static source error correction for altitude and airspeed.

The ADS consists of two air data modules (ADMs). The air data modules receive input from the pitot-static system, digitize the inputs, and transmit them to the MAUs.

Electronic Display System

The EDS that is installed in the Citation Sovereign aircraft generates flight path, navigation, engine, and systems information. The cockpit layout is designed so that each pilot has a dedicated PFD. The pilot’s MFD panel is normally designated as the EICAS display, and the co-pilot’s MFD houses the map display. The display controllers mounted in the glareshield are used to control the formats on the PFDs. Each pilot can control the formats for the on-side PFD and MFD displays in addition to the cross-side MFD display using the cursor control device (CCD).

Display System Limitation

All display units must be installed and operational.

The EDS provides information from remote sensors pertaining to automatic flight control systems, flight management systems, caution and warning systems, engine performance and airplane performance. Organization of the displays is as follows:

Primary Flight Display

Integrates attitude, heading, air data information, flight director modes with command bars, weather radar, and navigation information. It combines information from these separate sources into one easily interpreted comprehensive display.

Multi-Function Display

Displays heading, navigation map, weather radar, optional checklist, optional charts, and optional traffic and collision avoidance system (TCAS) information.

Engine Instrument and Crew Alerting System

Displays engine data, flight control data, systems status data, and warning/caution/advisory/status messages.

Figure 11-3: Electronic Display System

Primary Flight Display Limitation

Dispatch with a DU in reversionary mode is prohibited. Reversion of both PFDs to DU2 and DU3 is prohibited.

Primary Flight Display

The PFD consists of the following:

- Attitude Display
- Slip/Skid Indicator
- Flight Director Command Bars (single cue or cross pointer)
- Flight Director Mode Annunciations
- Autopilot Mode Annunciations
- Angle of Attack (AOA)
- Vspeeds (Automatic/Manual)
- Vertical Deviation Pointer and Scale
- Radio Altitude
- Decision Height
- Marker Beacons
- Altimeter Scale and Digital Displays
- Source Annunciations
- GPWS/Windshear Annunciations
- Minimum Descent Altitude
- Airspeed Scale and Digital Displays
- Elapsed Timer
- Vertical Speed Scale and Digital Display
- Heading
- Drift Bug

- Lateral Deviation Scale
- Bearing 1/2
- Distance
- FMS Messages
- Preview Mode
- Weather Radar Returns
- TCAS Resolutions Advisories
- Source Miscompare

PFD Display Controller

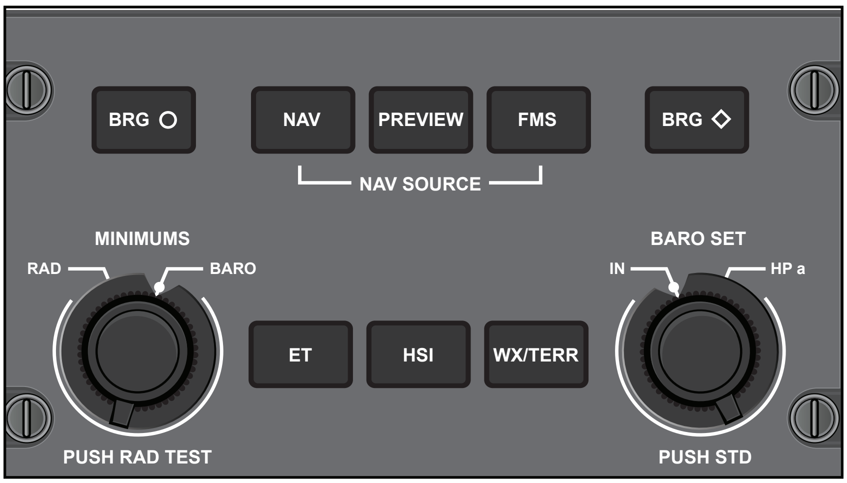

Figure 11-4: PFD Display Controller

Bearing Pointer Selection

The Bearing Circle pushbutton allows for the selection of VOR1, ADF1 or FMS1 for the onside PFD HSI display. The bearing pointer selection with alternate activation of the pushbutton is as follows:

OFF --> VOR1 --> ADF1 --> FMS1 --> OFF

When only one ADF is installed, the sequence for the bearing circle selection with alternate activation of the pushbutton is as follows:

OFF -->VOR1 -->ADF --> FMS1 -->OFF

The Bearing Diamond pushbutton allows for the selection of VOR2, ADF2 or FMS2 for the on-side PFD HSI display. The bearing pointer selection with alternate activation of the pushbutton is as follows:

OFF --> VOR2 --> ADF2 --> FMS2 --> OFF

When only one ADF is installed, the sequence for the bearing diamond selection with alternate activation of the pushbutton is as follows:

OFF --> VOR2 --> ADF --> FMS2 --> OFF

Navigation Source Selection

Selection of the navigation source data displayed on the on-side PFD is selected using the three navigation source selection pushbuttons: VOR/LOC, PREVIEW, and FMS.

Preview Pushbutton

With an FMS as the selected displayed navigation source, the available short range radio navigation sources may be previewed. The PREVIEW pushbutton toggles through the available VOR/LOC sources for preview on the on-side PFD. The format sequence for alternate activation of the PREVIEW pushbutton is as follows:

On-side VOR/LOC --> Cross-side VOR/LOC --> Off --> On-side VOR/LOC

With a previewed navigation source displayed and the active flight director lateral mode transitions from LNAV (FMS) to APP VOR, APP LOC, or BC LOC, the previewed navigation source is transitioned to the active navigation source display.

Activation of this pushbutton without a displayed FMS navigation source results in no change to the display.

Minimums Selection

Setting of the minimum value displayed on the on-side PFD is accomplished using the Minimum Select knob located on the DC-840. The Minimum Select knob is a dual concentric knob. The outer knob allows for selection of the minimum value to be based on a radio altitude (RAD) minimum or a barometric altitude (BARO) minimum. The inner knob is used to select the minimum value. The rate of change of the minimum select value is variable based on the rate of knob rotation. The slower rate of change allows for precise setting of the data (one click of the knob equals 10 feet). For a RAD minimum, the value starts at 200 feet. For a BARO minimum, the value starts at 1500 feet.

BARO SET Knob

Setting of the barometric set value for the on-side air data function is accomplished using the Baro Set knob located on the DC-840. The Baro Set knob is a dual concentric knob. The outer knob allows for selection of the displayed barometric setting based on a inches of mercury (IN) or Hectopascals (HPa). The inner knob is used to select the barometric set value. The barometric set value is calculated by the ADS function after the Control I/O function sends it raw knob position data from the controller. Setting the barometric set value to the standard atmospheric pressure value is accomplished by activating the button located on the end of the Baro Set Knob.

Elapsed Time

The first activation of the ET pushbutton selects the Elapsed Timer (ET) clock for display. The elapsed timer can be preset using the TIMERS page on the MCDU. If a preset time has been set, activation of the ET pushbutton will cause the elapsed timer to count down. If a preset time has not been set (elapsed timer = 0), activation of the ET pushbutton will cause the elapsed timer to count up. Additional activation of the ET pushbutton is the same for both the count up and count down modes as follows:

Start (Count up/down)--> Stop--> Reset--> Start

If the selection remains in the reset state for ten minutes, or the ET pushbutton is held depressed for two seconds, the elapsed timer display is selected as off. When the reset mode is selected following a count down from a preset value, the elapsed timer is set to zero and the elapsed timer preset value set using the MCDU is deselected.

When the elapsed timer has counted down to zero, the elapsed time digital readout turns inverse video (white background with black letters) and the elapsed timer automatically starts counting up.

During the first five seconds of counting up, the elapsed timer readout flashes 1 second on and 0.5 seconds off, after which the digits turn amber and continue the count-up process.

HSI Pushbutton

Pressing the HSI button toggles the PFD display between the Full and Arc mode compass displays. The full compass display shows the entire compass rose, and the arc display mode shows a segment 120° wide with the airplane heading in the middle. The default display at power up is full compass.

WX/TERR Pushbutton

Pressing the WX/TERR Pushbutton selects weather video (WX) or terrain video (TERR) for display on the on-side PFD Arc mode. If the HSI format is Full Compass when the WX/TERR Pushbutton is activated, it will automatically switch to Arc mode with WX displayed on the initial activation and then cycle to TERR after being pushed a second time.

Attitude Display

Artificial Horizon

The artificial horizon is the sky and ground shading representation displayed behind the attitude pitch tape. The artificial horizon consists of a horizon stabilized sky/ground solid color representation. For pitch angles greater than 25°, the attitude shading indicates the direction to the sky or ground as appropriate by preserving a portion of sky or ground shading.

Aircraft Symbol

A reference aircraft symbol is displayed in the attitude sphere. Single cue and cross-pointer symbols are selectable from the MCDU Display setup page. The apex of the single cue aircraft symbol is centered in the attitude sphere when single cue is selected. When cross pointer has been selected, the center square of the cross pointer aircraft symbol is displayed centered in the attitude sphere. The reference aircraft symbol color is normally white, but can change color depending on the display of the TCAS pitch targets.

Attitude Source Annunciations

Attitude source annunciations "ATT1" or "ATT2" (boxed) are displayed at the top of the attitude sphere to the left of the roll zero index marker in reverse video (amber background with black text), when appropriate.

The attitude source annunciation is suppressed when the pilot and copilot displayed sources are the on-side AHRS. When both the pilot and copilot displayed sources are the same, "ATT1" or "ATT2", as appropriate, will be displayed in amber on both PFDs. The appropriate annunciation will also be displayed in amber when both the pilot and co-pilot displayed sources are the cross-side AHRS.

Pitch Tape

The pitch tape is displayed through the center of the attitude display. The pitch tape is horizon stabilized and is capable of showing at least ±20° with pitch attitude at 0°. The pitch tape is linear with markings every 2.5° from 0° to ±10° and every 5° between 10° and 30°. The pitch tape is labeled with numbers on both sides of the tick marks through +30°/-20° and in the middle of the tick mark for greater than +30°/-20°. The scale is labeled with the following indices:

Up	Down
10	10
20	20
30	30
40	45
60	60
90	90

The pitch tape will appear to go behind the aircraft symbol and the radio altitude digits, if displayed. The pitch tape will park at -90 or +90°, respectively.

Figure 11-5: Primary Flight Display

Removal of the horizon line uses a logical hysteresis filter using absolute pitch angle with an upper bound of 25°, and a lower bound of 24°. The horizon line is displayed in the area with sky and ground shading (including outside the truncated sphere).

Roll Pointer/Slip-Skid Display

The bottom half of the roll pointer is used as a slip skid (lateral acceleration) indicator. Under zero lateral acceleration, the roll pointer and slip-skid indicator form a triangle. With lateral acceleration, the slip-skid indicator will move sideways. It will move to the left for positive inputs (right lateral acceleration) and to the right for negative inputs (left lateral acceleration). When lateral acceleration reaches the predetermined limit, an arrow is displayed attached to the indicator pointing in the direction of the indicator movement.

The roll pointer/slip skid indicator contains two alignment marks that line up vertically to assist the pilot in determining zero slip-skid. These alignment marks are displayed in the center near the edges of the roll pointer and the slip skid indicator.

Roll Pointer/ Slip-Skid Display Limitation

Intentional uncoordinated flight of greater than one slip/skid indicator bar width for longer than 20 seconds is prohibited.

Roll Scale

A roll scale is displayed on the top of the ADI sphere. The roll scale is linear and marked with tick marks at ±10°, ±20°, ±30°, and ± 60°. An inverted triangle will mark 0° and ±45°.

Bank Limit Arc

Whenever the AFCS is in the Low-Bank mode, a green arc is displayed immediately above the attitude sphere extending ±17° from wings level.

Bank Declutter

When the bank is greater than ±65°, the display is decluttered. The logic has 2° of hysterisis to prevent flashing symbols ON and OFF.

The symbology is restored when bank returns to less than ±63°.

Airspeed Display

The indicated airspeed display is to the left of the attitude display on the PFD. The display consists of a “rolling digit” window in the center of an airspeed vertical tape. The resolution of the rolling digits is one knot. The moving vertical tape moves behind the window and is labeled every 10 knots below 200 KIAS and every 20 knots above 200 KIAS, with the larger numbers at the top of the scale. The range of the airspeed scale is 30 to 900 knots with tick marks every 10 knots beginning at 30 KIAS. The airspeed tape parks at 30 or 900 knots as applicable.

Altitude Display

The altitude display is located to the right of the attitude display on the PFD. The altitude is indicated by means of a vertical tape display which has a "rolling digit" window in the center of an altitude vertical tape. The resolution of the digits is 20 feet. The hundreds, thousands, and ten thousands digits are larger digit numerals than the others. The vertical tape moves behind the window and displays a tape 550 feet both above and below the present indicated altitude, with the larger numbers at the top of the scale. The range of the altitude window is from -2,000 to +60,000 feet with tick marks located at 100 feet increments. Single-line chevrons denote the 500 feet increments and double-line chevrons the 1,000 feet marks. The chevrons extend back to the approximate midpoint of the altitude tape and are connected with each other by a vertical line.

The barometric pressure setting is controlled by the BARO SET knob on the PFD display controller. The STD button in the BARO SET knob allows a change to a barometric altimeter setting of 29.92 in. Hg. (or 1013 millibars) by pushing the button in. The baro correction setting display is located just below the altitude display. The BARO SET knob will change the altitude correction by 0.01 in. Hg. per click.

Standby altitude indications are available from the standby flight display (standby airspeed/ altitude/attitude indicator) which is discussed under Standby Flight Display System later in this section.

Figure 11-6: Altitude Display

Altitude Preselect Function

The altitude preselect knob is located on the Flight Guidance Panel. Rotation of this knob changes the altitude select value and bug displayed on both PFDs. The rate of change of the altitude select value is variable based on whether barometric altitude (BARO) minimums have been selected for display by either pilot. Selected data is transmitted by the GP-400 Flight Guidance Controller.

Minimums Preselect Function

When barometric altitude (BARO) minimums have been selected for display by either pilot, the resolution of the altitude select knob changes from one click equals 100 feet to one click equals 10 feet when the altitude preselect value is less than the BARO set value plus 1000 feet. For decreasing values, the resolution is 10 feet when within 1000 feet of the BARO value. For increasing values, the resolution is 10 feet for the first ten clicks (100 feet), then to 100-foot resolution.

Radio Altimeter Display

The radio altimeter display in located in the lower portion of the attitude indicator. The display will normally read a slightly negative value with the nose of the aircraft on the ground. During the radio altimeter test, the display of radio altimeter is allowed regardless of validity. The radio altimeter test is inhibited when the flight director mode indicates approach capture.

Vertical Speed Display

The vertical speed information is displayed in the upper right hand area of each PFD and is comprised of a scale, digital readout, and target speed. The range of the vertical speed indicator is 0 to ±6,000 feet-per-minute, with enhanced resolution from 0 to ±2,000 feet-per-minute with tick marks every 500 feet for the first ±2,000 FPM climb or descent rates.

The vertical speed indicator is a fixed type meter display. Selected vertical speed targets are displayed in the vertical speed readout box located at the top of the vertical speed indicator. A cyan vertical speed bug is displayed at the selected vertical speed tick mark on the indicator.

Figure 11-7: Vertical Speed Display

Heading Display

The AHRS transmits heading information for display on the PFD. The AHRS source is selected by the Display Control function. The source will default to on-side AHRS in the event that the Display Control function is invalid. The heading display will take on two distinct formats as selected by the Display Control function. The full compass consists of a 360° heading display that moves counterclockwise for positive increasing heading angles. The arc mode is a partial expansion of the 360° compass to show +/- 50° about the current heading.

Heading Source Annunciation

The heading source annunciation is displayed above and to the left of the digital readout box. When the normal on-side heading source is displayed on both MFDs (whether selected on DU2 or DU3), no source annunciation is given unless DG mode has been selected. In this case, a white "DG1" annunciation is shown on the pilot's MFD (when selected on DU2) and a white "DG2" is shown on the copilot's MFD (when selected on DU3).

Heading source information is selected by the on-side Display Control function. In the event ATT/HDG1 reversion is selected, an amber MAG1 or DG1 is displayed on the pilot's MFD (when selected on DU2) and the copilot's MFD (when selected on DU3). If ATT/HDG2 reversion is selected, an amber MAG2 or DG2 is displayed on the pilot's MFD (when selected on DU2) and on the copilot's MFD (when selected on DU3). If both pilot and copilot sources are cross-side, a white MAG2 or DG2 is displayed on the pilot MFD (when selected on DU2) and a white MAG1 or DG1 is displayed on the copilot MFD (when selected on DU3).

V-Speed Display

V-Speeds can be selected by use of the line select keys located on the Multi-Function Control Display Units (MCDUs). The bugs are labeled V_1 (V_1), V_R (V_R), V_2 (V_2), V_{ENR} (V_{ENR}) (this airspeed is automatically displayed whenever V_1, is selected for display; V_{ENR} is set to a fixed value of 180 knots), V_{REF}, and V_{APP}. The bugs are positioned on the right outside edge of the airspeed tape. They consist of a horizontal T-shaped symbol with its respective label positioned to the right of the symbol. All the takeoff set bugs are removed from the display when the airplane airspeed exceeds 230 knots, and the landing speed bugs are removed upon touchdown.

V_1 and V_R can be set equal to each other. In the event that this occurs, the display reading will be 1R when they are equal.

PFD Range Control

HSI arc mode range is active on the PFD and controlled by the corresponding CCD. The range of the PFD is changed by using the rotary knob on the CCD. Available range selections are: 5, 10, 25, 50, 100, 200, 300, 500, and 1,000 NM.

PFD HSI range is synchronized to the adjacent MFD range when the MFD format is in MAP and the MFD is adjacent to the associated PFD (i.e., the pilot range selection when the MFD display is on DU2 and the copilot range selection when the MFD display is on DU3).

When HSI ranges are synchronized to the PFD and adjacent MFD, the range can be changed on either the PFD or MFD (PFD in arc format and MFD in MAP format).

Multi-Function Display

The MFD contains 4 menu format selections at the top of the MFD display and full time display of generic information located in the lower half of the display.

The menu format selections are associated with an MFD format, which can be activated by positioning the cursor over the desired menu title button and pressing the “Enter” button on the CCD. The menu buttons are “CHECKLIST” menu, “TCAS” menu, “MAP” menu, and "PLAN" menu. Additional menu selections are displayed for the optional electronic charts, electronic checklist and uplink weather.

The MFD display consists of the following:

- Static Air Temperature
- True Airspeed
- Ground Speed
- Weather Radar Operating Modes and Display
- Lightning Sensor Data and Display
- Wind Display
- Distance to Waypoint
- Estimate Time En Route
- Heading
- Heading Select
- Flight Plan
- Vertical Profile
- Checklist
- TCAS Traffic Advisory
- EICAS System Displays
- Integrated Maintenance Test

The data resides in the lower left corner, the lower right corner, and the bottom portion of the display format.

Figure 11-8: Multi-Function Display

Each of the general areas of the MFD are described as follows:

- The lower left corner is further segmented into two display windows. The top left window contains the selected TCAS modes, the middle left window contains the selected weather radar and lightning sensor system modes.
- The lower right corner is further segmented into three display windows. The top right window contains readouts of RAT, SAT, and ISA air temperatures, the middle right window contains readouts of true air speed and ground speed, the lower right window contains the waypoint identifier and time-to-go displays.
- The bottom portion of the display contains a dashboard type display with display windows. The left most window contains the VHF Com active and preset frequencies. The middle left window contains the VHF Nav active and preset frequencies. The middle window contains the source annunciation (#1 or #2) for both the Com and Nav radios. The middle right window contains the active ATC Code and selected TCAS modes. The right most window, when displayed, will indicate Transponder Ident reply as "ID".

Menu Operation

Operation of the MFDs using the CCD allows the flight crew to control radio tuning, MAP/Plan range control, TCAS window control, checklist control, flight plan designator, and drop down menu operation. The default position of the CCD on the MFD format is the transponder unit selection window (or COM unit STANDBY frequency for aircraft not incorporating EPIC Phase 5). The CCD cursor box is displayed in this position on initial power up, initial selection of MFD format, and after 20 seconds of inactivity.

MAP Display

An FMS map display is the default MFD display and can be selected on the PFD when the primary navigation source is FMS and the Arc mode has been selected by the display controller.

Flight Plan Designator

The Flight Plan Designator function can be used on the MFD display in either the MAP or PLAN formats by selecting the Designator selection in either of these drop down menus. After the designator function is selected, the MFD or PFD drop down menu is closed and a new menu titled "Designator" is brought into view in place of the format menu. The designator menu has four selections; "Home", "Prev", "Next", and "Draw". The "Draw" function is the default selection that is highlighted when the designator menu is first entered. The display of the designator menu is accompanied by the display of the designator. The designator is set to the aircraft present position as the initial home position or reference point. In addition to the designator display, a display of designator position latitude and longitude is displayed in a "Designator" window in the lower central portion of the MFD.

There are two ways to exit the "Designator" menu. The first method utilizes a quick exit box. that is brought into view when the menu is displayed. The exit "box" is shown to the right of the cursor and will move to the line that the cursor is currently on. Moving the cursor over the box and selecting "enter" with the CCD will exit the menu. The selection window is defaulted to the Map menu selection arrow. The second exit method is a timeout after 20 seconds of inactivity. The selection window is defaulted to the COM or transponder preset window.

Plan Display

The MFD Plan format can be selected by placing the cursor over the Plan menu selection and selecting enter on the CCD.

Radio Tuning and Status Display

The Radio Tuning and Status display is located across the entire bottom of the MFD display. The Radio Tuning and Status display consists of the following:

- COM active frequency - selectable between on-side and cross-side radio
- COM standby frequency - selectable between on-side and cross-side radio
- NAV active frequency - selectable between on-side and cross-side radio
- NAV standby frequency - selectable between on-side and cross-side radio
- Transponder Code selection and annunciation
- Transponder ID (identification) annunciation
- Transponder mode selection and annunciation
- On-side and Cross-side radio selection and annunciation

TCAS Display

TCAS is displayed on the Map display, using the CCD to check the TCAS box on the Map menu. The TCAS zoom display is displayed on the lower portion of the MFD screen by activating the TCAS menu. The TCAS zoom format is a dedicated display with unique range control. The TCAS map overlay uses the map range setting.

When a TA or RA is encountered and the Map format is not in view at a range of less than 50 NM, the TCAS zoom format automatically pops into view. The TCAS zoom format has display priority over the weather and checklist formats when an auto pop-up occurs.

The TCAS menu and CCD are used to select TCAS range, normal or expanded modes, and absolute (ABS) or relative altitude for the on-side displays.

Checklist Display

The Checklist window is activated by positioning the cursor on the Checklist Menu button and selecting the Enter button on the CCD. The Checklist menu has no selections but performs the activation of the Checklist window.

Charts Display

Charts Display Limitation

Operators with the optional electronic charts must have back-up charts available to the flight crew.

The primary purpose of the chart function is for viewing Jeppesen terminal charts on the MFD. The CHART menu button is an option that is only displayed on the MFD when the aircraft and APM options configuration indicates that the chart function is installed in the aircraft. Pushing the CHART menu button on the MFD control bar displays the chart window.

The following is a list of the items that can be displayed through the chart function:

- Airport charts
- SID charts
- STAR charts
- Approach charts
- Noise charts
- NOTAMs
- Airspace charts

An option is available that permits the printing of the charts and NOTAMs when a cockpit printer is installed.

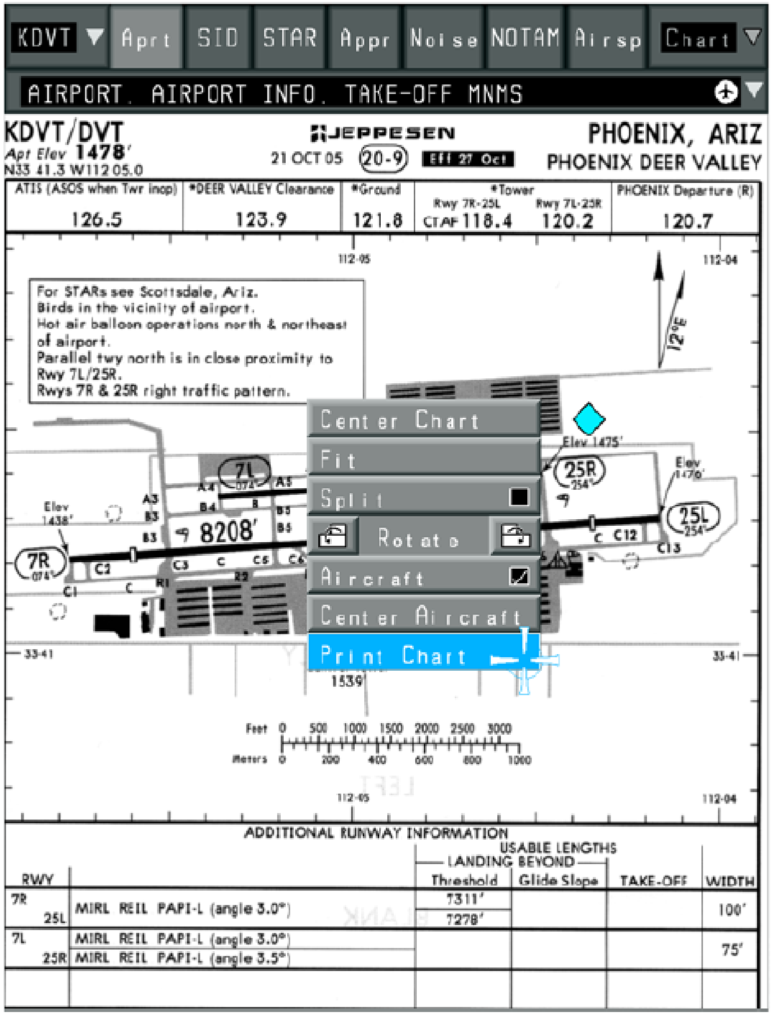

Figure 11-9: Charts Display

> ***NOTE:*** The aircraft symbol displayed on the electronic charts provides supplemental aircraft situational awareness information. It is not intended as a means for navigation or flight guidance. The aircraft symbol is not to be used for conducting instrument approaches or departures, and it should not be relied upon during low visibility taxi operations. Position accuracy, orientation, and related guidance must be assured by other means of required navigation.

EICAS Display

The status of the aircraft systems is displayed in the cockpit for the pilots on the EICAS display unit. The EICAS format can be selected between the 2 middle display units in the cockpit. The system status is displayed in digital and/or analog format. When an analog format is used, a 3D shaded pointer moves along a static scale to indicate the value. When a digital presentation is used, the system parameter is displayed as a number. Invalid data due to system failures are displayed as 3 amber dashes on the digital presentations. The EICAS display is divided into 7 functional areas, as shown in the figure below. Flow bars are used to separate the functional areas.

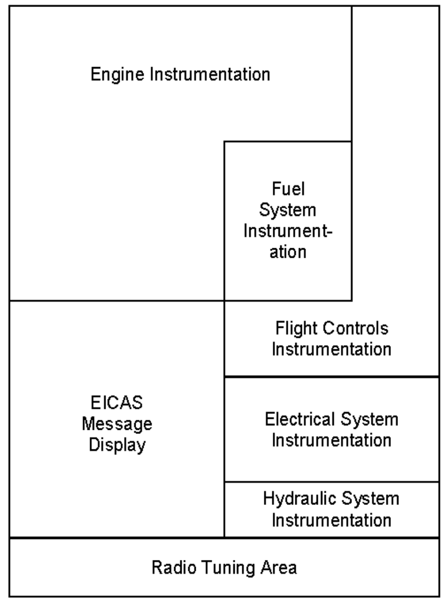

Figure 11-10: EICAS Display Areas

Engine Instruments

The engine instruments are displayed with the following logic in mind:

1. Dual tapes are used, one for each engine.
2. The bugs do not move to a new position unless the underlying value moves.
3. Amber means that continued operation may result in an exceedance. When an engine parameter enters into selected amber regions, the FADEC will start a timer that corresponds to the engine installation manual limit for that condition. When the timer expires, the FADEC will record an exceedance to the Central Maintenance Computer (CMC), causing the indication for that parameter to change to red.
4. Red means an exceedance has occurred and the engine may need a maintenance inspection upon landing.
5. Portions of the display are exaggerated with a non-linear scale to make the display more useful.
6. Data is taken first from the preferred FADEC channel. If the preferred channel is invalid, then the other channel is used. In selected cases, an amber annunciation is displayed.
7. The oil pressure and temperature limits change in a predefined way based on engine operating mode. The oil temperature limits change to allow ground warming. The oil pressure limits change to accommodate the flow regulated oil system.

8. The bug and text colors correspond to the positioning of the color bands they are pointing to. This is not directly enforced by EICAS, but rather a side effect of deliberate arrangement. For the oil pressure and temperature, the bands are coded in EICAS and the colors comes from the FADEC in control. For the N_1 and ITT, the bands come from the FADEC not in control and the colors come from the FADEC in control.

Fuel System Display

The fuel system instrumentation includes the following displays:

1. Fuel flow for left and right engines
2. Fuel quantity in the left and right fuel tanks
3. Total aircraft fuel quantity
4. Fuel temperature in the left and right fuel tanks.

Fuel Flow Digital Readout

Fuel flow is displayed on the EICAS in 20 PPH (pound per hour) increments. 3 amber dashes are displayed when the fuel flow rate is invalid and certain other conditions are met.

Fuel Quantity Digital Readout

Individual fuel tank quantity and aircraft total fuel quantity are displayed on the EICAS. Rounding and filtering is implemented in the fuel quantity system, so there is no need for additional rounding logic in the EICAS.

When an individual tank quantity displayed value becomes less than 500 lbs, it changes from green normal text to black text on amber inverse video. When the total fuel quantity displayed value becomes less than 1000 lbs, it changes from green normal text to black text on amber inverse video. Values at the respective trip points of 500 lbs and 1000 lbs are green.

Fuel Tank Temperature Digital Readout

Fuel tank temperature is displayed on the EICAS in 1°C increments. 3 amber dashes are displayed when the value is invalid. Otherwise, the display is white full time. Out-of-limit fuel temperature indications are not monitored by the EICAS.

Flight Controls Display

Aileron Trim Display

Aileron trim position is displayed on the EICAS display as a linear function of actuator travel. The pointer will park at the end of the scale for values beyond the scale. The pointer is removed when the position data is invalid.

The functioning of the display is different for on the ground versus in air operation.

Takeoff Phase Inhibit (TOPI) true or On Ground mode - A green safe takeoff band is displayed. The pointer is white when inside the takeoff band, amber when outside. The **NO TAKEOFF** message is also triggered when the pointer is outside of the takeoff band.

TOPI false and In Air mode - The green safe takeoff band is removed. The pointer is always white. The **NO TAKEOFF** message is not triggered.

Stabilizer Trim Display

Stabilizer trim position is displayed on the EICAS display as a linear function of stabilizer surface rotation. The range of stabilizer travel is +1.2° to -6.9°. When outside of the range, the pointer parks at the ends, but the digital display continues to show values beyond the range. The pointer is removed when the position data is invalid. The functioning of the display is different for on the ground versus in air operation.

TOPI true or On Ground mode - A green safe takeoff band is displayed. The pointer is white when inside the takeoff band, amber when outside. The **NO TAKEOFF** message is also triggered when the pointer is outside of the takeoff band. The takeoff band is from -2.0° to - 6.0°, of displayed surface travel. In the air, the green safe takeoff band is removed. The pointer is always white. The **NO TAKEOFF** message is not triggered.

Stabilizer Trim Digital Display

Stabilizer trim position is displayed digitally in increments of 0.1°. The color of the digits tracks the pointer color. When the pointer is white, the digits are white. When the pointer is amber, the digits are black text on amber inverse video. When the stabilizer position data is invalid, 3 amber dashes are displayed.

Rudder Trim Display

Rudder trim position is displayed on the EICAS display as a linear function of actuator travel. The pointer is removed when the position data is invalid.

The functioning of the display is different for on the ground versus in air operation.

TOPI true or On Ground mode - A green safe takeoff band is displayed. The pointer is white when inside the takeoff band, amber when outside. The **NO TAKEOFF** message is also triggered when the pointer is outside of the takeoff band.

TOPI false and In Air mode - The green safe takeoff band is removed. The pointer is always white. The **NO TAKEOFF** message is not triggered.

Flap Panel Synoptic

The flap position is indicated with a synoptic flap pointer that ranges from 0° to 35°. If the position data is invalid, the pointer will remain at the last known setting and change to amber.

Speedbrake/Spoiler Panel

The speedbrake/spoiler display is a generalized wing shape with annunciators for 5 panels on each side. The inboard and outboard panel on each wing are non-modulated panels, which means they have 2 states: up or down. The middle 3 panels on each wing are modulated panels, meaning that they have a continuous set of states. The idea of the synoptic is to indicate at the beginning of panel deployment. The synoptic shows the same presentation regardless of the amount of panel deployment. If a sensor failure has been detected, the synoptic shows the most likely position of the panels, but the indication is amber. In the air, the display of the effect of roll input on the modulated panels is suppressed. The operation of the mechanical system driving the panels is the same in the air and on the ground, but the display of that operation is suppressed.

Electrical Displays

The electrical systems indications are arranged into 2 columns, one for the left side electrical systems, and one for the right side systems.

The electrical system instrumentation includes the following displays:

1. DC generator voltage
2. DC generator current
3. Battery voltage
4. Battery current
5. Battery temperature

Generator Voltage Digital Readout

Generator voltage is displayed on the EICAS in 1 Volt increments.

Generator Current Digital Readout

Generator current is displayed on the EICAS in 5 Amp increments. Computed display values of 5 amps or below are displayed as 0 amps.

The digit color is normally green. The digit color changes to black text on amber inverse video when the associated **DC GEN O'CURRENT** message is active. The **DC GEN O'CURRENT** message has the appropriate engine start logic to prevent nuisance alerts.

When the input is invalid, the digits are replaced with 3 amber dashes.

Battery Voltage Digital Readout

Battery voltage is displayed on the EICAS in 1 Volt increments.

Battery Current Digital Readout

Battery current is displayed on the EICAS in 5 Amp increments. Computed display values of 5 amps or -5 amps are displayed as 0 amps.

The digit color is normally green. The digit color changes to black text on amber inverse video when the associated **BATTERY O'CURRENT** message is active.

The **BATTERY O'CURRENT** message has the appropriate engine start logic to prevent nuisance alerts.

When the input is invalid, the digits are replaced with 3 amber dashes.

Battery Temperature Digital Readout

Battery temperature is displayed on the EICAS in 1°C increments.

Hydraulics Displays

The hydraulic system instrumentation includes the following displays:

1. Hydraulic system pressure.
2. Fluid volume in the hydraulic reservoir. An analog presentation is also included for quick recognition.

Hydraulic Pressure Digital Readout

The pressure in the hydraulic system is displayed on the EICAS in 100 PSI increments. The hydraulic pressure is smoothed with a 1 second time constant filter.

Hydraulic Reservoir Volume Display

The volume of the hydraulic fluid in the reservoir is displayed on the EICAS in 10 Cubic Inch (CU IN) increments. The pointer and digital display change color to match the corresponding band.

CAS Messages Limitation

Takeoff is prohibited with a red CAS message displayed. Takeoff is prohibited with an amber CAS message displayed unless relief is specifically authorized in a Minimum Equipment List (MEL).

Crew Alerting System Messages

The Citation Sovereign Primus Epic System is configured with two Master Warning Systems hosted on individual processor modules, one installed in Modular Avionics Unit (MAU) 1 and one in MAU 4. Signals for use by the MWS are provided over ASCB from each of the avionics sub-systems, and typically input to a generic or custom I/O module for non-ASCB equipment.

The CAS display area comprises the left lower midsection of the usable EICAS display space. The color convention and displayed priority for the messages on the CAS display are defined as follows:

- RED: Warning (Crew Acknowledgement Required)
- AMBER: Caution (Crew Acknowledgement Required)
- CYAN: Advisory (Crew Acknowledgement Not Required)

EICAS Operation Limitation

Ground operation with the EICAS and/or avionics selected on without conditioned air is limited to 30 minutes when the Outside Air Temperature (OAT) is greater than 47°C (117°F).

EICAS Operation

The EICAS messages for the Sovereign are defined in the CAE SimuFlite Operating Handbook, and in the EICAS System Displays portion of each chapter in this manual. Unless otherwise specified:

1. Invalid data does not cause messages to be displayed.
2. If a message is triggered, but invalid data causes the color to be uncertain, the lowest color is displayed.
3. Invalid data does not trigger the 7 major inhibits (i.e. the messages are otherwise enabled).
4. The debounce is the amount of time the condition must be true before the message is posted or an existing message is promoted from a less severe color to a more severe color. The standard message "debounce" time is 300 milliseconds.
5. When a message is either removed or demoted from a more severe color to a less severe color, the condition must remain true for 300 ms before the message is removed or demoted.
6. Messages for redundant systems are combined into 1 line when multiple systems experience failures. For example, **PITOT/STATIC COLD L-RSTBY** has 7 possible combinations: **L**, **R**, **STBY**, **L-R**, **L-STBY**, **R-STBY**, **L-R-STBY**.
7. Messages with different colors for redundant systems are NOT combined. For example, if **PITOT/STATIC COLD L** is active as amber and **PITOT/STATIC COLD R** is active as cyan, the messages are not combined.

8. Message colors for the same system are mutually exclusive. For example, **PITOT/STATIC COLD L** cannot be displayed as both amber and cyan at the same time.
9. A large number of EICAS messages have some sort of inhibit in order to reduce crew workload and nuisance messages. Reference the following table:

TOPI	TakeOff Phase Inhibit
LOPI	Landing Operations Phase Inhibit
ESDI	Engine ShutDown Inhibit
EFI	Engine Fail Inhibit
BFI	Bus Fail Inhibit
On Ground	On Ground Inhibit
In Air	In Air Inhibit

The ESDI, EFI, BFI, On Ground and In Air inhibits are applied before the debounce. If the message is defined to have a latching action, that occurs after the debounce. The TOPI and LOPI inhibits are applied after the latch or debounce.

10. In order to meet safety assessment requirements, redundant processing elements are used. After power on or other processor reset condition, the backup processing elements will synchronize their latch states to the master processing element. This syncronization happens only once, and only on the backup elements.
11. Inhibits and debounce identified with an asterisk indicates a special modification that is specified in the message description. Frequently, this means that some other processing is used in place of the default processing defined above. For definition, see the respective message section for details.

Inhibit Phases

TOPI

Active:

- The aircraft transitions from on-ground to in-air.
- Either left or right airspeed transitions from <80 knots to >80 knots.

Inactive:

- The airplane is airborne for more than 25 seconds.
- Either left or right pressure altitude is >400 feet above field elevation.
- Either the left or right airspeed is <50 knots.
- TOPI has been active for more than 90 seconds.

LOPI

Active:

- The airplane transitions from in-flight to on ground.
- Radio altimeter (RA) transition from >200 feet AGL to <200 feet AGL.

Inactive:

- The airplane has been on the ground for more than 25 seconds.
- RA is >400 feet AGL.

- Either the left or right airspeed is <50 knots.
- LOPI has been active for more than 90 seconds.

ESDI

Active:

- The respective engine throttle is in CUTOFF or engine start sequence in progress, including automatic relight.
- Messages that naturally occur due to engine shutdown are inhibited in order to keep the number of active CAS messages to a minimum.
- ESDI is active with the cyan **ENGINE SHUTDOWN L-R** message displayed.

Inactive:

- Other than engine start, ESDI becomes inactive when the respective engine throttle is at IDLE or above.
- During engine start, ESDI becomes inactive at the completion of start (57% - 59% N2).
- The cyan **ENGINE SHUTDOWN L-R** message disappears.
- Any active ESDI messages can appear and alert the crew.

EFI

Active:

- TLA is out of cutoff.
- The engine is not running.
- Not in start sequence, including automatic relight.

BFI

Prevents nuisance messages during engine start and during bus failure in flight. Selected messages are inhibited when the respective power bus voltage falls below a certain point. Message debounces take effect after the bus fail inhibit.

On-Ground and In-Air Inhibits

Selected messages are inhibited when the airplane is on the ground or in the air.

The airplane is considered on the ground when the left and right weight off wheels indicates ground mode. The **WOW MISCOMPARE** message is active following a 20-second debounce when the left and right WOW modules disagree.

The airplane is considered in the air when the left or right weight on wheels indicates air mode.

CAS Message Comparison Monitors

The Monitor Warning function has a CAS comparison monitor. This monitor compares the displayed message stacks being generated by the two Monitor Warning Functions. In the event of a miscompare between the two functions, an annunciation is displayed at the bottom of the CAS message window. The annunciation is in inverse video and is either MW1 or MW2 depending on which Monitor Warning Function has the CAS priority. MW1 indicates that a miscompare exists and Monitor Warning 1 has CAS priority.

On the Display Setup (DISP SETUP) page on the MCDU there is a selection: MW1/MW2. This selection allows the crew to toggle the displayed CAS message list between MW1 and MW2. The default setting is the Monitor Warning Function with CAS priority.

A failure of both Montior Warning functions results in a red "X" being displayed on the CAS portion of the EICAS.

Multi-Function Control Display Units

The Multi-Function Control Display Units (MCDU) are capable of controlling several functions of the Citation Sovereign avionics system. 12 line select buttons, 6 on each side of the MCDU display screen, a dual concentric knob, command select buttons, and an alphanumeric keypad allow for command inputs to the MCDUs.

The MCDU is the central control unit for the Primus Epic integrated flight management system. FMS primary functions include navigation and performance calculations. Radio tuning is also incorporated into the FMS MCDU. Line select buttons are used to simplify operation by the flight crew of radio frequency tuning, selection and memory storage. Any selectable radio parameter can be changed by pushing the corresponding line select button to place the cursor box around the inactive frequency on the display. Once selected, the frequency is tuned with the TUNING knobs located on the lower right hand side of the MCDU display screen.

A viewable area of 14 rows by 24 columns is available on the display screen. This area is also divided into sections associated with the appropriate radio function (COM, NAV, ADF etc.). A paging system is used to identify and control the radio associated with the Epic integrated communications system.

More detailed information pertaining to MCDU operation can be found in the Navigation section of this chapter.

Figure 11-11: Multi-Function Control Display Unit (MCDU)

Reversion Controls

Both PFDs can be manually reverted, or displayed on an MFD, in order to provide redundancy and safety in case of a display failure. The EICAS can be reverted to either MFD if necessary. The system is designed, however, so that MFD data cannot be displayed on a PFD. If the pilot's PFD should fail, the PFD data can be reverted to the pilot's MFD; if the EICAS display should then fail, manual reversion of the EICAS display to the copilot's MFD is the remaining option. In this case, regardless of which MFD is selected, the Primus Epic system forces the EICAS data to the copilot's MFD.

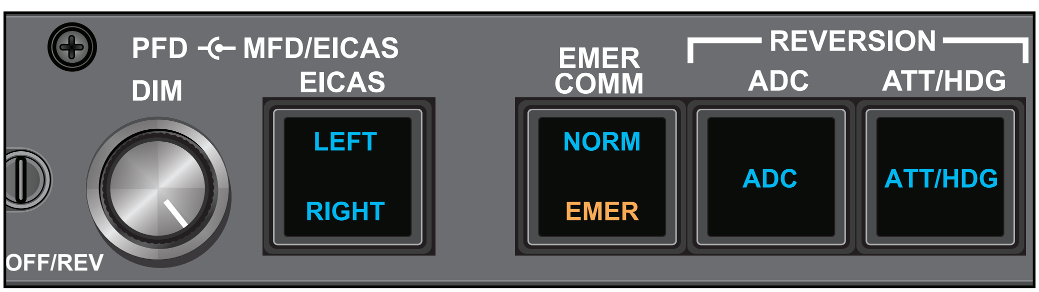

Figure 11-12: Reversionary Controller

PFD/MFD Reversion

The PFD-MFD/EICAS knob combines the PFD dimming control and reversion control into one knob. Turning the outer knob clockwise increases the intensity of the PFD. Turning the outer knob counterclockwise lowers the intensity of the PFD. Turning the outer knob completely counterclockwise puts the knob in the OFF detent position, reverting the PFD to the adjacent display unit.

EICAS Display Selection

The EICAS LEFT/RIGHT button located on the reversion control panel toggles the EICAS between DU2 and DU3. When a PFD is turned OFF, automatic reversion occurs and the EICAS format is displayed on the remaining tube that does not have a PFD format. One of the MAUs gives feedback lines to the reversion controller for proper indication of the EICAS position. This selection can be made on either the pilot or copilot reversion controller.

NOTE: For EASA certified airplanes, the EICAS display must remain in the LEFT position on DU2, except in case of a DU2 failure or PFD1 reversion. If a DU2 failure occurs, refer to Abnormal Procedures.

Emergency Communication

The EMER COMM button is used for selecting the emergency COMM frequency (121.5) as the active frequency, thus overriding tuning on the displays and MCDU. The button selection is indicated on the displays and MCDU to alert the flight crew in the event that the button is inadvertently set in the wrong position. This selection can be made on either the pilot or copilot reversion controller.

Air Data System Reversion

This button toggles the available ADC (air data computer) source for the on-side display unit. When both PFDs are not displaying on-side data, annunciators will display in the upper left corner of the ADI to inform the flight crew.

Attitude/Heading Reversion

This momentary button toggles the displayed ATT/HDG source for the on-side display. When both PFDs are not displaying on-side data, annunciators will illuminate on the ADI to alert the crew.

Cursor Control Devices

Two Honeywell CC-950 Cursor Control Devices (CCDs) are installed in the center pedestal in the cockpit. The CCD consists of a trackball, three display selection buttons, a conical switch, a TCAS window selection button, a dual concentric knob, and an enter button on either side of the palm rest.

Three display selection keys correspond to the respective crewmember displays. The pilot CCD controls DU1, DU2 and DU3, and the copilot CCD controls DU2, DU3 and DU4. In the case where the pilot and copilot may have selected the same display, the last cursor to select the display will have priority. The default position of the corresponding CCD is the pilot's CCD to DU2 and copilot's CCD to DU3.

Figure 11-13: Cursor Control Device (CCD)

Attitude & Heading Reference System Limitation

Taxiing the aircraft is prohibited until the attitude/heading ground alignment is completed (approximately 90 seconds for AHRS or 6 minutes with optional IRS).

Attitude & Heading Reference System

The Dual Collins AHS-3000 AHRS is installed as standard equipment on the Citation Sovereign. Attitude, heading and accelerometer functions are provided for display to the flight crew on the Honeywell Primus Epic Integrated Avionics System. Each AHS-3000 unit is comprised of three components: the AHS-3000 Attitude Heading Computer, the ECU-3000 External Compensation Unit, and the FDU-3000 Flux Detector Unit. These units operate in unison to provide the flight attitude and heading information for all flight conditions.

The AHS-3000 is a solid-state attitude and heading reference system using quartz based inertial sensor technology. Primary functions for the AHS-3000 are to provide pitch, roll and heading information for use by the cockpit displays, flight control and management system, weather radar stabilization, Enhanced Ground Proximity Warning Module (EGPWM), and TCAS systems.

Modes Of Operation

Initialization begins immediately after primary power is applied to the AHS-3000 unit. The power-up test takes approximately 5 seconds to verify that the Attitude Heading Computer is capable of performing the basic operating mode functions. After initial power is applied, the Attitude Heading Computer sets the attitude and heading invalid bits causing the HDG and ATT flags to be displayed on the PFDs. During initialization the compass card on the PFDs will turn to a North heading and then slowly rotate clockwise back to a North heading after the process is complete. Initialization of the AHRS unit takes approximately 35 to 50 seconds on the ground.

In normal mode the AHRS uses valid True Airspeed (TAS) from the ADM to improve attitude accuracy. If the true airspeed data are not available or is invalid, the system will automatically revert to the basic mode to operate autonomously. If true airspeed becomes valid again during basic mode operation, the system will revert to normal mode. Transition between normal and basic modes is controlled by the availability and validity of true airspeed data, and the transition is performed automatically in both directions.

In slaved mode, the heading loop of the AHS-3000 Attitude and Heading Reference Unit (AHRU) is supplied with magnetic heading data from the magnetic sensor unit (flux valve). The heading output is magnetic heading referenced to local magnetic north. The earth rate and gyro drift correction factors are updated continuously during slaved operation.

A dot/cross type of heading sync indicator is displayed at the top left of the Horizontal Situation Indicator (HSI) display in the PFD. The scale is green and the pointer is white. During straight and level flight, the indicator will be stabilized between the dot “o” and the cross “+”. and may temporarily drift to one side or the other. This indicates normal operation in the slaved mode. After a turn, the indicator should return to a centered indication within two minutes. The heading sync indicator can be quickly re-synchronized by cycling the DG/SLAVE/TEST switch to DG and back to SLAVE. The heading sync indicator is removed from the HSI when DG mode is selected, when there is an invalid flux valve heading, and when there is an invalid magnetic heading.

In DG (directional gyro) mode, the heading may be set as desired by the L SLEW (left) and R SLEW (right) switch of either AHRS system, after DG is selected on the appropriate system switch (DG/SLAVE/TEST). In DG mode the system acts as a free gyro; there is no magnetic input, and no update of earth rate and gyro drift estimation will be performed.

The AHRS basic mode is annunciated in the upper left corner of the MFD (i.e., AHRS BASIC- 1-2), in white, if the AHRS is not in a normal mode.

Figure 11-14: AHRS Switches

Standby Flight Displays Limitation

The standby flight display (including attitude, altitude and airspeed) and standby HSI must be functioning prior to takeoff.

Standby Flight Displays

A Standby Flight Display (SFD) is located in the center instrument panel between the pilot and copilot MFDs. This DC-powered AMLCD combines a standby attitude indicator, altimeter, and airspeed indications into one composite instrument. A Mach indication is also included in the instrument. Information for the SFD is obtained from the standby air data module via a dedicated ARINC-429 data bus.

The SFD is a stand alone unit containing inertial sensors for the measurement and presentation of aircraft pitch and bank attitudes. Application of 28-volt DC power to the display system initiates the attitude initialization process, which is identified by the display of the message “attitude initializing” in yellow on the SFD. The duration of the initialization process is normally less than 180 seconds.

The attitude display has an instantaneous display range of 360° of bank and 50° of pitch. A moving tape on the right side of the display includes a “rolling digit” depiction of altitude. Altitude tape information is displayed in 100 foot increments. Barometric pressure is set in the altitude display by a knob on the bottom right of the bezel; clockwise rotation increases the pressure setting and counterclockwise decreases it. The setting is displayed simultaneously in millibars at the top right of the display and in inches of mercury at the bottom right. On the left side of the display is a moving tape showing airspeed. The tape is marked in ten knot increments with a “rolling digit” display in the center. The airspeed display becomes active at 40 knots. The Mach number is displayed in the upper left corner of the display. The Mach display range is Mach 0.300 to 0.999.

Failure flag indications for airspeed and altitude are red crosses covering the appropriate tape box, with all indications removed from within the box. The failure flags for the Mach indication and barometric pressure setting are a series of four red dashes in the appropriate display area.

A light sensor is located on the bottom left side of the instrument case. It provides ambient light level data to the backlight control system to ensure optimum display brightness. The lighting level can still be controlled manually from the center instrument panel light rheostat control.

Figure 11-15: Standby Flight Display

The navigation display is selected through the MENU (M) button on the bottom of the display bezel. Selecting NAV ON from the menu results in display of ILS localizer and glideslope information from NAV1 receiver. The ILS can be flown by reference to the ILS localizer and glideslope display on the standby HSI.

Power to the SFD is controlled by a switch marked STBY PWR ON/OFF/TEST located on the electrical control panel at the lower right corner of the pilot's instrument panel. The SFD receives power from the emergency buses. In the event this power source becomes unavailable, the standby battery located in the nose compartment will supply electrical power to the standby instruments.

The battery pack is constantly charged by the airplane's electrical system, and should therefore be fully charged in the event of an electrical power failure. The STBY PWR switch must be ON for automatic transfer to battery power to occur. The SFD will operate for a minimum of 30 minutes on battery power. An amber POWER ON light next to the STBY PWR switch illuminates when the SFD is turned ON and the airplane's electrical system is not charging the emergency power supply batteries. When the SFD switch is held to the spring-loaded TEST position, a self-test of the battery and circuits is accomplished. The green GYRO TEST light, also next to the STBY GYRO switch, will illuminate if the test is satisfactory and the battery is sufficiently charged.

Maximum allowable airspeed V_{MO} is displayed in analog form by a red warning strip on the airspeed tape. When V_{MO} is reached, the numerals on the numeric airspeed display change from white to red. When the maximum allowable Mach number M_{MO} is reached, the numeric Mach number display will also change from white to red.

A Built-in Test system (BIT) will automatically detect any failure of the display at power up or during continuous operation. If the pilot desires to test the system after it is powered up, a selection can be made from the unit's menu screen. If a failure is detected, the appropriate part of the display is replaced with a message indicating the failure. Where it is not possible to display an appropriate message, the display backlight is switched off.

Standby Pitot-Static System

The standby pitot probe, behind and below the copilot aft window, provides total pressure produced by aircraft movement through the air. The total pressure value is used to calculate airspeed by the standby ADC.

The standby static ports are in the static port clusters on the lower left and right sides of the forward fuselage. The ports provide static air pressure for calculation of altitude, airspeed, and vertical speed by the standby ADC. The standby static ports are electrically heated and monitored.

Magnetometer

The magnetometer (heading slave) is in the vertical stabilizer. The magnetometer does not replace any of the existing heading sources. It is a stand alone unit dedicated to the standby instrument system. The unit uses a three-axis magnetic sensor that reads magnetic fields and converts these signals to a digital format that is transmitted to the SFD. The signal is then used with pitch and roll attitude to compute the aircraft's magnetic heading.

Standby Battery

The standby battery is located in the nose compartment. The STBY PWR switch controls power distribution from the standby battery to the standby equipment bus. This switch must be selected on for the standby equipment to operate. Electrical power will normally be supplied to the standby equipment bus from the left main bus. Electrical power for charging the standby battery pack is provided by the right main bus. With the switch on and after loss of a generator and external power, power is drawn from the standby battery pack. An amber light adjacent to the switch will indicate this. In the OFF position, the standby equipment bus is not powered, regardless of other electrical configuration. The TEST position permits the crew to test the lead-acid standby battery pack.

Following loss of electrical power, the standby equipment battery pack will continue to supply electrical power to the following equipment for a minimum of 180 minutes:

1. Standby Flight Display
    a. Magnetometer
    b. Standby Air Data Computer
2. Standby Horizontal Situation Indicator
3. Standby Engine Indicator

After loss of all generator electrical power, the flight controls will continue to operate normally (except rudder bias and primary stabilizer trim). Aileron, rudder and secondary stabilizer trim will be operable; the engines will continue to operate in ADC reversionary mode; pressurization will operate in manual mode; all bleed air anti-ice valves will fail open, except for the cross flow valves; landing gear control and indication will operate normally; normal brakes will operate (with antiskid protection). Primary stabilizer trim, flaps and thrust reversers will not be operative. Fuel system operation will be normal except boost pumps and crossfeed will not operate.

Electronic Standby Horizontal Situation Indicator

The Electronic Standby Horizontal Situation Indicator (EHSI) is a three-inch instrument located on the center instrument panel. The EHSI provides short range navigational guidance in case of PFD failure, flight director failure, or primary electrical system failure. The EHSI is hard-wired to the NAV 1 receiver and is powered by the emergency DC bus.

The EHSI displays compass heading, glideslope and localizer deviation and airplane position relative to VOR radials. The compass card is graduated in 5° increments and a lubber line is fixed at the fore and aft positions. Azimuth markings are fixed at 45°, 135°, 225°, 270°, and 315° on the compass face. A fixed reference airplane is in the center of the EHSI, aligned longitudinally with the lubber line markings.

The course cursor is set by a knob on the instrument. Once set, the cursor rotates in its set position with the compass card. The course deviation bar, which forms the inner segment of the course cursor, rotates with the course cursor.

A blue ADF needle, which displays ADF 1 bearings, rotates around the outer portion of the dial.

A heading (HDG) flag will appear in the instrument when the compass system is OFF, the heading signal from the SFD becomes invalid, primary power to the indicator is lost, or the error between the displayed heading and the received signal becomes excessive.

The course deviation bar moves laterally in the HSI, in relation to the course cursor. Course deviation dots in the HSI act as a displacement reference for the course deviation bar. When tracking a VOR, the outer dot represents 10°, while on an ILS localizer it represents 2.5°.

White TO-FROM flags point to or from a station along the VOR radial when operating on a VOR. A red warning flag comes into view when power is OFF, when NAV information is unreliable, or when signals from the NAV receiver are not valid. The standby HSI displays only NAV 1 information.

Figure 11-16: Standby HSI Display

The glideslope deviation pointer is located to the right side of the display. When receiving glideslope information during an ILS approach, the green deviation pointer will be uncovered by the red VERT warning flag which will normally be visible. If an ILS frequency is not tuned and being received, or the ILS signal is unusable or unreliable, the deviation pointer will be covered by the red warning flag.

Standby Engine Instruments

A standby engine indicator is installed between the MFDs in the center instrument panel. The indicator combines six liquid crystal displays to relay engine N_1%, N_2%, and ITT°C information to the flight crew in the event of a loss of power to the EICAS system. Power is normally provided to the standby engine instruments by the emergency bus system. In the event that this power source becomes unavailable, a standby battery located in the nose compartment will supply electrical power. A placard showing engine operating limits is located directly below the information display.

In the event of a FADEC channel becoming unreliable, the standby engine indicator has the redundancy of using a second FADEC channel to provide the flight crew with engine power and temperature information. During initial power up the standby indicator will display all eights (8s) and flash these digits for approximately three seconds. If the display shows all dashed lines, the information on the ARINC-429 serial bus data line is invalid or a signal has been lost.

Clocks

The Honeywell Primus Epic integrated avionics system uses an integrated digital clock. A section in the PFDs labeled CLOCK is located at the lower left hand side of the display. The digital readout provides the time of day in hours, minutes and seconds in the HH:MM:SS format.

Flight Hour Meter

The quartz hour meter, located next to the right circuit breaker panel, displays the total flight time on the airplane in hours and tenths. The landing gear squat switches activate the meter when the weight is off the gear. A small indicator on the face of the instrument rotates when the hour meter is in operation. It receives DC power from the FLT HR METER circuit breaker located on the left circuit breaker panel.

EGPWS/TAWS

The EGPWS is a terrain awareness and alerting system that gives aural warnings and cockpit displays that the pilot uses to avert impending situations that can jeopardize the aircraft's safety. For additional information, refer to an applicable Aircraft Flight Manual (AFM) or EGPWS aircraft flight manual. The EGPWS uses aircraft inputs including:

- Geographic Position
- Attitude
- Altitude
- Airspeed
- Glideslope Deviation

These are used with internal terrain, obstacles, and airport databases to predict a potential conflict between the aircraft flight path and terrain or an obstacle. If a terrain or obstacle conflict exists, the egpws sounds an audio caution or warning alert, and shows a display of the situation. The egpws alerts the pilot as to excessive glideslope deviation too low with flaps or gear not in landing configuration. It can also warn of excessive bank angles and altitude callouts, severe windshear conditions are also annunciated in certain types of aircraft.

The EGPWS incorporates several enhanced features:

Terrain Alerting and Display (TAD) - The TAD is a graphic display of the surrounding terrain that is displayed on the weather radar indicator, EFIS, or a dedicated display. The aircraft's position is superimposed on the internal terrain topography database that is within the display range selected. All terrain that is above the aircraft or 2,000 feet below the aircraft altitude is displayed in the cockpit.

Peaks - Peaks is a TAD supplemental feature that displays additional terrain features to enhance the pilot's situational awareness, independent of the aircraft's altitude. This includes digital elevations for the highest and lowest displayed terrain, additional colored elevation bands, and a representation of 0 MSL elevation (sea level and its corresponding shoreline).

Obstacles - Obstacles is a feature that uses the obstacle database to alert and display potential obstacle conflicts. GND PROX and warning visual alerts are displayed and audio alerts are sounded when a conflict is detected. When TAD is enabled, obstacles are graphically displayed similar to terrain.

Envelope Modulation - A process feature called envelope modulation uses the internal database to tailor EGPWS alerts at certain geographic locations to reduce nuisance alerts and give added protection.

Terrain Clearance Floor (TCF) - The terrain clearance floor feature adds another element of protection by alerting the pilot of a possible premature descent. This is used for nonprecision approaches and is based on the current aircraft position relative to the nearest runway.

Runway Field Clearance Floor (RFCF) - RFCF is similar to the TCF feature except that RFCF is based on the current aircraft position and height above the destination runway based on geometric altitude. This improves protection at locations where the destination runway is significantly higher than the surrounding terrain.

Aural Declutter - The aural declutter feature reduces repetitive aural warning messages.

Geometric Altitude - Geometric altitude is based on GPS altitude. It is a computed pseudobarometric altitude that is designed to reduce or eliminate altitude errors resulting from temperature extremes, nonstandard pressure altitude conditions, and altimeter miss-sets. This ensures an optimal EGPWS alerting and display capability.

Some of these features were added to the EGPWS as the system evolved and are not present in all terrain awareness warning computers (TAWC). For the specific TAWC part number and functions, refer to the Aircraft Flight Manual (AFM) or EGPWS Aircraft Flight Manual Supplement (AFMS).

In later versions, the TAWC conducts radio altitude reasonableness checks based on the computed terrain clearance (pseudo-radio altitude). Computed terrain clearance is computed by subtracting the elevation of the (database) terrain below the aircraft from geometric altitude above sea level (ASL).

Radio altitude is considered unreasonable when it indicates a terrain clearance that is less than the computed terrain clearance by more than 2,000 feet. For example, if the computed terrain clearance is 10,000 feet and the radio altitude is any value (0 - 2,500 feet), then the radio altitude is considered unreasonable. This is only performed if TAD is enabled, high integrity terrain and position data are available, and the computed terrain clearance is greater than 4,000 feet. This feature reduces the potential for nuisance alerts caused by false tracking of the radio altimeter.

TCAS

The TCAS is an independent airborne system that does not rely on ATC for control or coordination. It detects unsafe traffic conflicts with other transponder-equipped aircraft and assists the flightcrew in avoiding intruders inside a protected airspace. This is done by interrogating surrounding aircraft Mode A, Mode C, and Mode S transponders, tracking their responses, and issuing advisories to the flightcrew of the vertical separation from intruders.

TCAS Operation

Vertical guidance to avoid midair collisions is computed using two levels of advisories:

- TA (Traffic Advisories) - TAs indicate the range, bearing, and relative altitude of the intruder to aid in visual acquisition of the intruder.
- RA (Resolution Advisories) - RAs indicate what vertical maneuver must be executed to assure safe separation.

Each type of advisory has a corresponding aural message that is sounded by the TCAS computer and broadcast in the cockpit.

Mode A equipped intruders can only be detected and displayed as TAs. Intruders not equipped or not using their transponder are invisible to TCAS.

TCAS generates both RAs and TAs when the TA/RA mode is selected on the MCDU RADIO 1/2 page. The two types of advisories correspond to time-based protection zones around the aircraft. The airspace around the TCAS aircraft where a RA is annunciated represents the warning area, while the larger airspace that results in a TA being annunciated is the caution area.

Only one Mode S transponder in the protected aircraft is required for TCAS operation. When two Mode S transponders are installed, the selected transponder is used by TCAS, the other operates as a backup. The TCAS receiver/computer uses its directional antenna to display intruder bearing.

A TCAS map overlay and a TCAS zoom format can be displayed on the MFD. The two formats are mutually exclusive. The traffic symbols displayed are limited to the eight highest priority intruders in order to avoid clogged displays with low priority intruders.

Each pilot can control the on-side TCAS display independent of the selected controls on the other side.

Weather Radar

Description

The Primus 880 weather radar system is an X-band digital radar designed for weather detection, turbulence detection and avoidance, and ground mapping.

The primary purpose of the systems is to detect storms along the flight path and give the crew a visual color indication of rainfall intensity and turbulence content. After proper evaluation, the crew can chart a course to avoid storm areas.

Components

The Primus 880 weather radar consists of the following:

- WU-880 Integrated Receiver/Transmitter/Antenna (RTA) unit
- Two WC-880 weather radar controllers
- MFD virtual controller
- PFD controller.

The RTA is mounted in the nose of the aircraft. The system uses a 24-inch antenna.

The virtual controller consist of the CCDs and the WX mode information displayed on the MFD pulldown menu.

The RTA transmits and receives X-band radio frequency energy for the purposes of weather detection and ground mapping (GMAP). The transmitted signals are sent directly to the antenna from the transmitter circuitry, which is mounted on the rear of the antenna. Echo signals received by the antenna are applied directly to the receiver. The RTA receiver gain is adjustable to increase or decrease the receiver sensitivity when performing GMAP or weather analysis. There is also a rain echo attenuation compensation technique (RCT) function available to allow the RTA to adjust sensitivity automatically to compensate for attenuation losses caused by the weather target.

The system range can be adjusted to six different distances between 10 and 300 NM, and a target alert option can be activated to alert the pilot when severe weather outside of the selected range is detected. The system can detect storms up to 300 NM from the aircraft.

The antenna sweep is selectable for either normal sweep mode (120°) or sector scan sweep mode (60°). Normal sweep covers 60° for each side of the aircraft. Sector scan covers 30° for each side. The WX radar system has an OFF option, and also a SLV option, where one controller can be off and the other can control both radar sweeps. There are also standby and forced standby modes, in which the unit is on but not active.

The antenna tilt is manually adjustable, using the TILT knob in 1° increments between -15° down and +15° up with respect to the horizon. When the stabilization feature is active, the antenna tilts to maintain its line-of-sight with respect to the horizon within the 30° pitch attitude limit, regardless of the aircraft attitude. The antenna can be stabilized in the pitch and roll axis through attitude information from the AHRS or optional installed IRU.

The Primus 880 system contains functions for turbulence detection and altitude compensated tilt (ACT). ACT adjusts the antenna tilt in relation to the aircraft altitude and selected range so the radar remains pointed at the horizon. The radar processes return signals in order to determine if a turbulence signature is present. Turbulence detection can only be engaged in the WX mode and at selected ranges of 50 NM or less.

The WX menu and CCD control the WX display of WX information on the MFD in the Map mode only. All display data is controlled using the weather radar controller pictured below. Weather can be displayed on the PFD using the display controller WX/TERR button. Weather can be displayed on either the full or partial compass display on the HSI section of the PFD.

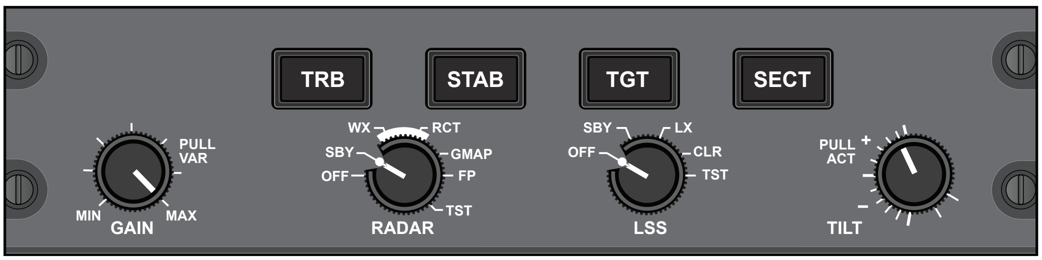

Figure 11-17: Weather Radar Control Panel

Controls and Indications

The Citation Sovereign uses a single weather radar controller. When a single controller is used, all weather radar displays show the same radar data. For expanded information pertaining to the Weather Radar Controller, refer to the Honeywell Primus EPIC Pilot's Guide.

Lightning Strike System

The Lightning Strike System (LSS) is an option onboard the aircraft. The LSS, consisting of a sensor antenna and processor, is used to detect and locate areas of lightning activity in a 200 NM radius around the aircraft and to give the flight crew a visual display of the lightning rate of occurrence and position relative to the aircraft. LSS is an enhancement to the WX system to aid the flight crew in finding areas of storm activity and operates in conjunction with the weather radar. The LSS information can also be displayed if the weather radar is either OFF or has failed.

When the LSS option is installed on the aircraft, the weather radar controller has an added LSS mode selector knob located on the weather radar control panel (pictured above). The Primus EPIC avionics system manual contains a detailed description of the LSS.

Cockpit Voice Recorder

An FA2100 CVR system provides a continuous 60-minute record of all voice communications originating from the cockpit as well as sounds from warning horns and chimes. The system is protected by a 5-ampere circuit breaker CVR located in the LH power J-Box.

The sensitive microphone is located in the instrument panel near the lower right corner of the fire tray. The system is energized when the battery switch is in the BATT position. The control panel, located on the center pedestal, contains a TEST button, and an ERASE button. System operation is checked by pressing the TEST button. When the TEST button is held down for five seconds illumination of the green light on the control panel indicates correct functioning of the voice recorder system. Pressing the ERASE button for approximately 2 seconds will cause the entire record to be erased. Erasure can only be accomplished on the ground with the main entry door opened.

Figure 11-18: Cockpit Voice Recorder

The installation is equipped with a 5-G switch which will activate any time the airplane is subjected to a five-G force; this will disable the system's erasure mechanism until a reset button on the G-switch is pressed. The switch is directly mounted to the CVR tray structure and is located in the tailcone. The CVR is also equipped with an underwater locator device which is located with the recorder mechanism in the tailcone.

Digital Flight Data Recorder

For airplanes operated under FAR Part 135, a digital flight data recorder is installed which continuously records at least 27 parameters of aircraft and systems operation. The optional L3 Communications FA2100 recorder installed in the aircraft records the information digitally using a solid state method and records up to 25 hours of data. Recorder operation requires no attention from the crew. A cyan **FDR FAIL** CAS message will illuminate if the flight data recorder malfunctions or if power to the system fails. The flight data recorder receives 28-volt DC power through a 5-ampere circuit breaker and is powered by the right avionics bus.

Emergency Locator Transmitter

The standard remote control switch for the Emergency Locator Transmitter (ELT) is located on the copilot's side panel. In the ON (up) position of the switch, the ELT will transmit, the ELT horn will sound, and the HORN light will illuminate. In the ARMED position, the ELT will transmit, the ELT horn will also sound and the horn light will illuminate if activated by impact forces. Pressing the HORN MUTE button will cancel the horn. The RESET position resets the ELT logic.

Angle-of-Attack/Stall Warning System

The Angle-Of-Attack (AOA) and Stall Warning system senses airflow relative to airplane angle of flight and provides that information for display and stall prevention. A Stall Warning Angle-Of-Attack Transducer senses AOA and combines the AOA and stall warning functions into one Line Replaceable Unit (LRU). Each LRU consists of an AOA vane and a Stall Warning Computer.

The AOA/Stall Warning system is made up of a left and right channel. Pilot and Copilot systems receive input information from the following: Anti-Ice switch, transducer, landing gear position inputs, MAU inputs, Weight-on-Wheels input, and computes a normalized angle-of-attack for display in the AOA section of the PFDs. Outputs to the stick shakers are also computed. Low Airspeed Awareness (LAA) information is also displayed on the inside of the indicated airspeed tape.

A pilot activated self test mode is available by placing the Rotary Test knob to the AOA position. In this position, all related EICAS messages will be displayed, the AOA meter will function, stick shaker activation will occur.

Indications for the system are provided by the AOA PFD section and the AOA indexer located at the top center of the glareshield. Range for the AOA indicator is from 0.1 (zero lift condition) to 1.0 (maximum lift condition).

Angle-of-Attack/ Stall Warning System Limitation

A satisfactory preflight check of the AOA / Stall Warning Systems must be accomplished in accordance with AFM Section III, Normal Procedures, prior to take off.

Angle-of-Attack Display

Figure 11-19: Angle-Of-Attack Display and Indexer

The area at the lower part of the scale (0.1 to 0.57) represents the normal operating range of the airplane, except for approach and landing. The narrow white arc (0.57 to 0.63) covers the approach and landing range and the middle of the white arc, 0.6, represents the optimum landing approach (V_{APP} or V_{REF}). The yellow range (0.63 to 0.85) represents a caution area where the airplane is approaching a critical angle-of-attack. The red arc (0.85 to 1.0) is a warning zone that represents the area just prior to stick shaker activation and continuing to full stall. At an indication of approximately 0.79 to 0.88 (depending on flap setting and rate of deceleration) in the warning range, the stick shaker will activate.

If the AOA system loses power or becomes inoperative for other reasons the needle will deflect to the top of the scale and stow at a 1.0 indication. A red X will also appear at the ADI slow/fast indication. The airplane may not be flown if the stick shaker is found to be inoperative on the preflight check, or if the angle-of-attack system is otherwise inoperative.

A stick shaker is located on both the pilots' control columns, approximately 9 inches (22.86 cm) down from the control wheel and on the forward side. The stick shaker provides tactile warning of impending stall. The angle-of-attack transmitter causes the stick shaker to be powered when the proper threshold is reached.

WARNING

If the AOA vane heater fails and the vane becomes iced over, the stick shaker may not operate or may activate at normal approach speeds.

Communications

General

The radio functions of the Citation Sovereign were developed using the MCDU for the Primus EPIC radio tuning functions. The system is designed to have a radio tuning function that matched, as closely as possible, the behavior of the Honeywell radio management unit (RMU) and the Rockwell Collins radio tuning unit (RTU).

Radio tuning is accomplished through the Multifunction Control Display Unit (MCDU), or cursor control device (CCD) manipulating radio data on the MFD. When the aircraft is operating on emergency batteries, the MCDU provides radio tuning for the VOR/ILS datalink (VIDL), VHF data radio (VDR), and transponder (XPDR). The primary data path is the Avionics Standard Communications Bus (ASCB) between the Modular Avionics Unit (MAU) and the Modular Radio Cabinet Network Interface Module (MRC NIM). The MRC NIM translates the ASCB data to radio control bus (RCB) to communicate with each radio module.

The radio tuning function is accessed by way of the RADIO function key on the MCDU, that displays the RADIO 1/2 page. All other pages are accessed from RADIO 1/2 using the line select keys or the NEXT and PREV function keys.

Modular Radio Cabinets

Two Honeywell MRC-855A MRCs are installed in the Citation Sovereign, both are located in the aft avionics bay. The MRCs integrate all communication, navigation functions including VOR, ADF, DME, ILS, VHF Communication and Diversity Mode S transponder modules. Each major function has its own associated module with a self contained power supply.

Audio/Interphone System

The digital audio system is part of the integrated radio system in that the audio digitization occurs within the remote mounted radio cabinets, even for radios such as the HF (High Frequency) which are not inherently part of the Honeywell system. There is no separate remote mounted audio integrating LRU (Line Replacement Unit) required. Audio is transmitted digitally from each side’s cabinet on a shielded twisted wire pair to all audio panels in the system. All audio from one side is contained on the single digital bus.

The system gives the following functions:

- Interphone link between crewmembers
- Operation of communication and radio navigation audio systems with individual volume controls.
- Input of audio warnings (TCAS, GPWS, AW tones etc.)
- Operation of maintenance interphones
- CVR (calibrated voltage ratio) output

- PA (passenger address) selection and switched microphone output.
- A/CHIME amplifier is required).
- Audio bus interfaces
- Dual digital audio bus inputs
- Analog interphone audio bus
- Mask, boom, and hand MIC (microphone) inputs
- Selected MIC output to each transceiver
- Audio output drivers for cockpit and cabin speakers and interphone, headphone and CVR interfaces
- Five audio warning inputs
- Two maintenance crew interfaces.

Digital Audio Control Panels

Two AV-850A audio control panels are installed in the cockpit instrument panel, one each on the pilot's and copilot's side. These units receive digital audio from the remote NAV and COM units through a high speed digital audio bus on each side of the airplane. Each panel selects the proper channels from the digital audio and creates a headphone and speaker signal.

Located at the top edge of each panel is a row of microphone select buttons. Once pushed these buttons connect the on-side microphone with the selected radio and enable the audio associated with that radio. This is regardless of the position of the ON/OFF buttons. Activation of the audio ON/OFF buttons latches it and the associated audio is turned off. Pushing the button energizes the audio to the headphone and speaker while also enabling volume adjustment through rotation of the popped up button.

Three rows of audio selector buttons and various microphone selector arrangements are on the panel. Inputs for intercom, crew annunciation, crew communication, hot microphone, and full time emergency warning inputs from airplane systems are also incorporated.

Digitized operation provides the advantage of allowing for each individual volume control to be adjusted independently by each flight crew member. An example of this would be when the pilot wants to have a loud COM 1 and a soft COM 2 and the copilot wants the VOR to be loud and COM 1 to be soft with a moderate COM 2, the audio panel can adjust each input individually.

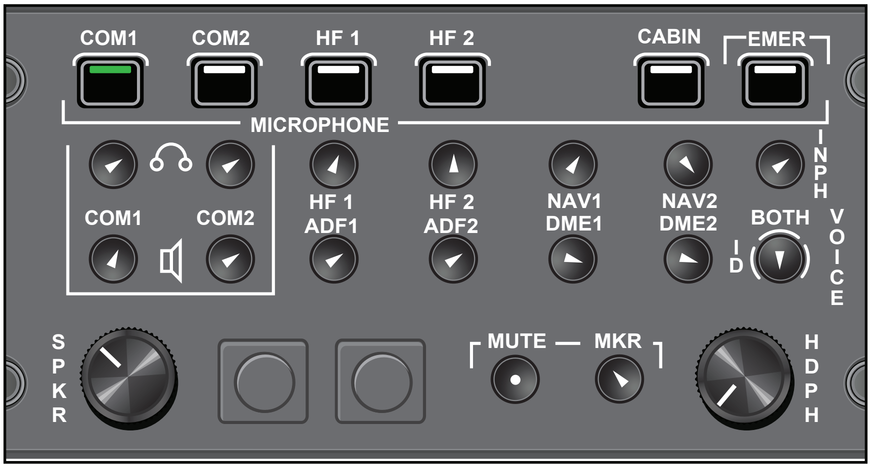

Figure 11-20: AV-850A Audio Control Panel

Stuck Microphone Protection

An automatic out-of-time feature is incorporated to avoid the problem of the communications system becoming locked in the Transmit mode. After approximately two minutes have elapsed of continuous transmission, the COMM turns the respective transmitter OFF and sounds a beep to alert the flight crew to the automatic shutoff. The respective COMM radio then reverts to the receive mode eliminating a stuck microphone button problem.

MCDU RADIO Function Key

Primary control of the VHF COM radios is through the MCDU. The standard equipment COM 1 and COM 2 radios are supported by the MCDU.

Each MCDU contains two types of radio display pages. The main page is the RADIO 1/2 and the detail page is COM. A detail page for each COM radio is used. To display the RADIO 1/2 page press the RADIO button once. RADIO 1/2 gives tuning access to change frequencies on COM 1 or COM 2, ACTIVE and PRESET COM frequency access, and capability to move to the COM detail pages.

Tuning of the COM radios is accomplished by accessing the RADIO 1/2 page. The inactive PRESET frequencies are displayed in white under their respective COM radio display section. Using the concentric tuning knobs on the MCDU panel will allow direct tuning of the PRESET frequency. Once the PRESET frequency is tuned pressing the line select button next to the ACTIVE frequency will change the PRESET and ACTIVE frequency positions, making the PRESET frequency now ACTIVE. Direct tuning of the ACTIVE frequency is made possible by using the scratchpad as explained previously in this section.

Accessing the COM detail pages allows the flight crew to tune COM 1 and COM 2 storage frequencies for later use. Separate detail pages for each COM radio are available to the flight crew. The COM detail pages allow for direct tuning of the ACTIVE COM frequency through the scratchpad function. PRESET tuning in the COM detail page is available through the use of the TUNING knob. Each COM detail page also allows for the entry of up to 12 frequencies to be stored for later use using the MEMORY feature.

A detailed description of the MDCU communications function and sub-pages can be found in the Primus Epic Pilot's Guides.

Figure 11-21: MCDU Radio Page

COM Tuning

Tuning of the COM frequency is accomplished by using the dual concentric knob at the upper right on the CCD. This will change the PRESET frequency in the MFD COM display box. To activate the PRESET frequency, with the CCD selected to the desired COM radio box, press either of the Enter buttons on the side of the palm rest.

HF Communication

An optional single or dual Honeywell KHF 1050 high frequency radio system is available. The KHF 1050 is a solid-state high frequency single sideband transceiver system which provides voice and data communication. Data communication is through an external modem.

Navigation

General

Navigation (and performance) calculations are primarily performed using two Multi-Function Control Display Units (MCDUs), which integrate these functions within the FMS. The MCDUs are located on the forward section of the center pedestal.

The baseline avionics system includes the following navigation subsystems:

- Radio Management Capability - Dual
- VHF Navigation Systems (VOR, Marker Beacon, Localizer, Glideslope) - Dual
- Distance Measuring Equipment (DME) - Dual
- Automatic Direction Finder (ADF), with provisions for an optional second unit
- Global Positioning System (GPS) - Dual
- Mode S Transponder - Dual
- Electronic Display System (EDS) - Dual
- Air Data System (ADS) - Dual
- Automatic Flight Control System (AFCS) - Dual
- Flight Management System (FMS) - Dual
- Radio Altimeter (RA)
- Attitude and Heading Reference System (AHRS) - Dual

Navigation Radios

NAV radio functions are accessed in the RADIO 1/2 page of the MCDU. Frequency tuning/storing for the NAV radios is operated identically to the COM radios, discussed earlier in this chapter.

Refer to the Honeywell Primus Epic Pilot's Manual for a complete description of radio operations and functions.

VHF Navigation

Housed in the MRC is the Honeywell NV-855 Navigation Module. This module enables VOR enroute and terminal navigational and area guidance, Localizer/ Glideslope (LOC/GS), and Marker Beacon (MKR) distance to runway threshold information. The VOR/LOC receiver operates in the frequency range of 108.00 to 117.95 MHz in 50 kHz increments. A glideslope frequency range of 329.15 to 335.0 MHz is also available in 150 kHz increments. Localizer and Glideslope channels are automatically paired by the receiver. The Marker Beacon receiver operates at 75 MHz and has a high/low sensitivity switch located on the AV-950A audio panel.

DME

Dual DM-855 DME modules are installed in the MRC. Each DME module operates in the 960.0 to 1215.0 MHz frequency range. The DME modules are capable of tracking four channels to provide slant range distance, ground speed, time to station and ident information. Two additional channels track station ident of preset channels for rapid acquisition when activated. DME frequencies are automatically paired with the VHF NAV or MLS channels depending on display selection.

Control for the NAV1 and 2 radios is available using the MCDU RADIO page.

ADF

One DF-855 ADF Module is installed in the pilots MRC (MRC 1) enabling navigational and area guidance by associated NDB stations on the ground. Provisions for a second optional ADF module installed in MRC 2 exist. It operates in the frequency band of 190.0 to 1799.5 kHz being tunable down to 0.5 kHz increments. In addition the maritime frequency range of 2181 to 2183 kHz can be selected for emergency listening.

Two selectable bandwidths are available for flight crew selection. The narrow band mode reduces noise during navigation use and the wide band mode will improve clarity when listening to voice signals.

Audio from the ADF is transmitted from the digital audio bus to each AV-850A audio control panel.

GPS

The Citation Sovereign aircraft consists of two Honeywell Primus Global Positioning Systems (GPS 1 and GPS 2) contained within the Primus Epic Dual Flight Management System (FMS).

GPS 1 is located in Modular Avionics Unit 3 (MAU 3) above the rear baggage compartment on the forward avionics shelf. The GPS 1 antenna is on the top of the airplane.

GPS 2 is located in Modular Avionics Unit 2 (MAU 2) in the right side nose avionics compartment. The GPS 2 antenna is on the top of the airplane.

Transponder

The dual ATC diversity Mode S transponder system enables aircraft identification, altitude reporting, and data link capability. The diversity Mode S transponder systems are part of the integrated radio system. The transponder function is a module in the radio cabinet. Code and mode selection and altitude data is given over the system network interface bus. The transponder gives data and control to the TCAS computer through an ARINC 429 link. Each transponder has dedicated dual antennas for TCAS operation.

Marker Beacons

Marker beacons are transmitted by the NAV receiver. The markers are always displayed from the selected NAV VOR/LOC source. If the selected source is other than VOR/LOC, the markers are displayed from the on-side NAV receiver. The markers are displayed outside the right hand corner of the attitude sphere, directly above the localizer miscompare annunciation when active and toggle reverse video 1 second on and .5 seconds off for as long as corresponding marker is active.

Marker Display

The marker beacon display consists of a boxed character with the character displayed as follows:

Outer Marker - O

Middle Marker - M

Inner Marker - I

Radio Altimeter

Citation Sovereign uses a single RT-300 radio altimeter system. The radio altimeter is used to determine the radio altitude of the aircraft. The radio altitude is displayed on both PFDs.

If the radio altimeter information is lost, - RA - is displayed in place of the radio altitude display.

Flight Management System Overview

The FMS has two primary functions and multiple secondary functions. The primary functions are position computation and flight planning. These functions work with the associated guidance in both the lateral and vertical axes. The navigation database (NDB) contained in the FMS is essential to these functions. The database is used to store waypoints, navaids, airways, procedures, airports, and other navigation data.

The FMS connects to a variety of short range and long range navigation sensors. The primary short-range sensors are VOR/DME and DME/DME. Long-range sensors include dual GPS sensors, with an Inertial Reference System (IRS) installed as an option. Using the available sensors, the FMS develops a position based on a blend or mix of sensor inputs. Based on the position and the flight plan, the FMS generates information for display on the MCDU and EDS.

The lateral navigation function of the FMS can calculate navigation information relative to selected geographical points. The pilot can define flight plan routes worldwide. The system outputs advisory information and steering signals that show the pilot or FGCS how to guide the aircraft along the desired route. Routes are defined from the present position of the aircraft to a destination waypoint along a great circle route or through a series of great circle legs defined by intermediate waypoints.

System Architecture and Components

The FMS is resident in one of the processor modules in the MAU.

The primary purpose of the FMS is to manage navigation sensors to produce a composite position. Using the composite position, along with flight planning capabilities, the FMS can control navigation, performance, and guidance work throughout the flight. The FMS consists of the following components:

- Multipurpose control display unit (MCDU)
- Modular avionics unit (MAU)
- Data management unit (DMU).

MCDU

The Multi-Function Control Display Unit (MCDU) is the pilot interface to the FMS system. MCDU operation is designed to be simple and to minimize crew workload in all phases of flight. Pilots enter data using the alphanumeric keyboard and the line select keys.

The MCDU is capable of controlling several functions of the Citation Sovereign avionics system. 12 line select buttons, 6 on each side of the MCDU display screen, a dual concentric knob, command select buttons, and an alphanumeric keypad allow for command inputs to the MCDUs.

A viewable area of 14 rows by 24 columns is available on the display screen. This area is also divided into sections associated with the appropriate radio function (COM, NAV, ADF etc.). A paging system is used to identify and control the radio associated with the Epic integrated communications system.

Figure 11-22: MCDU

MCDU Color Coding

Color on the MCDU display page is designed to highlight important information. Color assignments are coordinated as much as possible with other displays. Refer to the following table for a definition of color assignments.

Assigned Color	Parameter
Blue	Vertical, Performance, and Atmospheric Data
Green	Lateral, Modes
Yellow	Warnings, FROM Waypoint, Flight Plan Names
Magenta	TO Waypoint
White	Names and Titles
Red	Failures

Figure 11-23: MCDU Color Coding Scheme

Line Select Keys

Pushing a line select button causes the data field associated with that button to be highlighted. Transfer of information from the scratchpad will also be attempted if available and the data is valid for that particular radio or function. The cursor will allow the TUNING knobs to change the digits or modes selected. In some cases the line select buttons will toggle modes or recall a stored frequency. Additionally, if the line select button is pushed and held, the ADF and ATC memories are recalled, or the system enters or exits the COM NAV direct tune mode.

Scratchpad Area

Radio tuning, waypoints, and performance information can be entered using the scratchpad area on the bottom line of the MCDU display. Alphanumeric data after being typed directly into the scratchpad can be transferred to a destination field. Destination field identification is accomplished by pressing the corresponding line select button. Validation of the format is determined by the field the data is to be transferred to. If the data is valid the field will accept the input from the scratchpad. In the event of an invalid format the **INVALID ENTRY** message is displayed. Pressing the CLR (clear) button will remove the **INVALID ENTRY** message. Scratchpad data is cleared once it is transferred to the appropriate destination.

Function Keys

The 13 function keys located directly below the screen access primary functions, indices (menus), and page selection.

Function Key Paging - Function key paging is an option that, when activated, can be used to advance function pages using additional pushes of the function key instead of the NEXT key. For example, when initially selecting a function key, the MCDU displays page 1 for that function key. Pushing the same function key again displays page 2 for that function.

PERF Key - Pushing the PERF function key displays page 1 of the performance index. The pilot can select any of the index functions by pushing the respective line select key.

NAV Key - Pushing the NAV function key displays page 1 of the navigation index. The pilot can select any of the index functions by pushing the respective line select key.

PREV/NEXT Keys - The specific page and number of pages in a particular function or menu display are shown in the upper right corner of the display. The page number format is AA/BB where AA is the current page and BB is the total number of pages available. Page changes are made by pushing the PREV (previous) and NEXT keys. The keys can be held down for repeated page changing.

FPL Key - Pushing the FPL key displays the first page of the active flight plan. If no flight plan is entered, the pilot can perform the following:

- Manually create a flight plan
- Select a stored flight plan
- Load a flight plan from a data storage device

- Create a stored flight plan

PROG Key - Pushing the PROG key displays the first progress page. This mode shows the current status of the flight. The first progress page displays the estimated time en route (ETE), distance to, and fuel projection for the TO waypoint, the NEXT waypoint and destination. It also displays the current NAV mode, the required and estimated navigation performance, and the navaids that are presently tuned.

DIR Key - Pushing the DIR function key displays the active flight plan page with the DIRECT, PATTERN, and INTERCEPT prompts. If other than an active flight plan page is displayed when pushing the button, the first page of the flight plan is displayed. If the active flight plan is already displayed when pushing the button, the display remains on the same page with prompts displayed. DIRECT is the primary function. PATTERN and INTERCEPT must be selected at 6L or 6R, respectively.

Menu - Pushing the MENU function key displays the MCDU menu page, that accesses the maintenance and status information.

DLK - Pushing the DLK function key accesses the communication management function (CMF) datalink functions.

Radio - Pushing the RADIO function key results in the display of the RADIO 1/2 page. From this location and the RADIO 2/2 page, the pilot can tune various radios including COM1, COM2, HF1, ADF1 and ADF2.

Function keys are added as line select keys on the MISC Page on the MCDU, providing a backup method of selecting these functions in the event of a function key hardware failure.

Navigation and Performance Functions

The FMS is capable of extensive navigation and performance planning functions through the use of the MCDU. The Honeywell Primus EPIC Pilot's Guide for the Flight Management System contains detailed information pertaining to the NAV and PERF functions. The CAE SimuFlite instructor will also provide hands-on practice in the use of programming the MCDU. Refer to the Honeywell manuals and class notes for more information.

The following is an example of navigation and performance data entry pages for the FMS pre-departure flow:

- NAV IDENT
- POS INIT
- FLIGHT PLAN
- PERF INIT / PERF DATA
- DEPARTURE
- TAKEOFF INIT/TAKEOFF DATA

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Autopilot

General

The autopilot installed in the Citation Sovereign is of the dual channel type for system fail-operational capability. Automatic reversion to either channel in the case of a malfunction is annunciated to the flight crew through the EICAS system. Reversion to the functional channel is seamless and requires no flight crew action.

Flight Control Interfaces

The primary interface to the AFCS is via the Avionics Standard Communication Bus (ASCB). The ASCB provides bi-directional communication between the primary functions within the Primus Epic avionics system. The ASCB is also the medium by which the majority of the external aircraft system information is distributed to the AFCS and other avionics functions.

The AFCS interfaces directly to selected functions beyond the core MAU avionics system. These direct interfaces are warranted due to the nature and criticality of particular functions performed by the AFCS. The direct interfaces provide for faster transmission and reception of data for functions that are time critical, thus minimizing data transmission lag times. The direct interfaces also provide alternate paths for selected signals in order to meet the safety requirements of the associated functions. Detail on the AFCS interfaces to external systems is provided in the following paragraphs.

Flight Control Limitation

Autopilot minimum use height:

- *Enroute and Descent: 1,000 feet AGL*
- *Precision Approach: 80 feet AGL*
- *Non-Precision Approach: 200 feet AGL*
- *Takeoff, Climb, and Missed Approach: 400 feet AGL*

Control Surface Travel

- The maximum deflections for each elevator are 15° trailing-edge down and 15° trailing-edge up.
- The maximum deflections for each aileron are 14° trailing-edge down to 21° trailing-edge up.
- The maximum deflection for the rudder is ± 30.5°.
- The control column gearing to elevator, aileron, and rudder surface travel are linear for normal autopilot inputs.

Spoiler Interface

The Citation Sovereign uses combination speed brake/spoiler panels. The middle 3 panels in each wing are modulated and perform the speed brake and spoiler functions. The inboard most and outboard most panels are non-modulated panels that only perform the speed brake function.

Control Wheel Interface

The AFCS receives two discrete signals from the pilot and copilot control wheels, autopilot disconnect and TCS. The signals are provided by momentary switches on both control wheels:

Autopilot disconnect: A red autopilot AP/TRIM/NWS DISC push button is located on the outboard horn of each control yoke. Pressing either button disconnects the autopilot and yaw damper. A warning tone will sound until the button is pressed a second time. Verification of autopilot engagement and disengagement can be viewed on the PFD.

TCS: TCS push buttons are located adjacent to the autopilot disconnect buttons on each control yoke. Pressing either button momentarily disconnects the autopilot, allowing the pilot to maneuver the aircraft manually (while the button is held down). Releasing the button automatically re-engages the autopilot and references the new attitude, airspeed, and vertical speed.

If the autopilot is disengaged, the TCS button may still be used to reference (re-sync) a new attitude, airspeed, or vertical speed. Any time that the TCS button is pressed, A TCS ENG annunciation appears at the top-center position of each PFD.

Figure 11-24: AP/TRIM/NWS DISC push button

Throttle Interface

The AFCS receives a discrete Take-Off/Go Around (TOGA) signal from the throttle quadrant. The ground/open signal is provided by a momentary normally open switch in either throttle handle, and connected to both channels of the AFCS via the guidance panel. The signal is used to initiate either take-off or go around modes in the flight director, based upon current conditions, and to disconnect the autopilot, if engaged.

Automatic Flight Control System

Description

The Automatic Flight Control System (AFCS) provides the following functions:

- Autopilot (including automatic pitch trim)
- Yaw Damper
- Flight Director Guidance

The autopilot functions includes pitch and roll control. The yaw damping functions include dutch roll damping and turn coordination.

Components

The AFCS portion of the Primus Epic system consists of the following components:

- AFCS processing within each MAU
- Single Guidance Panel (GP)
- Pedestal mounted pitch wheel
- Elevator, aileron, and rudder servos and brackets

The AFCS function is hosted in the MAU. The Citation Sovereign installation contains two AFCS, to provide both manual and automatic reversion and interface capabilities sufficient to maintain full AFCS functionality, despite the absence of the other AFCS (due to failure). The fail-operational design of the AFCS provides automatic reversion following in-flight failure of an MAU. The reversion will be annunciated to the crew, but will result in no changes to the mode selection or engage status.

Autopilot Disconnect

A red autopilot AP/TRIM/NWS DISC push button is located on the outboard horn of each control yoke. Pressing either button disconnects the autopilot and yaw damper. A warning tone will sound until the button is pressed a second time. Verification of autopilot engagement and disengagement can be viewed on the PFD.

Touch Control Steering

TCS enables the airplane to be maneuvered manually during autopilot operation without cancellation of any selected flight director modes. To use TCS, press the TCS button, maneuver the airplane and release the TCS button. TCS is operable with all autopilot modes. During TCS operation the yaw damper will remain engaged.

If the autopilot is engaged in a bank and it is desired to hold the bank, press the TCS button, engage the autopilot and release the TCS button. The bank will be maintained if it is in excess of 6°. The airplane may be rolled level with the turn knob. The memory function holding the autopilot in a bank will be canceled when the turn knob is moved out of detent.

In the case of FLC (IAS or MACH annunciated) mode, vertical speed (VS) mode or altitude hold (ALT) mode, the TCS button may be depressed and the airplane maneuvered to a new reference. When the TCS button is released, the flight director/autopilot will maintain the new reference.

Takeoff/Go-Around Buttons

Pressing the TO/GA button in the throttle lever will activate the flight director go-around (GA) mode when airborne. Once pressed the flight director will receive guidance information setting the FD display on the PFD to 10° nose-up wings level target attitude. No autopilot functions except for the Flight Director are active in the GA mode.

Takeoff (TO) mode is activated when the TO/GA button on the throttle is depressed on the ground. The flight director will move to a 13° nose-up wings level target attitude. No autopilot functions except for the Flight Director are active in the TO mode.

Flight Guidance Panel

The GP-400 Guidance Control Panel is the main interface between the flight crew and the AFCS. A single guidance control panel provides the means for selection of all AFCS functions except the master AFCS channel, Takeoff/Go Around mode (TOGA), TCS and Quick Disconnect. Additional functions related to display control are also included within the guidance panel. The display control functions controlled via the guidance panel include: course pointers, heading bug, speed bug, pre-selected altitude reference, and flight director command bars out of view.

The AFCS functions controlled by way of the guidance panel include: flight director modes, pitch wheel references, engagement of the autopilot, and yaw damper function and selection of left or right PFD data to be used by the AFCS. The same pushbuttons are used to activate and deactivate each function (toggle on/off).

The flight crew may input vertical speed and pitch hold command changes via either pitch wheel (GP-400 or pedestal mounted unit). The pedestal mounted pitch wheel input to the Primus Epic system performs the same functions as the FGP-mounted pitch wheel.

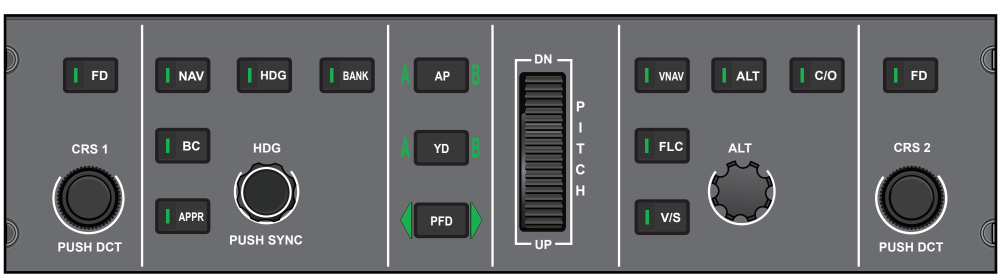

Figure 11-25: Flight Guidance Control Panel

Lateral Mode Buttons

Lateral navigation modes are selected by pressing the NAV button. Navigation source information for the AFCS is determined by the NAV source on the selected PFD. The following navigation sources may be activated: VOR, Localizer, and LNAV (FMS course navigation).

Upon arming any NAV mode, HDG select mode is automatically activated. HDG select mode will be canceled upon capture of the selected NAV mode.

The AFCS will generate flight director roll guidance commands for interception, capture, and tracking of the above listed conditions when they are displayed on the selected PFD. In order to maintain continuity between the navigation display and flight director calculations, the AFCS will input and select data consistent with the selected PFD data.

FMS LNAV - The AFCS will receive a lateral steering command and a validation signal from the FMS indicated on the selected PFD. The FMS lateral steering command will align the airplane with the FMS flight plan.

The flight director is capable of performing an automatic transition from FMS navigation to an approach or back course mode via the approach preview mode. A previewed approach may be established on EFIS by selecting the localizer preview display and setting the appropriate course. In order to use this feature the selected NAV source must be FMS, and the NAV radio must be tuned to localizer frequency. The previewed approach is then armed by pushing the APPR or BC button on the GP-400 guidance panel. Once the capture criteria have been met for the approach the LOC or BC will capture and the new lateral mode will replace LNAV.

VOR LNAV - If the selected VOR station is retuned to another VOR frequency the VOR mode will cancel and rearm automatically if in the VOR capture, track, or overstation phase.

When the airplane is passing over the VOR transmitter, in the cone-of-confusion, the VOR mode will fly towards the selected course reference. If the selected course remains unchanged from that selected before entry into the cone-of-confusion, the previously computed wind correction angle will continue to be applied and VOR mode will not command a turn toward the selected course pointer. Changes of course pointer setting when overstation will result in an equivalent change in the course hold reference. If DME information is available, the cone-of-confusion entry boundary is estimated based upon distance to transmitter and altitude, or VOR TO/FROM transition.

Vertical Mode Buttons

Pressing the VNAV button will activate the vertical navigation (VNAV) mode. VNAV will signal the AFCS to select track sub-modes based on valid targets from the selected FMS. While in another VNAV mode the flight crew will have the capability to activate the VFLC mode by pressing the FLC button. AFCS will transmit the FLC pressed signal to the FMS, which will then determine the proper mode transition.

Vertical Mode Buttons Limitation

Use of barometric VNAV vertical guidance is prohibited when the barometric altitude is corrected to the landing field elevation (QFE operations).

VNAV Arm (VNAV)	AFCS will transition to VNAV Arm when the VNAV button is pressed, the active vertical mode on will remain engaged. Upon a valid mode request from the FMS, AFCS will transition to one of the following sub-modes
VNAV Flight Level Change (VFLC)	AFCS guidance commands are based on the altitude and IAS/MACH speed target from the FMS. The VFLC function will act in the same manner as FLC mode, with speed and altitude reference from the FMS.
VNAV Path (VPTH)	AFCS vertical speed guidance commands will be based on a vertical speed target received from the selected FMS. VPTH and VS modes perform identically with the exception of the reference source.
VNAV Altitude Select Capture (VASEL)	AFCS will arm the VASEL mode based on selected FMS altitude. VASEL will be displayed on the PFD during altitude capture but will not be indicated during arm.
VNAV Altitude Hold (VALT)	AFCS will automatically transition to VALT upon capture of the FMS selected altitude. If the FMS requests a direct transition into the altitude hold mode, the AFCS will maintain that altitude upon transition request.
VNAV Glidepath (VGP)	AFCS will coordinate with the FMS for arming and capturing of the VGP mode. Once captured VGP mode operates in the same manner as the GS mode and ASEL will be inhibited once VGP capture is established.

AFCS pitch guidance will not generate commands to exceed V_{MO} or M_{MO} when in VFLC or VGP modes.

PFD Select Annunciation

Green PFD select arrows (pointing left or right) are displayed above the attitude sphere, as appropriate. The pointer of the arrow corresponds to the selected PFD that is to be used for guidance coupling. The PFD select arrow will remain green when the on-side Flight Director is being displayed. If the cross-side Flight Director is being displayed, the select arrow will be amber.

Flight Director Overview

Through the flight director, the AFCS will provide flight guidance outputs for display on the primary flight displays (PFD). The flight director function consists of the following elements:

- Mode selection
- Computation of guidance
- Data management and source selection
- Command bar output for display

Display Presentation

The AFCS outputs pitch and roll commands for display as flight director command bars on the PFD. Where single source sensor data is to be used, the command bar computations will use data from the sensor suite selected via the PFD select pushbutton on the guidance panel. The AFCS will also output mode annunciation data and the PFD selection for display on both PFDs.

Flight Director Modes of Operation

The AFCS mode selection is accomplished using the guidance panel and the TOGA buttons in the throttle handles. The following tables identify the mode capabilities and show EFIS annunciation examples:

Flight Director Modes Limitation

When the flight director or autopilot is coupled to VOR or ILS, HDG mode must be selected (HDG bug synced to current heading) prior to switching navigation frequencies. When the next VOR or ILS frequency is satisfactorily received, NAV mode may be re-engaged.

Lateral Modes

Button	Mode	Annunciation
HDG (GP)	Heading Select	HDG
LNAV (GP)	LateralNavigation Modes: Based on displayed navigation source (FMS, VOR, Localizer)	LNAV VOR LOC
APPR (GP)	Lateral Approach Mode (VOR displayed)	VAPP
BC (GP)	Back Course	BC
BANK (GP)	High/Low Bank (HDG mode only)	

Vertical Modes

Button	Mode	Annunciation
FLC (GP)	Flight Level Change	FLC
None	Automatic Altitude Preselect	ASEL
ALT (GP)	Altitude Hold	ALT
VS (GP)	Vertical Speed Hold	VS
VNAV (GP)	Vertical Navigation Modes: Requested by FMS VFLC	VASEL VALT VPTH VGP

Dual ILS Mode

ILS lateral/vertical capture and guidance are established based on data from the selected PFD. The localizer must be captured before the glideslope in order to prevent an inadvertent descent. Altitude select mode (ASEL) is inhibited during glideslope capture and tracking.

Emergency Descent Mode

The MWS determines when to begin the EDM activation. Once the request for EDM is received, the AFCS will automatically cancel any non-approach flight director mode and initiate heading hold and FLC. An airspeed target is established that provides a V_{MO} descent speed and a heading that is less than 90° of current heading at a bank angle of 30°.

The autopilot must be engaged for the airplane to enter EDM. EDM is activated by the MWS upon cabin pressure exceedance of 13,500 feet when the airplane pressure altitude is 30,000 feet or greater. EDM automatically sets the altitude preselect to 15,000 feet and the pilot must physically move the throttles to idle, or the descent rate will be reduced to maintain the V_{MO} descent speed.

Preflight Procedures

Abnormal Procedures

Display Unit Failure

Primary Flight Display

Check the PFD DIM knob to ensure that it is not selected to the minimum position. Set the PFD DIM Knob of the affected side, outer concentric knob to OFF/REV position.

> **NOTE:**
>
> - With the pilot's PFD reverted to DU2, the EICAS display will automatically move to DU3 and the MFD presentation will not be available.
> - With the copilot's PFD reverted to DU3, the MFD presentation will not be available.
> - The EICAS display cannot be moved using the EICAS LEFT/RIGHT button until the PFD is returned to its normal DU position.

EICAS

Using the EICAS display button on either reversionary panel, select the LEFT or RIGHT (functional DU) and ensure that the CAS message display is checked.

Autopilot Aural Warning Fails to Cancel

Failure of the autopilot aural warning to cancel with the AP/TRIM/NWS DISC button could be an indication of a possible guidance control panel failure. Even though the MASTER WARNING light will not be illuminated, pressing the button will cancel the aural warning.

Loss of Radio Audio Functions

Push the Audio Panel EMER button on the affected side. This ensures that the on-side microphone is connected directly to COM 1. The on-side headphone will have only COM 1 audio, and the other controls on the audio panel will be inoperative for controlling headphone audio. The cockpit speaker is not affected by the Audio Panel EMER button, and the other controls on the audio panel can continue to be used for controlling the speaker.

Loss of Radio Tuning Functions

Select the MCDU Backup Radio Page on the affected side. Push the MCDU MENU Key and MCDU NEXT Key from the MENU 2/2 page. Select the BKUP line select key and tune the COM 1 or NAV 1 radio as desired.

Deviation Scale Flashing Amber

This indicates that the localizer or glideslope limit for a Category II approach has been exceeded. This indication is only displayed on airplanes equipped for Category II operations. Intiate the Go-Around Procedure and reinitiate the Category II Approach if required.

EICAS System Displays

Information pertaining to the avionics system is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit.

Messages are displayed in cyan, amber or red, according to their urgency. The following are possible messages displayed that relate to the avionics system.

Cyan Messages	Description
AHRS BASIC L and/or R	This message indicates that the respective AHRS has lost air data information and has entered a reversionary mode.
FDR FAIL	This message indicates the flight data recorder has failed.
IRS ALIGNING L and/or R	This message is displayed when the IRS is aligning. This message is only displayed if the optional IRS is installed.
RAAS FAIL	This message is displayed when the optional runway awareness advisory system (RAAS) is enabled but the function is inoperative.
RAAS INHIB	This message is displayed when the optional RAAS is enabled but advisories are inhibited because TAWS MUTE is selected ON.
RAAS NOT AVAIL	This message is displayed when the optional RAAS is enabled but the system either has no position information or the airplane is at an airport that has not been validated.
SELCAL VHF 1 and/or VHF 2 and/or HF 1 and/or HF 2	This message is displayed when the SELCAL system receives a VHF or HF radio transmission with the airplane specific tone sequence.
TAWS AUDIO INHIB	This message is displayed when TAWS MUTE is selected ON. The windshear (Mode 7) function remains active even with all other TAWS modes inhibited.
TAWS FLAP OVERRIDE	This message is displayed when TAWS FLAP OVRD is selected ON.
TAWS GLIDESLOPE CANCEL	This message is displayed when TAWS G/S CANCEL is selected ON.
TERR FAIL	This message is displayed when the TAWS is unable to display terrain and obstacles or provide enhanced mode alert warnings.
TERRAIN INHIBITED	This message is displayed when the TAWS TERR INHIB is selected ON.
Amber Messages	**Description**
ADC1 ADC2	This message is displayed in the top left portion of the ADI in both PFDs when both pilot's and copilot's selected air data sources are the same or are cross-side.
ATT	This message is displayed in the top right portion of the ADI in both PFDs when the MWS detects a difference of ±5° pitch or ±6° roll between the pilot's and copilot's attitude information.

Amber Messages	Description
ATT1 or ATT2	This message is displayed in the top left portion of the ADI on both PFDs when both pilot's and copilot's displayed attitude sources are the same or are cross-side.
CAT2	This message indicates that the Category II approach mode criteria are not met.
CHECK DU 1 and/or 2 and/or 3 and/or 4	This message is displayed when the display unit wrap-around monitor has failed.
DGR	This message is displayed in the lower right portion of the HSI on both PFDs if the estimated position uncertainty (EPU) is greater than the current RNP or if the horizontal integrity limit (HIL) is greater than the integrity alarm.
DR	This message is displayed in the lower right portion of the HSI on both PFDs if the FMS is operating in dead reckoning mode.
DU 1 and/or 2 and/or 3 and/or 4 O'TEMP	This message is displayed when the respective display unit detects an overtemperature and will shutdown due to the overtemperature.
EICAS	This message is displayed in the top right portion of the HSI in both PFDs when the MWS has detected a mismatch of the cyclic redundancy check (CRC) or the CRC is not received by the MWS.
FD FAIL	This message is displayed in the top portion of both PFDs when valid pitch or roll data from the AFCS is lost.
FD MODE OFF	This message is displayed when the AFCS has dropped the selected modes and reverted to basic pitch and roll modes.
FMS 1 and/or 2 GPS MISCOMPARE	This message is displayed when the FMS calculated position does not agree with the GNSS sensor position.
GPS 1 and/or 2 INACTIVE	This message is displayed when one or both GNSS sensors become inactive.
GS	This message is displayed in the bottom right portion of the ADI on both PFDs when the MWS detects a difference of ½ dot between the pilot's and copilot's glideslope information.
HDG	This message is displayed in the upper right portion of the HSI on both PFDs when the MWS detects a difference of ±10° between the pilot's and copilot's heading information.
IRS POSITION FAULT	This message is displayed when the IRS position is not entered (FMS position not initialized) or there is an IRS alignment fault (if installed).
IRS NOT READY	This message is displayed on the ground only when there is excessive motion of the airplane before IRS alignment is complete (if installed).
IRS FAIL L and/or R	This message is displayed when the IRS has detected an internal failure (if installed). The red ATT and HDG messages may also be displayed on the affected side PFD and MFD.
MAG1 or MAG2	This message is displayed in the top left portion of the HSI on both PFDs and the MFD when both pilot's and copilot's displayed heading sources are the same or are cross-side.

Amber Messages	Description
TCAS FAIL	This message is displayed in the TCAS window on the MFD when TCAS has failed due to an internal fault or a failure of one or more of the components required for TCAS operation (i.e., AHRS, IRS, radio altimeter, or transponder) has been detected.
TRU1 or TRU2	This message is displayed in the top left portion of the HSI on both PFDs and the MFD when both pilot's and copilot's displayed heading sources are the same or are cross-side and true heading is in use.
WX	This message is displayed at the 3 o'clock position on the weather radar or terrain display and indicates the selected image is not reaching the display.
WX FAIL	This message is displayed as FAIL in the Weather Radar mode window on the MFD and indicates the weather radar has detected an internal fault and is failed.
Red Messages	**Description**
ATT and/or HDG FAIL FAIL	These messages are displayed on the PFD when pitch and roll, and/or heading information from AHRS or IRS is invalid.

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12

Electrical and Lighting

Contents

Electrical System

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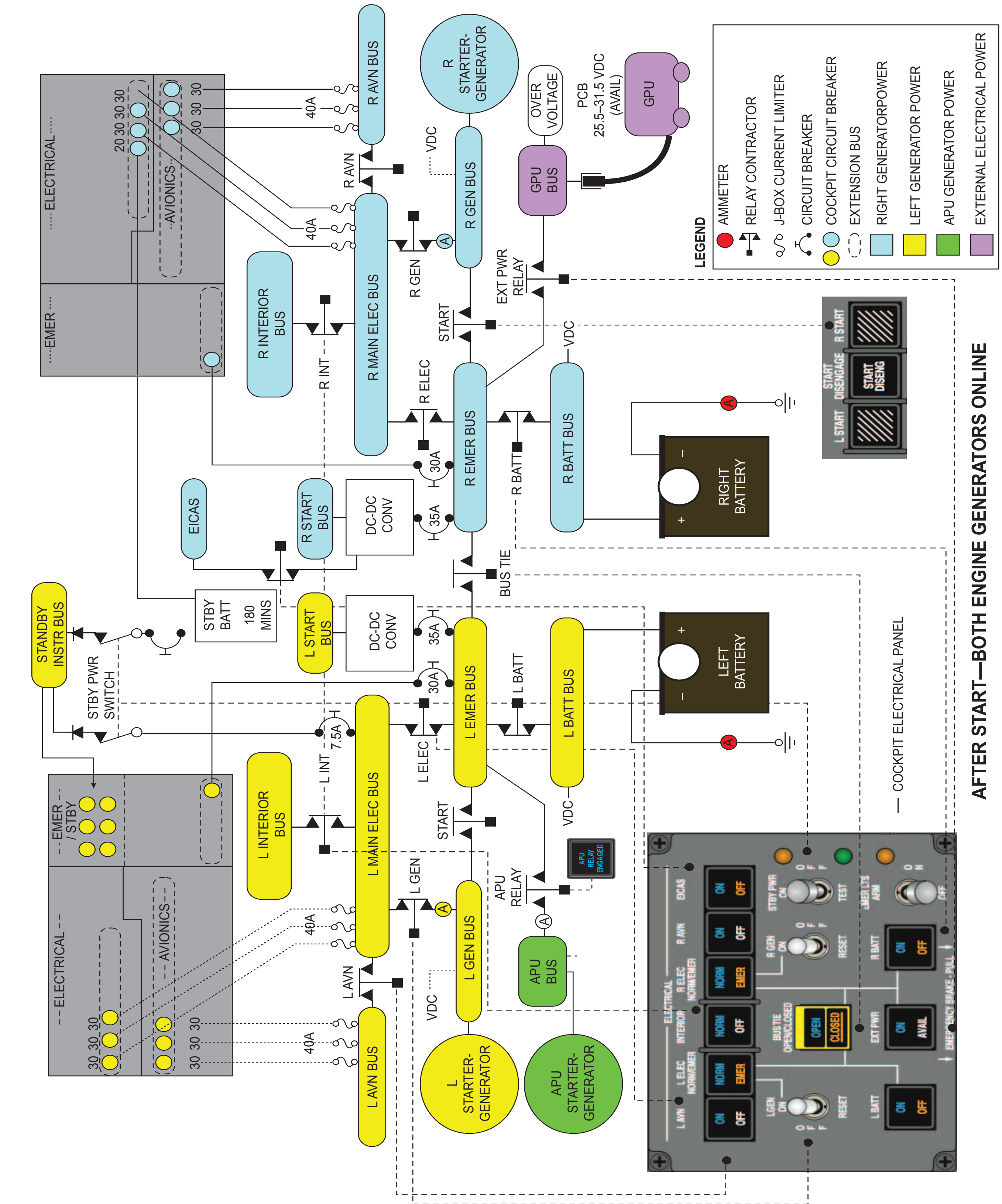
Electrical System

General

The electrical power system is a split-bus type which provides both Alternating Current (AC) and Direct Current (DC) to aircraft systems. Power is controlled through switches, circuit breakers and monitoring circuits. Distribution of power is accomplished by cables and wires connected through buses.

Primary power sources include engine-driven DC starter generators, an APU starter-generator, or a DC external power unit. AC alternators provide electrical power solely for the windshield heat system.

Electrical System



Description

The DC electrical system provides up to 300 amps at 28.5 volts from each engine driven starter-generator. A single APU-driven generator (which also functions as the APU starter) provides up to 275 amps at 28.5 volts, for use on the ground or in flight. The two engine-driven generators can be operated simultaneously with the APU generator in a standby mode. Generator Control Units (GCUs) provide voltage regulation, over voltage protection, over excitation and ground fault protection. One GCU is installed for each engine driven generator and for the APU generator. Two 44 amp-hour batteries, left and right, provide airplane battery power.

The main electrical control panel located on the lower right-hand side of the pilot's instrument panel provides control for the electrical system. Push-button switch-annunciators are used as a means of control for avionics power, battery power, opening or closing of the bus-tie relay, external power, interior power, and power to the EICAS system. Toggle switches control the left and right hand generators, standby power (provided by the standby battery) and emergency lighting. Control for the APU generator power is located on the APU system panel on the copilot's side console. Power from the batteries is made available to the airplane by use of the L or R BATT buttons located on the main electrical panel.

A Ground Power Unit (GPU) receptacle allows for the use of a GPU. Power supplied by the GPU is made available for use by the EXT PWR button on the main electrical panel.

Figure 12-1: Electrical Control Panel

Although the left and right bus systems normally operate separately and independently, a bus tie relay (which connects between the left and right bus systems at the emergency buses) allows both sides of the electrical system to operate from a single power source. On the ground, the bus tie relay opens and closes automatically. The relay closes automatically when a single primary power source is selected, or when an engine or APU start button is pressed. In flight, the bus tie is operated manually by the crew in the event of a generator loss, or for an in-flight engine or APU start.

Direct Current (DC) Power Generation

The L GEN, R GEN and APU GENERATOR buttons select generator power. With the L GEN, R GEN or APU GENERATOR buttons in the ON position, the GCUs will place the respective generator on-line when the engines or APU are running.

The left and right engine generators operate independent of one another. No load paralleling is available. The APU driven generator will not come on-line or will drop off-line if the left engine generator is on-line. The RESET position on the L GEN and R GEN toggle switches is momentary and will reset the respective GCU if a system trip has occurred.

Engine Driven Generators

Engine Generator Limitation

Maximum engine generator limit on the ground and in the air up to 35,000 feet is 300 amps. Maximum engine generator limit above 35,000 feet is 275 amps.

Each engine is equipped with a starter/generator rated at 300 amps (275 amps above 35,000 feet). The generators are self-cooled on the ground and are cooled by ram air when in flight. Transient current in excess of the constant 300 amps is allowed during engine start and up to 2 minutes following start completion.

Each generator serves two functions:

- To provide DC power for the airplane systems
- To charge the airplane batteries and the standby battery

The generators normally provide 28.5 volts to their respective side electrical buses. An overvoltage of approximately 31.5 volts will cause a generator to drop offline.

The engines are normally started with the L and R GEN switches in the ON position. If the engines are started with the L and R GEN switches in the ON position, the GCUs will bring their respective generators online automatically. The RESET position of the L and R GEN switches is a momentary position, and is used to reset the generators before placing them into operation when there has been a system trip. Each generator is wired directly to a separate power junction box, and each has electrical terminal filtering to suppress radio noise output.

A single generator is capable of supporting the entire electrical system requirements. Generator limitations are the same whether one or both generators are in operation.

Generator cooling is an operational concern prior to engine shutdown or prior to engine start. For generator cooling during ground operations, the engine must be operated at idle with the generator load less than 75 amps for 4 minutes prior to shutdown. Otherwise, a 35-minute cooling period after engine shutdown is required prior to engine re-start.

APU Generator

The APU generator is capable of providing 28.5 volts of DC power to the entire aircraft electrical system. The APU is equipped with a generator rated at 275 amps up to 30,000 feet. Normally, the APU generator is limited to 275 amps during ground or in-flight use; however, it can supply up to 450 amps when assisting the batteries during an engine start. Transient currents above 275 amps are permitted during engine start and up to 2 minutes following engine start completion. The APU generator is of the same design and is interchangeable with the engine generators. The APU generator connects directly to the left emergency bus. Once the left engine-driven generator is available, the APU generator is automatically replaced by the engine-driven generator.

APU Generator Limitation

Maximum APU generator limit is 275 amps (ground and flight).

Airplanes 680-0001 thru -0072 incorporating SB680-49-02 and airplanes -0073 and subsequent (Configuration AF) are permitted to use the APU generator in flight. This service bulletin installs additional cooling for the APU generator.

Main Batteries

Two standard 25-volts, 44 amp-hour, nickel-cadmium batteries are connected directly to their respective left and right battery buses, which are connected, through isolation relays, to the emergency battery buses. Battery power is used primarily for engine and APU starting, or as an emergency power source in-flight if no other power source is available. Battery power is selected by the L BATT and R BATT buttons. Battery 1 is located in the left aft fuselage fairing, and Battery 2 is located in the right aft fuselage fairing. They are vented overboard through tubes located on the belly beneath the batteries. Selecting L BATT or R BATT supplies battery power to the respective left and right-hand emergency buses, and also allows battery charging.

Battery Start Limitation

The battery start limit is three engine starts per hour, or nine APU start cycles per hour.

Figure 12-2: Aircraft Main Battery

The batteries are a secondary source of DC power that is used to provide power during the engine starting sequence, and to provide power to the emergency battery bus in the event of a dual generator failure.

With no generators on-line and the L ELEC and R ELEC buttons set to NORM, the batteries will provide power to all aircraft systems except cabin interior items for approximately 20 minutes. No battery power is provided to the INTERIOR button with all generators off-line and the L and R ELEC buttons in the NORM position. Selecting both of the buttons to EMER within 5 minutes after a loss of generator power will allow the batteries to supply power for approximately 60 minutes to the emergency bus equipment only.

Battery Temperature Limitation

The battery temperature indicating system must be operational for all ground and flight operations.

The main batteries are supplemented by a 10.5 amp-hour, 24 VDC lead-acid power pack, located in the airplane nose compartment, which provides emergency electrical power to the standby instruments for up to 180 minutes if the main batteries are depleted.

Temperature sensors located within the battery assembly continuously monitor cell temperatures and provide a variable signal to the EICAS display. Normal battery operating temperature is between -20°C and 63°C (-4°F and 145.4°F). Battery temperature will be displayed in the electrical portion of the EICAS system. If the battery temperature falls below -20°C (-4°F), battery temperature will be displayed in black on amber inverse video on the EICAS.

A battery overheat condition will cause the EICAS to display a red battery overheat warning message of **BATTERY O'TEMP L** and/or **R** and an aural "BATTERY OVERTEMPERATURE" warning will be heard. When battery temperature has been exceeded, the battery must be serviced per the maintenance manual.

Standby (Emergency) Battery

A standby battery located in the left nose compartment supplies power to the standby flight and engine instruments if left and right main electrical bus power is not available. The standby battery can power the standby bus for up to 180 minutes during emergency operation. Emergency power is controlled through the STBY PWR switch on the ELECTRICAL panel.

Four separate emergency lighting battery packs are installed to power the emergency lighting system during night or reduced visibility evacuation. Emergency lighting batteries are discussed in the Lighting section of this chapter.

External Power

External Power Limitation

Maximum external power limits for starting are 1,500 amps, 28 volts DC.

External DC power can be connected to the airplane through a receptacle located on the right side of the fuselage. Ground power requirements dictate a 28-volt unit, with a nominal current capability of 1,500 amps. If an adjustable power unit is used, it should be adjusted to provide a setting of 1,500 amps. Ground power units with a soft start capability are preferable. The batteries should be disconnected if the airplane is to be connected to a ground power unit for a prolonged period of time.

External power is applied to the right-hand emergency bus when the GPU is connected to the airplane and the GPU is started. The EXT PWR button will illuminate the AVAIL annunciator when external power is being provided by a GPU. When selecting the EXT PWR button to ON, external power is applied to the right-hand emergency bus. External power then becomes available to the complete airplane electrical system. Ground external power will automatically be disconnected by the external power relay after an engine has been started, assuming that the engine generator switch is in the ON position.

Figure 12-3: External Power Receptacle

Both airplane batteries will charge from the ground power unit. With either battery button selected to BATT and the ground power unit connected and in operation, external power will be applied to the airplane buses and the respective battery will be charged. The ground power unit should have the voltage adjusted to maintain 28.5 (±0.5) volts.

DC Power Distribution

DC power originating from the batteries, airplane generators, on board APU, or ground external power source is initially controlled with different main DC power buses being activated by power contactors located in the aft power junction box (J-Box). Three separate junction boxes are located at the forward end of the baggage compartment. The main electrical power J-Box contains components of the emergency electrical system. An amber CAS message **REMOTE CB TRIPPED** alerts the crew of a tripped circuit breaker that is not accessible by the crew in flight.

Three electrical, three avionics, and one interior cable per main J-Box route DC power to the right and left circuit breaker panels in the cockpit. Current limiters and circuit breakers protect the entire system. An isolation relay separates the DC emergency bus from the main bus so that, if required, the emergency bus may be separated from the other buses and their loads.

The left and right feed buses are connected through a bus-tie relay. The bus-tie relay is closed on the ground during initial power up and then opens automatically when the second generator comes on-line after engine start on the ground. This allows the left and right electrical systems to operate independently. The bus-tie relay can be pilot controlled in the air (automatic on the ground) using a bus-tie OPEN/CLOSED button on the electrical switch panel. In the event that a generator overcurrent causes a generator to be automatically shut off, the crosstie relay will be latched open and cannot be selected closed.

Split Bus System

The split bus system is designed to allow separate/independent electrical sources to operate if multiple sources are available. The safety and protection features of the split bus system include:

- Only one generator can be connected to a single bus system at any time
- EPU overvoltage and under-voltage protection is provided
- Two separate distribution systems supply power
- A power source that is malfunctioning will not prevent the remaining power source(s) from furnishing power
- Power sources can be disconnected individually or collectively in flight, including batteries
- Generators can be deactivated with an ENG FIRE PUSH button
- Generator overvoltage protection is provided if the voltage exceeds 35 volts

Battery Buses

Battery power is available to each battery bus either with or without the battery buttons on the cockpit panel selected ON. Section III of the Airplane Flight Manual contains a list of items powered by the “hot” battery buses.

DC/DC Converter

The DC-to-DC converters connect the emergency buses to the start buses. The purpose of a DC/DC converter is to prevent important systems (such as the FADEC or EICAS) from experiencing a momentary voltage drop during engine starts. The DC/DC converter attempts to restore voltage back to 24 volts DC if the voltage drops. The converters are located near the aft J-box, accessed from the baggage compartment.

EICAS Bus

The EICAS bus is powered from the right emergency bus through one of the DC/DC converters. During emergency power operation, the EICAS bus is unavailable, and the EICAS display becomes unusable. Several standby annunciators are provided as a backup to EICAS operation.

Bus Tie Relay Operation

The status of the bus tie relay is indicated by an OPEN or CLOSED indication on the guarded BUS TIE OPEN/CLOSED button, located on the electrical control panel. Operation of the bus tie relay is automatic on the ground. The bus tie relay will open and close automatically according to its pre-programmed logic.

On the ground, the bus tie will automatically close when:

- Either L START or R START button is pressed
- The APU START button is pressed
- The EXT PWR button is selected ON
- A single generator is online (either APU or engine)

When the bus tie relay is closed, a cyan CAS message **BUS TIE CLOSED** will appear on the EICAS. The message changes to amber after 5 minutes from the time that a generator is active on both sides.

On the ground, the bus tie will automatically open when:

- Engine start is completed (unless that generator is the only one online)
- APU start sequence is completed
- A primary power source is active on both bus systems (not batteries)
- A major generator overcurrent condition develops

Except during engine or APU start operations, only primary sources of power (such as EPU or generator) cause the bus tie to automatically open or close.

When in flight, the bus tie relay will not activate automatically; it must be selected manually by the crew. The only exception occurs with a major overcurrent condition. If the bus tie relay is forced open in flight due to an electrical malfunction, it cannot be closed until all power is removed from the aircraft.

NOTE:	The BUS TIE button should be selected CLOSED in flight only when directed by a checklist procedure to do so.

DC Power Controls and Indications

Generator Controls and Switches

A three-position generator switch, located on the tilt panel (DC Power Panel), immediately to the left of the pedestal, is provided for each generator. The switch is labeled L or R GEN, ON, OFF and RESET. Selecting the ON position with the engine running will supply a signal to the generator control unit, which monitors the battery bus voltage and generator condition. It will connect the generator to the bus when a "ready to load" signal is received from the FADEC and generator voltage is sufficient. With the engines running and generators operating, power is supplied to the left and right main buses through the respective generator buses. Placing the switch to the OFF position disables the signal to the GCU, the generator will be dropped off-line, and the respective (amber) **DC GEN OFF L-R** annunciation will appear.

The RESET position is a momentary position that will momentarily connect the armature directly to the field creating a rapid buildup to 28.5 volts. The switch is spring-loaded from the RESET back to the OFF position; therefore, it must be manually positioned to ON when the RESET feature is utilized, and the generator will then come back on line.

Figure 12-4: Electrical EICAS Display

The RESET position will reset a generator that has been tripped as a result of an overvoltage, feeder fault, or if the fuel and hydraulic firewall shutoff valves have been activated. Generator operation will again be disabled during reset attempts if the fault still exists or until the firewall shutoff valves have been de-activated. The MASTER WARNING indicator will flash at any time both generators have faulted or have been tripped off-line for any reason, and a red **DC GEN OFF L-R** CAS message will appear in the flashing mode. An attention chime will also be heard, and if the voice warning system is installed a voice synthesis will be heard until the annunciation is acknowledged.

Generator Control Units (GCU)

Three GCUs, one for each starter/generator, are installed in the aft tailcone. The GCU is used to control the operation of the starter/generator and provides the following control features:

- Voltage regulation at 28.5 VDC
- Overvoltage protection at 35.0 VDC
- Reverse current control of the line contactor
- Generator feeder ground fault protection
- Start contactor control and field weakening during start
- Overspeed sensing and protection resulting from sheared starter shaft
- Generator self-excitation and subsequent regulation without an external source of power (such as a battery)
- Generator deactivation when the firewall shut-off is activated

Protective Functions

- Reverse Current Protection
- Overvoltage Protection
- Overexcitation Protection
- Reverse Polarity Protection
- Overspeed Protection (Start Cycle)
- Anti Cycle Protection
- Open Shunt Protection
- Build Up Ground Fault Protection
- Ground Fault Protection

Control Functions

- Generator (Line) Contactor Control
- Starter Field Current Control (Field Weakening, Torque Limiting)
- Automatic Starter Cutout Control
- Paralleling Control
- Threshold Selection

The voltage and amperage of the engine-driven DC generators can be read from the electrical portion of the EICAS system. The voltage, amperage, and temperature of both batteries is also displayed on the EICAS.

Eight different EICAS messages may be annunciated to apprise the crew of abnormal electrical system operation. The messages are:

- **BATTERY O'CURRENT L-R** (amber)
- **BATTERY OFF L-R** (amber or cyan)
- **BATTERY O'TEMP L R** (red)
- **BUS TIE CLOSED** (amber or cyan)
- **DC EMER BUS L-R** (amber or cyan)
- **DC GEN O'CURRENT LR- APU** (red or amber)
- **DC GEN OFF L-R-APU** (red or amber)
- **REMOTE CB TRIPPED** (cyan)

Specific causes for the appearance of the messages are covered under Engine Indicating and Crew Alerting System (EICAS) in this section. The ammeters function as load meters, indicating the load being carried by each generator or by the APU. When the auxiliary power unit is in operation output current can be monitored at all times on the APU ammeter (DC AMPS APU) which is mounted on the copilot's meter panel.

Figure 12-5: APU Ammeter

BATT Buttons

The battery relays are each controlled by their L BATT or R BATT buttons. The buttons are on the cockpit ELECTRICAL panel and have two positions:

- ON: Closes the relay and connects the respective battery bus to the emergency bus
- OFF: Opens the relay and disconnects the respective battery bus from the emergency bus

An open relay illuminates an amber CAS message **BATTERY OFF L** (or **R**) on the EICAS.

If a BATT button is selected OFF due to a battery overtemperature condition, a cyan CAS message **BATTERY OFF L** (or **R**) appears on the EICAS. The aircraft batteries must be installed and the BATT buttons in the ON position,or the aircraft generator(s) must be operating, prior to and during all APU operations to assure fire protection system power.

ELEC NORM/EMER Buttons

The L and R ELEC NORM/EMER buttons are located on the electrical control panel. The buttons allow each battery (or generator) to be isolated from its respective main DC bus during an emergency.

In the NORM position with both generators operating, the generators will power their respective buses and charge their respective battery. Manually selecting either button to EMER opens the electric relay and illuminates an amber CAS message. These relays also have the ability to open and close as commanded by start logic. The crew verifies that the button indicates NORM after the start sequence is complete.

AVN Buttons

The L AVN and R AVN buttons are located on the electrical control panel. These buttons allow power to be distributed from the left and right main DC buses through the left and right avionics relays, which are activated by the AVN buttons.

> ***NOTE:*** Both AVN buttons should be selected OFF for engine start if OAT is 0°C or less, or when conducting an engine start using battery power only.

INTERIOR Buttons

The INTERIOR button supplies power to both interior buses and the cabin J-box circuit breakers. This allows all cabin equipment and appliances to be powered, except for emergency lighting which is provided power through separate sources. Power to the interior buses is automatically shed until an engine generator is available, if the first engine start is on battery power only. Loss of an engine generator automatically sheds the respective interior bus. The INTERIOR switch generally remains in the NORM position.

EICAS Button

The EICAS button on the electrical control panel allows emergency bus power to be supplied to the EICAS bus. Display of the EICAS is either DU 2 or DU 3, depending on which display is selected to the ON position.

EXT PWR Button

The external power relay is controlled by the EXT PWR button on the cockpit ELECTRICAL panel. The button is a momentary switch with the annunciation of AVAIL and ON. If the appropriate voltage is supplied to the aircraft from a EPU, the AVAIL annunciation displays. If the EXT PWR button is then pressed and the external power contactor closes, the ON annunciation displays. External power is then supplied to the right emergency bus to be distributed throughout the aircraft electrical system.

APU Generator Button

The GENERATOR button is on the APU SYSTEM panel. For APU operation, the APU generator is placed online by pushing the GENERATOR button to ON. The ON position closes the APU relay and connects the APU generator to the left emergency bus.

Engine Start Buttons

L START, R START and START DISENGAGE buttons are on the ENGINE control panel on the center pedestal below the throttles. The momentary buttons initiate the start of the respective engine. A START DISENGAGE button disengages the starter.

When pressed, the START buttons illuminate white, indicating the respective start relay is closed. The main batteries (assisted by another available power source, if applicable) are utilized for any type of start using the START button. Battery voltage should read at least 24 volts, and battery amps should be observed less than 100 amps prior to engine starting.

During the start sequence, the START buttons illuminate when pressed and automatically extinguishes at 44% N_2. An extinguished START button indicates the respective start relay has reopened.

If an illuminated START button does not extinguish, the START DISENGAGE button is pressed to manually terminate the start sequence.

Pressing the START DISENGAGE button commands the GCU to terminate the start by opening the start relay(s).

The START DISENGAGE button is also used during engine dry motoring to discontinue the motoring procedure.

Standby Power

Standby Power Switch

Control for the standby instruments is provided through a STBY PWR toggle switch on the ELECTRICAL panel. The switch has three positions: ON, OFF, and TEST:

- ON: Powers the standby bus and the standby instruments initialize. Power for the standby instrument bus is supplied as follows:
  - Through left main electrical bus power.
  - Right main electrical bus power (if the left side is not available).
  - The standby battery (in the left nose compartment) if neither main electrical bus power is available. The illumination of the amber light, next to the switch, indicates that the standby battery is powering the standby system.
- OFF: The standby instrument bus is not powered.
- TEST: The spring-loaded position tests the standby battery system circuitry. Illumination of the green light indicates a successful test.

Standby Annunciations

Standby annunciators directly above the Standby Flight Display (SFD) provide warnings while operating on emergency DC power. Indications include warnings for fuel level low, horizontal stabilizer out of takeoff range, both engine-driven generators off, or low oil pressure.

EICAS Display

Electrical system monitoring is continuously displayed in the ELECTRICAL area of the EICAS. The area is divided into two columns representing the left and right electrical bus systems. During normal operation, the digital displays will be colored green. In an abnormal condition the digits will turn to inverse video amber or inverse video red. Invalid data is presented as amber dashes.

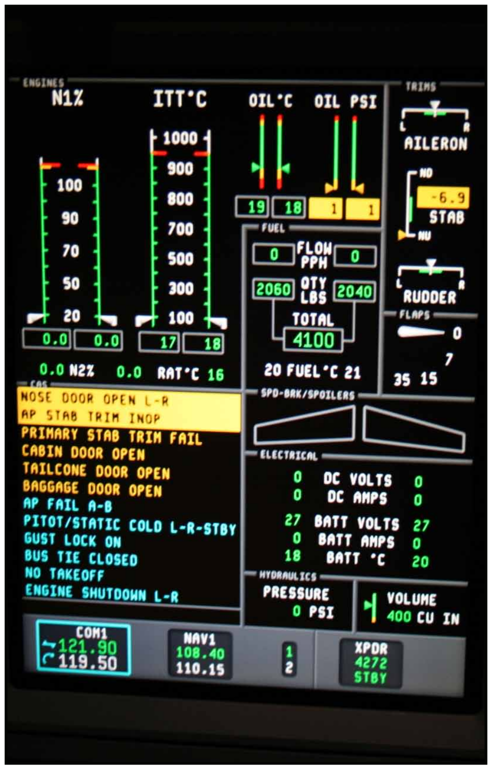


Figure 12-6: EICAS Display System

DC Volts

Digit colors display as follows:

Green. . . . . .23 TO 29 VOLTS

Amber . . . . <23 OR >29 VOLTS

NOTE:	The digital readouts remain green if the corresponding engine is not running.

DC Amps

Voltage range is 0 to 35 volts. Generator voltage < –3 volts or > +35 volts is considered invalid (values between –3 volts and 0 volts display as 0 VOLTS). When data is invalid, three amber dashes display in place of digits.

Generator DC amps display as follows in 5 amps increments:

On the ground:

Green. . . . . –20 TO 300 AMPS

Amber . . . . ≥300 AMPS

In flight (FL350 and below):

Green. . . . . –20 TO 300 AMPS

Amber . . . . >300 AMPS

In flight (above FL350):

Green. . . . . –20 TO 275 AMPS

Amber . . . . >275 AMPS

NOTE: The digital readout remains green during engine start and for 2 minutes after engine start.

Amperage range is 0 to 1,600 amps. Generator current less than 0 amp or greater than 1,600 amps is considered invalid and three amber dashes replace the numbers.

Battery Volts

Digit colors display as follows:

Green. . . . . .23 TO 29 VOLTS

Amber . . . . <23, >29 VOLTS

NOTE: The digital readout remains green during engine start and for 2 minutes after engine start.

Battery voltage range is 0 to 35 volts. Battery voltage less than –3 volts or greater than 35 volts is considered invalid. When data is invalid, three amber dashes replace the numbers.

Battery Amps

Digit colors display as follows in 5 amps increments:

Green. . . . . –195 TO 195 AMPS

Amber . . . . ≤–200 OR ≥200 AMPS

Battery amperage range is –1,600 to 1,600 amps. Battery current less than –1,600 amps or greater than 1,600 amps is considered invalid. When data is invalid, three amber dashes replace the numbers.

The BATT AMPS display shows a negative sign as appropriate. A positive sign does not display for current above 0 amp.

Battery Temperature

A battery temperature of >63°C (145.4°F) illuminates the battery temperature numbers as red inverse video in the electrical area of the EICAS. A red CAS message **L-R BATTERY O'TEMP** flashes in the EICAS, the MASTER WARNING button flashes, and a double chime or aural warning "Battery overtemperature" sounds.

If the temperature continues to rise to >71°C (159.8°F), the warnings again appear, provided they were acknowledged at the first indication.

The battery temperature numbers in the EICAS electrical window change to amber inverse video when the battery temperature is less than –20°C (-4 °F).

Digit colors display as follows:

Green. . . . . –20 TO 63°C

Amber . . . . <–20°C

Red . . . . >63°C

Battery temperature range is –70°C (-94°F) to 160°C (320°F). A battery temperature less than –70°C (-94°F) or greater than 160°C (320°F) is considered invalid. When data is invalid, three amber dashes replace the numbers.

The BATT °C display shows a negative sign as appropriate. A positive sign does not display for temperatures above 0°C (32°F).

Safety and Protective Features

Safety and protective features of the split-bus system include:

- Not more than one generator will be connected to a single bus at any time.
- Ground external power overvoltage protection is provided.
- Two separate and distinct distribution systems, and related subsystems, supply power.
- No malfunctioning power source can prevent the remaining power sources from furnishing power to essential loads.
- Individual, or collective disconnection of the electrical power sources, including batteries, is available in flight to the flight crew.
- When fuel and hydraulic firewall shutoffs are activated, the respective generators are de-activated, and cannot be re-activated until the fuel and firewall shutoffs are reopened.
- Generator overvoltage protection at 31.5 (±0.5) volts is provided.
- All circuit breakers are "push-to-reset" and cannot be reset if a fault is present in the circuit.
- Each battery is provided with a separate switch to provide for individual battery disconnection.

Cockpit Circuit Breakers

Push-to-reset, pull-off type circuit breakers, with the amperage rating marked on each breaker, are installed in panels located on both sides of the cockpit. The panels are readily accessible to the flight crew during flight. The panels shown are typical installations for the Sovereign.

Each cockpit CB panel is divided into three sections. The left side panel is labeled:

- AVIONICS
- ELECTRICAL
- EMERGENCY/STANDBY

The right side panel is labeled:

- AVIONICS
- ELECTRICAL
- EMERGENCY

The CB panel sections are labeled the same as the extension buses within. The following extension buses are in the cockpit CB panels:

- Left and right ELECTRICAL extension buses
- Left and right AVIONICS extension buses
- Left and right EMERGENCY extension buses
- STANDBY INSTRUMENT bus (left panel only)

The cockpit circuit breakers are checked during the preflight inspection. Refer to the AFM for more information.

The previously listed buses are extensions of their respective main buses in the aft J-box. Power is transferred from the rear (aft J-box) to the cockpit and terminates at the 30 amps circuit breaker clusters on each ELECTRICAL and AVIONICS CB panel section. The emergency buses transfer power through a single cable. The cockpit circuit breakers connect to one of the buses and distribute power to their individual systems.

Cabin Circuit Breakers

Two interior electrical buses and circuit breakers are in the cabin J-box. Non-essential cabin equipment such as cabin lighting, Air Show™, and other equipment receive power from the cabin J-box when the cockpit INTERIOR button is in the NORM position. Unlike the circuit breakers in the aft J-box, these circuit breakers are not monitored and if tripped, will not display an associated CAS message.

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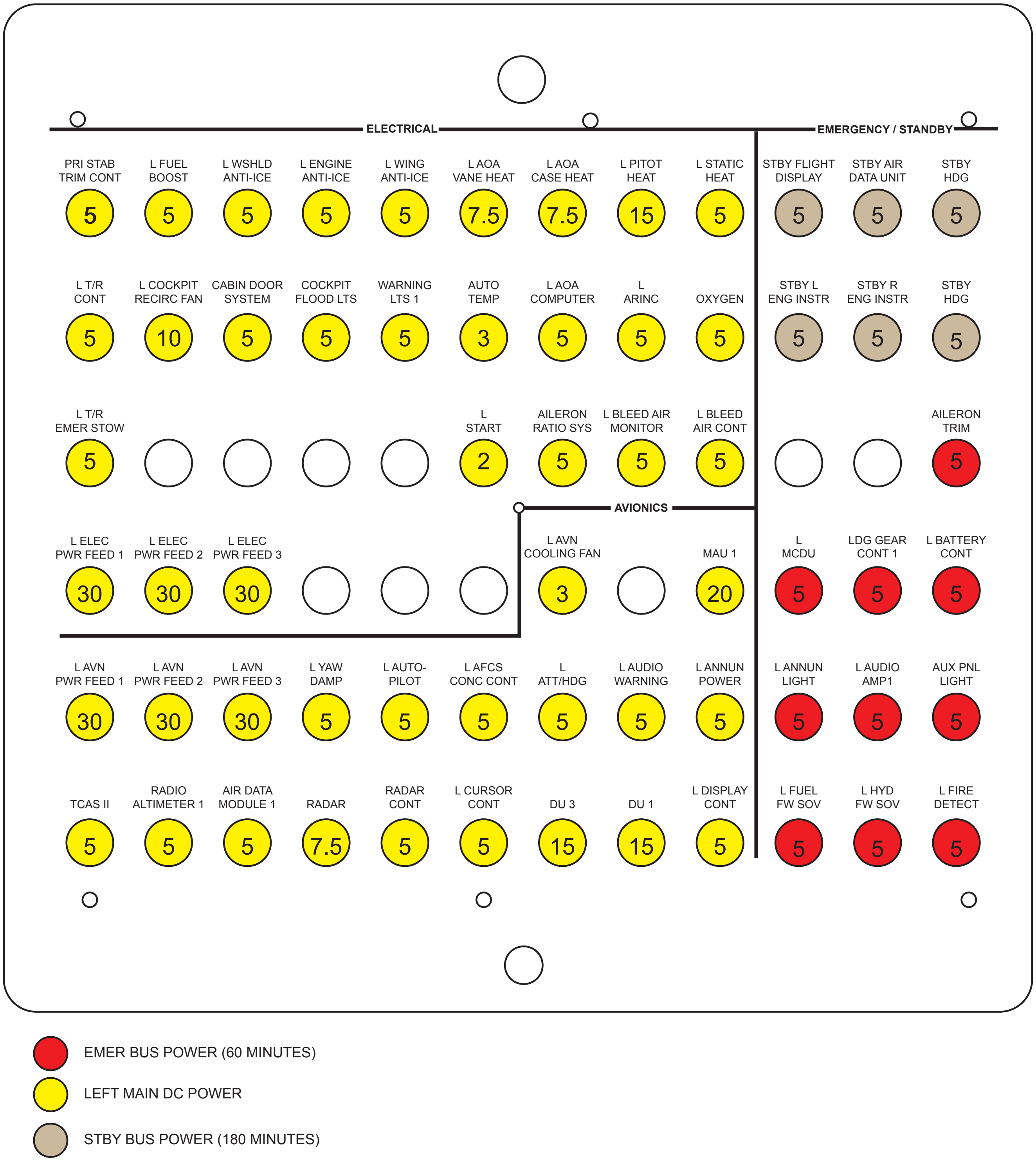
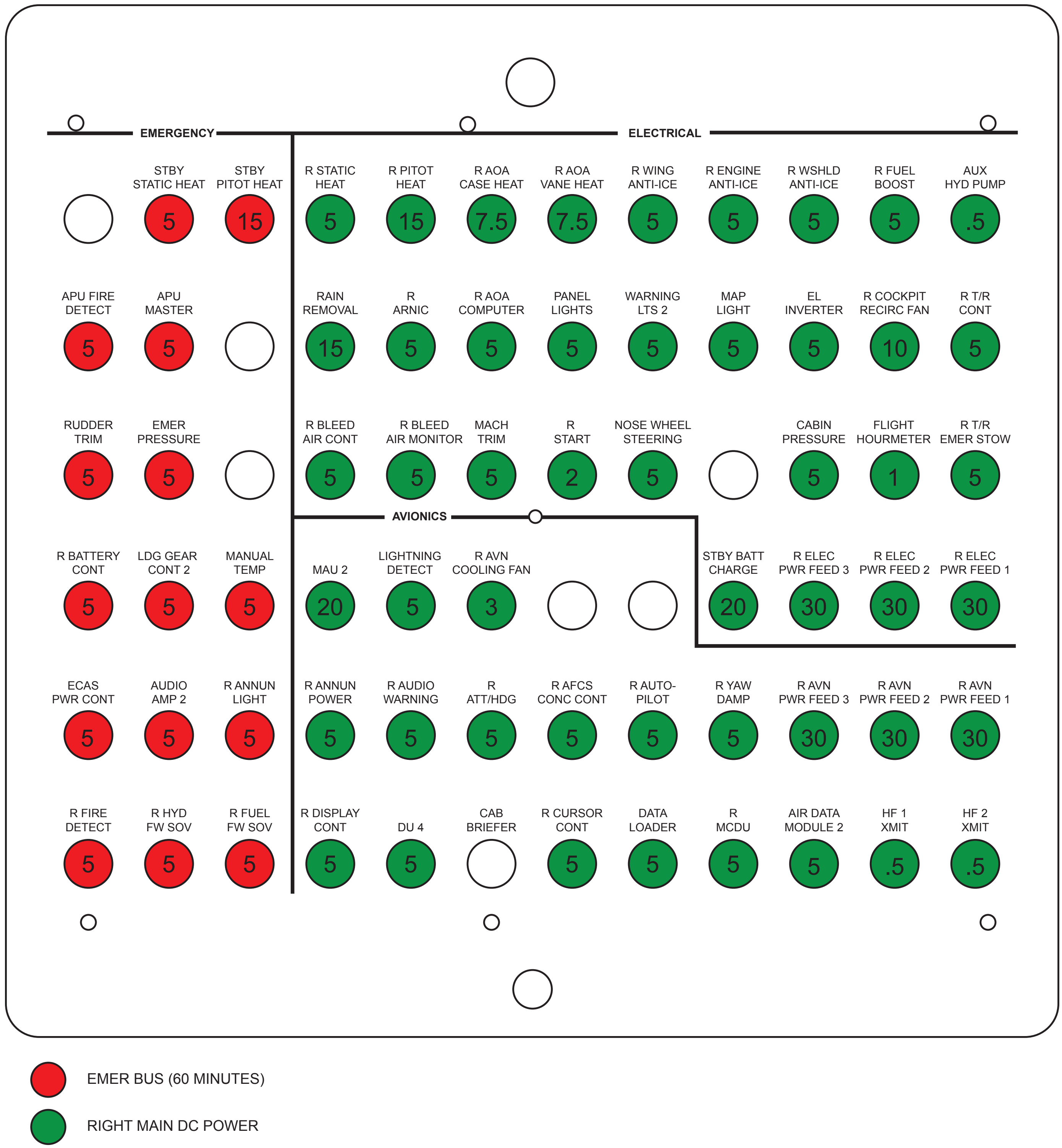
Left Circuit Breaker Panel



Right Circuit Breaker Panel



Aft Power and AC Junction Boxes

The main left and right power junction boxes and the AC junction boxes are located in the aft baggage compartment. These junction boxes incorporate a number of major relays, logic modules, and circuit breakers that supply remote signals which provide warning and caution messages to the EICAS system.

AC Power Generation

AC Alternators

An AC alternator is connected to each engine gearbox. The only function of the AC alternators is to supply power for the windshield anti-ice/defog system. Additional information regarding the AC alternators can be found in the Ice and Rain Protection System chapter.

Permanent Magnetic Alternator

The engine FADEC channels switch over from start bus power to their dedicated Permanent Magnet Alternator (PMA) power sources at 25% N_2 during start. The FADEC can change back to start bus power if a PMA fault occurs.

Preflight and Procedures

Preflight

The cockpit preflight check for the electrical system starts by checking that all circuit breakers are in. If any are extended (tripped), check with maintenance. Ensure the battery buttons are OFF, then check the emergency lighting system by placing the EMERG LTS switch to ON. Check the emergency lights in the cabin, the wing exit light in the right fairing, and the ground light in the landing light are illuminated. Place the switch to OFF. Check the standby power by placing the STBY PWR switch to the TEST position and the green light will illuminate. Then, with no other power on the airplane, turn the switch to the ON position and the amber light should illuminate.

Check the generator/alternator inlets and exhausts during the exterior preflight inspection.

Abnormal Procedures

The following are abnormal procedures associated with the electrical system. For detailed checklist procedures, refer to the CAE SimuFlite Operating Handbook.

Single Generator Failure

With a **GEN OFF L or R** CAS message, the initial action is to reduce, if required, the electrical load on the operating generator. One generator is usually capable of supplying all electrical requirements during flight. If possible, after reducing the load, direct attention toward the failed generator while checking CBs and resetting switches.

After reducing load, check the generator switches to ensure they are in GEN; check for any extended CBs. Select voltmeter to read voltage output of each generator before attempting a generator reset. If voltage output on the failed generator is less than 10V, the field relay is closed and might be resettable; if its voltage output is 10V or more, but less than normal (28.5V), the power relay is open and the generator will probably not reset. Voltage output of the operating generator should be normal (28.5V).

After resetting the failed generator, check that its voltage output is normal (28.5V) before moving its switch to GEN. If the generator does not reset, turn it OFF and continue the flight with the one operating generator.

BATTERY O'CURRENT L and/or R

This message is displayed when the battery current is ≥200 amps (positive or negative). Select the affected BATT button to OFF. If the R ELEC button is in EMER, select the EICAS display button to RIGHT. If the battery amps on the affected side are still high, land as soon as possible. Equipment on the associated emergency bus will be inoperative.

BATTERY OFF L and/or R

This message is displayed when the respective L BATT or R BATT button has been selected OFF. This message will be cyan if the battery has been selected OFF in response to a battery overtemperature and the overtemperature condition still exists. If the BATT button was not selected off due to another malfunction, select the BATT button on the affected side to ON.

BUS TIE CLOSED

This message is displayed when the bus tie contactor between the emergency buses is closed. To accommodate in-flight engine or APU starts, selected cases initially display cyan and then change to amber after 5 minutes if an electrical source is active on both sides. Check and set as required.

DC EMER BUS L and/or R

This message is displayed when the respective emergency bus isolation relay is open, either automatically by DC generator overcurrent protection or by pilot selection of the affected electrical L or R ELEC buttons to EMER. This message is inhibited when the opposite side engine start contactor is closed. The affected R or L ELEC button will indicate amber EMER.

If the current exceeds 600 amps for 4 seconds or more, the bus tie relay will automatically latch open and the amber **DC EMER BUS L** and/or **R** message will be displayed. The respective emergency bus will be on battery power only. If the current exceeds 600 amps for seven seconds or more, the generator relay will automatically open and the amber **DC GEN OFF L** and/or **R** message will be displayed along with the amber **DC EMER BUS L** and/or **R** message. Check battery amps and configure the electrical system in accordance with the appropriate procedure based upon amperage. Land as soon as practical.

DC GEN O'CURRENT L and/or R and/or APU

This message is displayed when the current for the respective generator is too high. This message is inhibited during engine start and for 2 minutes after Configure the electrical system as directed in the abnormal checklist procedure to determine where the fault exists. Land as soon as practical.

> ***NOTE:*** A generator over-current in excess of the in-flight limitation is permitted, provided that the amber CAS message is not displayed.

DC GEN OFF L and/or R and/or APU

This message is displayed when a source of generated power is available, but the respective generator is not on line. This message will be red if all available sources of generated power are lost. As outlined above, if the associated amber **DC EMER BUS L** and/or **R** message is also displayed, an overcurrent condition was detected on the main bus or one of its extension buses.

REMOTE CB TRIPPED

This message is displayed when a circuit breaker in the aft J-box has tripped. These circuit breakers cannot be accessed by the crew.

Emergency Procedures

The following is a discussion of emergency procedures associated with the electrical system. For detailed checklist procedures, refer to the CAE SimuFlite Operating Handbook.

Electrical Smoke and Fire

Don oxygen masks and smoke goggles. Ensure right and left MIC SEL buttons are selected to MASK. If the fire source is known and away from the oxygen system, select passenger oxygen ON if required and ensure that passenger are receiving oxygen.

Ensure PAX SAFETY button is ON.

If source of fire cannot be found:

- Push the AP/TRIM/NWS DISC button
- Ensure AUX lights knob is in desired position
- Monitor Standby Instruments
- Ensure both GEN switches are OFF
- Ensure both ELEC buttons are in EMER

> ***NOTE:*** After the L and R ELEC buttons have been selected to EMER, the following indications will be present: both amber inverse video T/R UNLK annunciations, aileron and rudder trims will be blank, stab trim will be amber dashes, fuel quantities will be amber dashes, the flap position indicator will be amber, hydraulic pressure will be amber dashes, and hydraulic volume will fluctuate erratically. The following messages will also be displayed: amber **BLEED AIR MONITOR FAIL**, **CABIN ALTITUDE**, **DC EMER BUS L** and/or **R**, and **HYDRAULIC VOLUME LOW.**

Control pressurization manually. Land as soon as possible.

Battery Overtemperature

Illumination of the **BATTERY O'TEMP L** and/or **R** CAS message indicates a battery temperature exceeding +63°C. The red **BATTERY O'TEMP** message will first occur at +63°C.If the battery temperature continues to rise, the MASTER WARNING and aural warning will repeat at +71°C. If the **BATTERY O'TEMP L** and/or **R** EICAS message begins flashing, the temperature has exceeded 71°C and a thermal runaway may be occurring. Turn the affected BATT switch OFF immediately. If the battery temperature continues to rise, land the aircraft as soon as possible. If the battery is isolated and generators are still operating, all main DC items continue to operate normally.

Loss of Both Generators

A dual generator failure is indicated by a red **DC GEN OFF L** and/or **R** and/or **APU** CAS message, red MASTER WARNING lights, and a loss of voltage indication on the EICAS electrical page. If both generators fail, attempt to reset the generator that is closest to 29 volts. If the attempt is successful continue the flight with the operating generator on and the BUS TIE closed. If neither generator resets, descend to FL300 or below and start the APU. If the APU start is successful, it can be used as an alternate source of electrical power. If the APU cannot be started, the batteries will be the only source of electrical power. The crew should monitor the standby instruments and manually adjust pressurization as necessary. Adjust load to a minimum and land as soon as possible.

EICAS System Displays

Cyan Messages	Description
BATTERY OFF L and/or R	This message indicates the respective battery (L or R BATT button) has been selected OFF in response to a battery overtemperature condition and the battery overtemperature condition still exists. This message will be amber when one or both BATT buttons are selected OFF and a battery overtemperature condition is not present.
BUS TIE CLOSED	This message is displayed when the bus tie contactor between the emergency buses is closed. To accommodate in-flight engine or APU starts, selected cases start out cyan and change to amber after 5 minutes when an electrical source is active on both sides.
Amber Messages	**Description**
BATTERY O'CURRENT L and/or R	This message is displayed when the battery current is ≥200 amps (positive or negative).
BATTERY OFF L and/or R	This message is displayed when the respective L BATT or R BATT button has been selected OFF. This message will be cyan if the battery has been selected OFF in response to a battery overtemperature and the overtemperature still exists.
BUS TIE CLOSED	This message is displayed when the bus tie contactor between the emergency buses is closed. Selected cases start out cyan and then change to amber after 5 minutes if an electrical source is active on both sides.
DC EMER BUS L and/or R	This message is displayed when the respective emergency bus isolation relay is open, either automatically by DC generator overcurrent protection or by pilot selection of the affected electrical L or R ELEC buttons to EMER.
DC GEN O'CURRENT L and/or R and/or APU	This message is displayed when the current for the respective generator is too high. This message is inhibited during engine start and for 2 minutes after start.
DC GEN OFF L and/or R and/or APU	This message is displayed when a source of generated power is available, but the respective generator is not online. This message will be red if all available sources of generated power are lost.
REMOTE CB TRIPPED	This message is displayed when a circuit breaker in the aft J-box has tripped. These circuit breakers cannot be accessed by the crew.
Red Messages	**Description**
BATTERY O'TEMP L and/or R	This message is displayed when the battery temperature is at +63°C. If the battery temperature continues to rise, the MASTER WARNING and aural warning will repeat at +71°C.

Red Messages	Description
DC GEN OFF L and/or R and/or APU	This message is displayed when the aircraft is operating on battery power only and at least one source of generator power is available (left or right engine generator, or APU generator if the APU is running).

Lights

General

The lighting system increases visibility to enhance cockpit workflow, cabin comfort and exterior maintenance and servicing. Exterior lights also improve aircraft visibility for collision avoidance and increase flight crew situational awareness during night landings. Battery powered emergency illumination guides the crew and passengers in locating egress pathways. The lighting system is divided into the following subsystems:

- Exterior Lights
- Cockpit Lighting
- Cabin Lighting
- Baggage, Tail Compartment, Pylon and Service Panel Lighting
- Emergency Lights

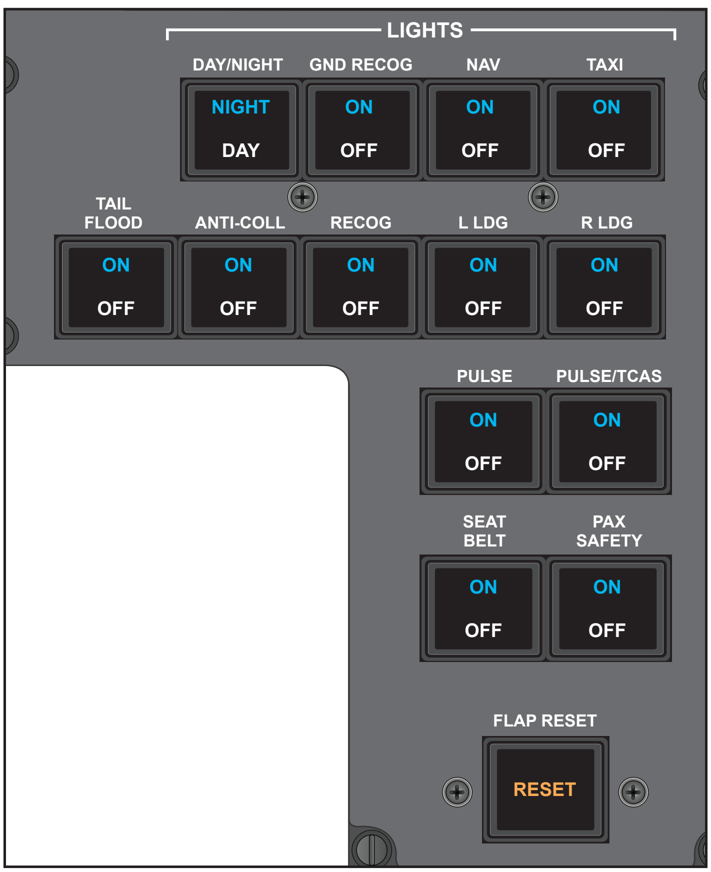


Figure 12-7: Lights Control Panel

Exterior Lights

Exterior lighting consists of:

- Landing lights
- Position/Anti-collision lights
- Wing inspection lights
- Tail floodlights
- Ground recognition beacon
- Taxi lights

Landing Lights

The landing lights are located in each wing root leading edge. They are controlled by two separate L LDG and R LDG buttons on the exterior lighting panel. With the L LDG and R LDG light buttons in the OFF position, the landing lights can function at a lower intensity as recognition lights. The single RECOG button on the lighting control panel illuminates both lights in the recognition mode.

Figure 12-8: Landing Light

Pulse Lights

An optional pulse light system provides pulse sequencing for the landing lights. The system is activated by a two position button labeled PULSE on the LIGHTS panel. When the button is in the ON position, and the L LDG/R LDG lights and RECOG lights are in the OFF position, the pulse sequence is active and the lights will flash at approximately 45 times per minute through a controller. The ON position of the L LDG/R LDG lights or RECOG lights will override the pulse lights.

In addition to the standard PULSE button, an optional pulse light button labeled PULSE/TCAS may be installed. With this button in the NORM position, a TCAS RA will cause the landing lights to pulse regardless of the PULSE button position. The PULSE/TCAS button will not override any normal operation of the lights. If the landing lights are on, the pulse may not be noticeable, due to the intensity of the landing lights.

NOTE:	The Pulselite System must be OFF and remain OFF during the following night ground and night flight operations: Taxi, takeoff, and landing approach at 300 feet AGL and below.

Position/Anti-Collision Lights

The position lights are located in each wingtip and on the aft end of the vertical tail. The position system includes red and green wingtip lights, and a white vertical taillight. Selecting the nav switch to the NAV ON position powers the position lights.

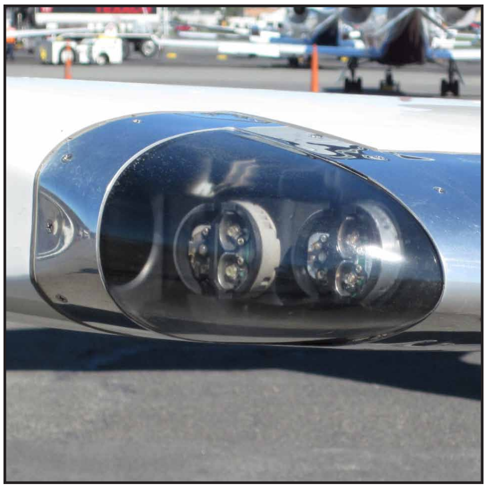


Figure 12-9: Wing Position Lights

Figure 12-10: Wing Anti-collision Light

Wing Inspection Lights

The wing inspection lights are mounted on each side of the fuselage just above each wing leading edge and are used to detect the presence of ice on the wing. A button located on the ANTI-ICE control panel labeled WING INSP LTS is used to power the wing inspection lights ON.

Figure 12-11: Wing Inspection Light

Tail Floodlights (optional)

The tail floodlights are installed on the upper surface of the horizontal stabilizer. Selecting the tilt-panel mounted button labeled TAIL FLOOD powers lights that illuminate both sides of the vertical stabilizer.

Ground Recognition and Anti-Collision Lights

A red ground recognition beacon light is mounted on top of the vertical tail for optimum line of sight visibility and is used during ground taxi operation. The anti-collision light system includes strobes at each wingtip. Selecting the tilt panel-mounted GND RECOG button to ON powers the beacon. Selecting the ANTI-COLL button to ON powers the anti-collision strobe lights.

Taxi Lights

Two taxi lights are mounted on the front of the nosewheel strut. The lights consist of two sealed beam lamps controlled by a single TAXI button on the LIGHTS panel. The taxi lights only illuminate when the aircraft is on the ground (all three squat switches indicating on ground). The taxi lights turn as the nosewheel turns.

Figure 12-12: Ground Recognition Light

Figure 12-13: Taxi Lights

Cockpit Lighting

Map Lights

The map lights are 28-VDC overhead lights, which are on the left and right forward overhead panel. The intensity of the light is controlled by two separate dimming knobs (L MAP LIGHT and R MAP LIGHT), which are on the left side and right side outboard switch panel.

Floodlights

The floodlights are 28-VDC overhead lights. A rheostat on the LIGHTS panel on the pedestal (aft of the FLAP handle) controls the intensity of the two floodlights.

Cockpit Lighting Controls

Cockpit lighting is controlled by rheostats on the center pedestal and by a DAY/NIGHT button in the lighting control panel.

The PANEL rheostat controls light intensity for all glass gauge panel and control panel lighting. Panel lights are powered by main DC power via the PANEL LTS circuit breaker on the right cockpit CB panel.

The EL PANEL rheostat controls light intensity for all electroluminescent (EL) panel lighting. EL panel lighting is powered by main DC power via a small AC inverter protected by the EL INVERTER circuit breaker on the right cockpit CB panel. EL lighting illuminates the alphanumeric wording. Adjust the overhead floodlight intensity with the FLOOD rheostat.

Floodlights are powered by the main DC power through a circuit breaker on the left CB panel. Map lights are powered through a circuit breaker on the right CB panel.

LED lights under the glareshield provide indirect lighting for the instrument panel. The light intensity is adjusted by the AUX rheostat. The auxiliary lights are powered by emergency DC power through the AUX PNL LIGHT circuit breaker on the left cockpit CB panel.

DAY/NIGHT Button (Cockpit)

The DAY/NIGHT button is a two-position button on the cockpit center pedestal lighting panel. The two-position button can be pressed to the white DAY or cyan NIGHT position. The button operates as follows:

- DAY position: Bypasses the light rheostats and illuminates all buttons to their maximum intensity
- NIGHT position: Dims the buttons, routes power to the PANEL and EL PANEL rheostats for light intensity control, and activates the ice detection lights on either side of the center windshield post

Cabin Lighting

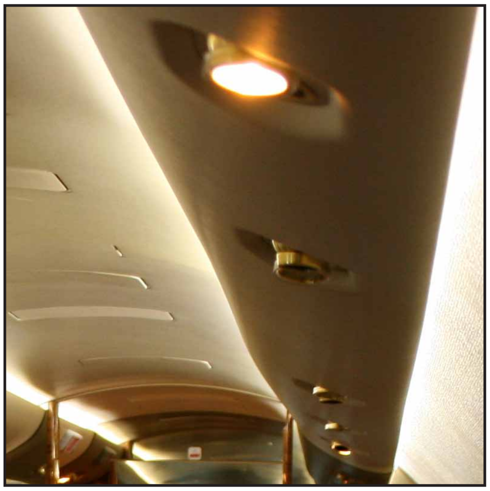


Figure 12-14: Overhead Cabin Lights

Figure 12-15: Passenger Touch Panel

Cabin Lights

Cabin aisle lighting consists of ten strip lights located on either side of the dropped cabin aisle. Each passenger service unit includes a 12-watt directional halogen reading lamp. Cabin illumination is available from the indirect overhead fluorescent lights.

Indirect Lights

The indirect lights are a cool-temperature LED-type and can operate when 28-VDC is supplied. Two rheostat switches control the dimming through five power supplies installed in the overhead PSUs.

Reading Lights

The 12-watt overhead reading lights operate when 28-VDC is supplied. Each light is personally controlled. During emergency conditions, the reading lights will operate.

Passenger Safety Signs

The no smoking/fasten seat belt sign and RETURN TO SEAT sign are controlled by the SEAT BELTS and PAX SAFETY annunciator switches on the LIGHTS switch panel on the pedestal.

Aisle Footwell Lights

The aisle footwell lights operate when the entry light switch is in the ON position.

Cabin Door Threshold Lights

When the cabin door is open, the threshold and step lights operate if the entry light switch is in the ON position. An internal lamp in the switch automatically comes on as the door opens.

Baggage Compartment, Tailcone and Service Lighting

Detachable lights located in the tailcone inspection and baggage areas provide interior lighting for tailcone inspection. Power is from the hot battery bus. The OFF/ON switch is mounted on the access doorframe and is wired through the door-closed micro-switch. Closing the tailcone compartment door extinguishes the respective light, regardless of OFF/ON switch position.

Optional work lights are on the bottom of each engine pylon. The lights are for maintenance, loading baggage, or performing preflight checks at night. Both lights are powered from the right battery bus and controlled by the same toggle switch in the baggage compartment that controls the baggage compartment lights. Closing the baggage compartment door extinguishes both lights.

Emergency Lights

Emergency lighting is a separate and independent system used to provide illumination in case of a primary electrical power failure or in a hard landing situation. The emergency lighting system consists of two emergency battery packs (with 5G inertia switch control), five illuminated emergency exit marking and locating signs, four overhead lights for illumination of exit areas, two strips of floor proximity escape path lighting along the cabin dropped aisle, six cabin door step lights, and two exterior lights for external overwing illumination during night evacuation.The emergency lights are normally powered from the main DC power system, with the emergency battery packs being trickle charged by the DC power system.

The lights are controlled by a three position EMER LTS switch located at the bottom of the left instrument panel. When the switch is in the OFF position, none of the emergency lights are illuminated. With normal DC power on and the switch in the OFF position, an amber light adjacent to the switch is illuminated to remind the pilot to place the switch to either the ON or ARM position before flight.

In the ARM position (normal flight mode), the amber light next to the switch extinguishes, but the emergency lights do not illuminate unless either the passenger safety switch is placed in the PAX SAFETY ON position, normal airplane power is lost, or a 5G impact is sustained to the airplane.

In the ON position, the amber light adjacent to the switch extinguishes and all emergency lights are illuminated. These lights will be powered from either the main power bus or, if not available, from the emergency battery packs.

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13

Fire Protection

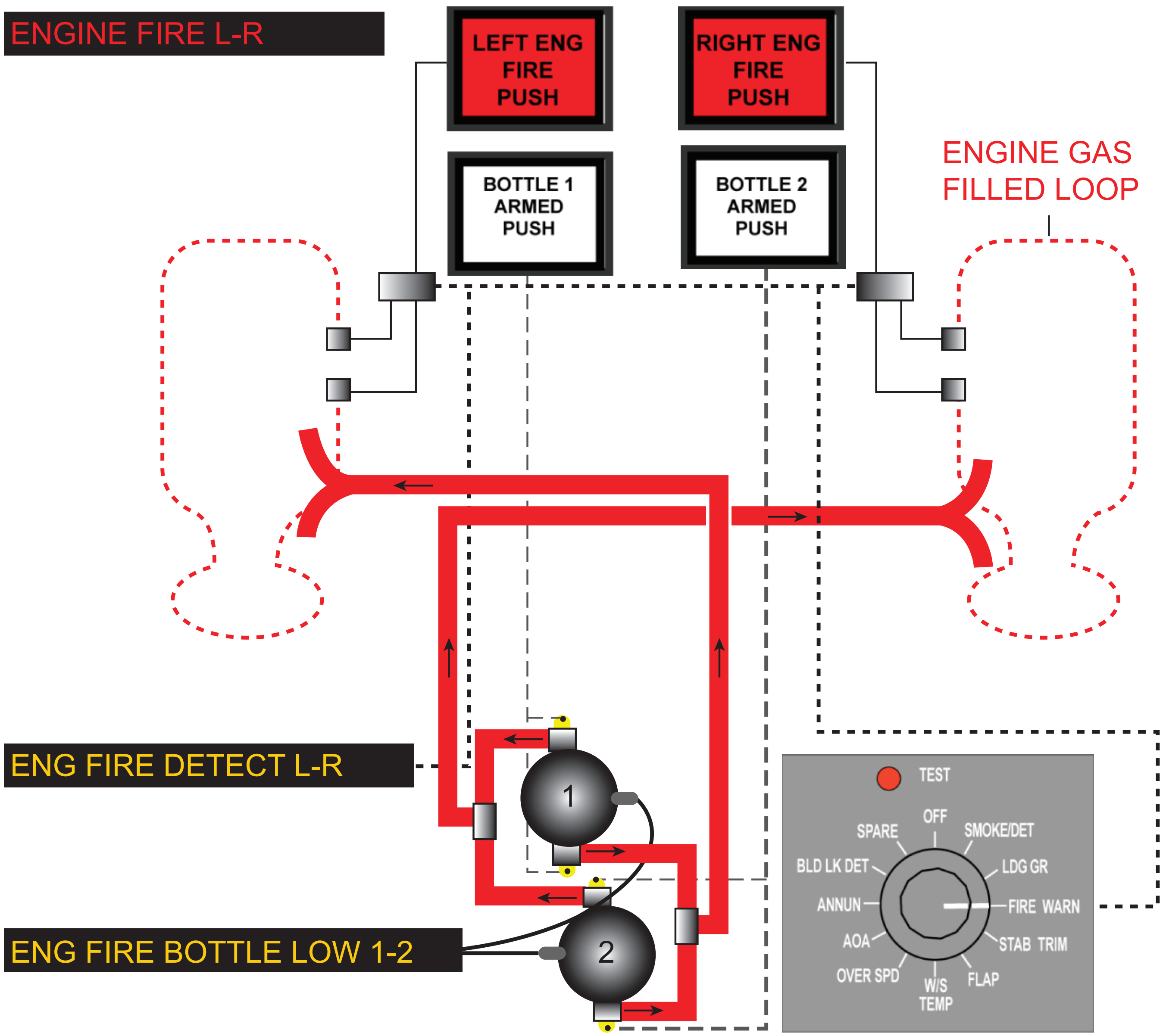
Contents

Fire Protection System

General

The fire detection, warning and extinguishing systems provide identification of fire in the engines or APU, or smoke in the tailcone baggage compartment of the airplane. These systems also provide extinguishing capabilities for the engines, APU, and tailcone baggage compartment. There are two fire detection sensors on each engine, one sensor for the APU, and two smoke detectors in the tailcone baggage compartment. Two engine fire bottles provide extinguishing materials that can be used on either engine, and two baggage compartment fire bottles are installed for use in the event of a tailcone baggage fire. APU fire protection is provided by sharing one of the baggage compartment fire bottles. Two portable fire extinguishers are standard equipment in the cockpit/cabin area.

Engine Fire Protection System



Engine Fire Protection System

Description

The engine fire protection system monitors temperatures in each engine nacelle. If a fire or bleed air leak develops, the crew is alerted by various lights and CAS messages in the cockpit.

Components

Loops and Sensors

The engine fire detection system consists of two continuous elements routed around critical areas within the engine. One loop surrounds the engine outer case while the other is located internally. Each element consists of a tube filled with hydrogen gas and a stabilizing chemical. If the gas within the tube is heated, molecular motion within the tube increases, resulting in a rise in pressure. As the loop reaches a pre-determined pressure due to a rise in temperature, system monitoring triggers the fire indications in the cockpit.

Engine Fire Bottles

Two fixed 86-cubic-inch (1.4 liter) spherical steel fire extinguisher bottles in the tailcone are cross-plumbed so that either bottle can be discharged into either engine. The fire extinguisher bottles incorporate fill and pressure relief valves, temperature compensating pressure switches, and explosive cartridge operated discharge valves.

Each fire bottle provides one extinguishing shot. A plumbing network attached to each cartridge assembly directs the extinguishing agent to an engine. Either bottle or both can be discharged into either engine, depending on which cartridge is (or if both cartridges are) activated. Depressing the appropriate ENGINE FIRE button selects the correct cartridge.

Each bottle contains bromotrifluormethane (Halon 1301). The extinguishing agent is non-corrosive; therefore it has no damaging effects on any of the engine components, and it is not necessary to clean or replace the components after the bottles are fired.

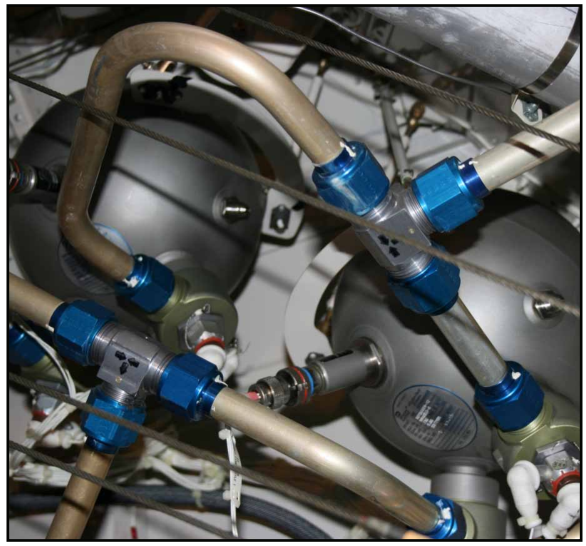


Figure 13-1: Engine Fire Extinguishing Bottles

Firewall Shutoff Valves

There are two electrically motorized firewall shutoff valves for each engine: one fuel and one hydraulic. These close when the corresponding ENGINE FIRE button is initially pressed; they open if the button is pressed a second time. The valves open or close in approximately one second.

The fuel firewall shutoff valve on the aft side of the rear wing spar isolates the primary fuel line to its respective engine. The left and right hydraulic firewall shutoff valves are between the hydraulic reservoir and the suction side of each hydraulic pump.

Pressing either ENG FIRE button directs emergency bus power to close the fuel and hydraulic shutoff valves on the affected engine's side. A cyan **FUEL FW SHUTOFF L** and/or **R** message illuminates on the EICAS to indicate that the corresponding engine's fuel firewall shutoff valve is fully closed.

Controls and Indications

ENG FIRE Buttons

In the event of an engine fire, the EICAS will display the **ENGINE FIRE L** and/or **ENGINE FIRE R** warning message. The red MASTER WARNING lights will illuminate and an aural "LEFT ENGINE FIRE" and/or "RIGHT ENGINE FIRE" announcement will also be heard.

BOTTLE ARMED Buttons

Pushing the L or R ENGINE FIRE PUSH annunciator button will illuminate the BOTTLE 1 and BOTTLE 2 ARMED PUSH annunciator buttons. The engine fire bottles will then be armed for use in engine fire extinguishing. Either bottle may be discharged to the selected engine by pushing the BOTTLE 1 or BOTTLE 2 ARMED PUSH annunciator button. In the event an engine fire indication still exists, the remaining engine fire bottle may be utilized.

Figure 13-2: Fire Buttons

Operation

If an excessively high temperature exists in the engine compartment, the respective red fire light illuminates. The MASTER WARNING buttons flash and the corresponding CAS message appears on the EICAS. If the illumination of the LEFT or RIGHT ENG FIRE light was caused by a bleed leak, bringing the throttle to IDLE on the respective engine may lower the temperature of the escaping bleed air. The fire loop begins to cool and the respective ENG FIRE light extinguishes within 15 seconds. If the ENG FIRE light remains illuminated, pressing the button accomplishes the following:

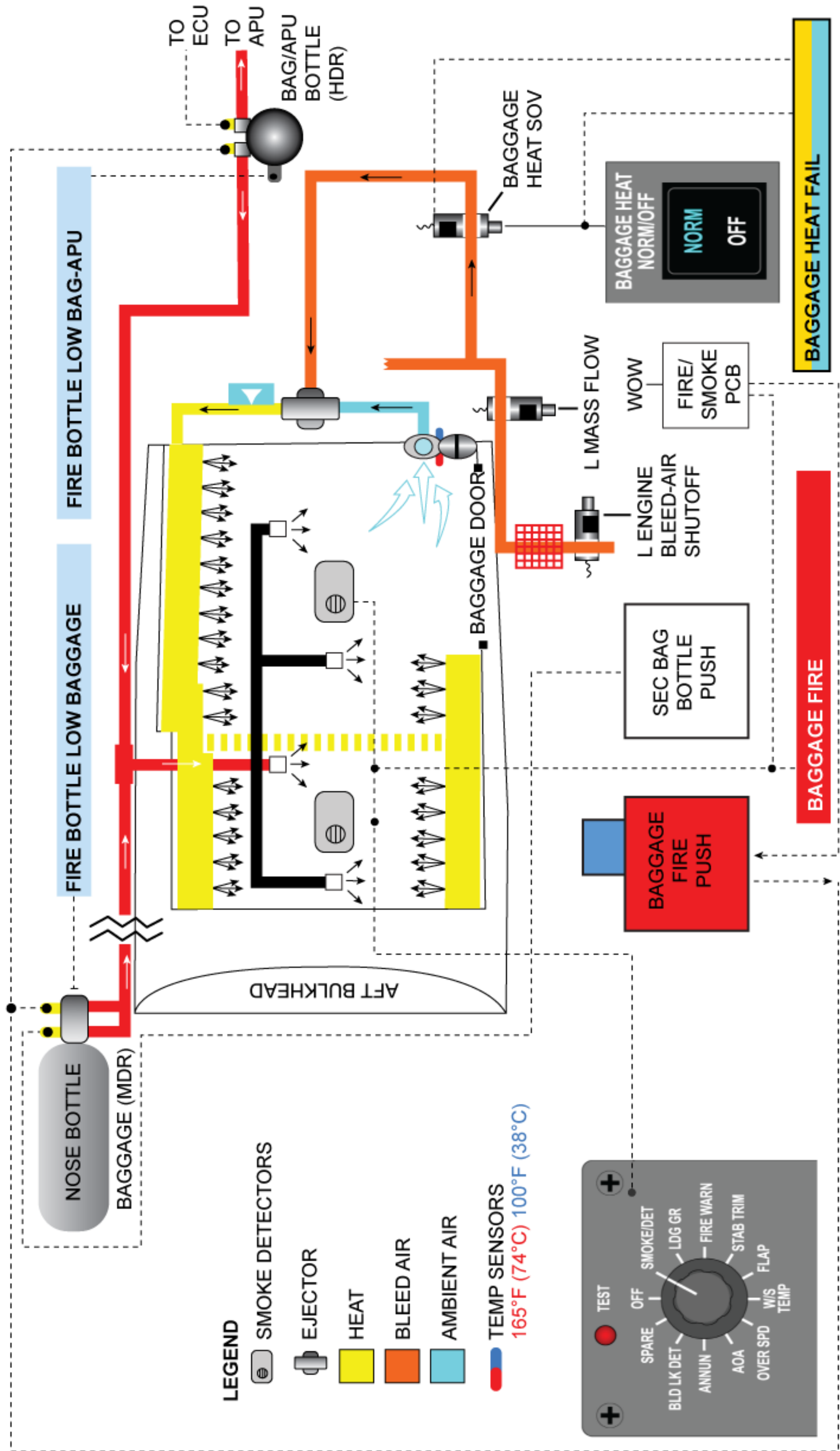
- Engine fuel firewall shutoff valve closes
- Fuel shuts off in the engine's HFCU (Hydromechanical Fuel Control Unit)
- Hydraulic firewall shutoff valve closes
- Engine generator is deactivated (field relay opens)
- Thrust reverser is disabled
- Both fire bottles are armed

Several CAS messages appear, confirming the shutdown of the engine and FSOV closing.

Either of the illuminated BOTTLE ARMED buttons can then be pressed. This sends an electronic signal to the squib on the respective bottle, releasing the extinguishing agent into the engine compartment that was selected by the ENG FIRE button.

Follow checklist procedures to secure the engine. If the ENG FIRE button is still illuminated, the second bottle may be discharged into the engine compartment by pressing the remaining illuminated BOTTLE ARMED button.

Baggage Compartment Smoke Detection



Baggage Fire Protection System

Description

The baggage compartment smoke detection system indicates a presence of smoke in the tailcone baggage compartment. Multiple warnings and provisions are provided to extinguish a tailcone baggage compartment fire.

Components

Baggage Smoke Detectors

Two smoke detectors are in the ceiling of the baggage compartment, one forward and one aft. Each detector is composed of a light emitting source and a photoelectric cell placed on opposite sides of an enclosure with a white interior. Vents in the enclosure allow compartment air to circulate through the interior. In normal conditions, the photoelectric cell receives a constant level of illumination from the light source and produces a steady voltage. If the air within the baggage compartment is contaminated with smoke or particles, less illumination is received by the photoelectric cell and voltage output drops, signaling the presence of smoke.

Fire Extinguisher Bottles

The baggage fire protection system includes two fire bottles that supply an initial knockdown concentration of halon, a low-metered rate of halon for continued flight at cruise conditions, and a high-metered rate of halon for descent and landing. The bottles are located as follows:

- One shared baggage/APU bottle in the tailcone, which incorporates two discharge ports (one for the baggage compartment and one for the APU)
- One dedicated baggage fire bottle in the nose compartment, which incorporates a low-discharge squib for cruise flight and a high-discharge squib for descent and landing

Both bottles are monitored for bottle pressure and if pressure is low, a switch activates one of two cyan CAS messages, **FIRE BOTTLE LOW BAGGAGE** or **FIRE BOTTLE LOW BAG/APU**. The illumination of either cyan CAS message prevents baggage heat from operating.

Figure 13-3: Nose Compartment Fire Extinguisher Bottle

Controls and Indications

BAGGAGE FIRE Button

Once a baggage compartment fire condition is detected, a red **BAGGAGE FIRE** annunciation is displayed on the EICAS, the aural "BAGGAGE FIRE" warning is heard, the red BAG FIRE PUSH button (located on the right instrument panel) and the red MASTER WARNING light will illuminate. The baggage heat shutoff valve will close. If the baggage heat shutoff valve fails to close, the EICAS will display the amber **BAGGAGE HEAT SHUTOFF FAIL** annunciation.

When the BAGGAGE FIRE PUSH button is pressed, both baggage compartment fire bottles will discharge. The pressure of both baggage compartment fire bottles is monitored. Upon a low bottle pressure condition, the EICAS will display the cyan **FIRE BOTTLE LOW BAG-APU** and/or the cyan **FIRE BOTTLE LOW BAGGAGE** message.

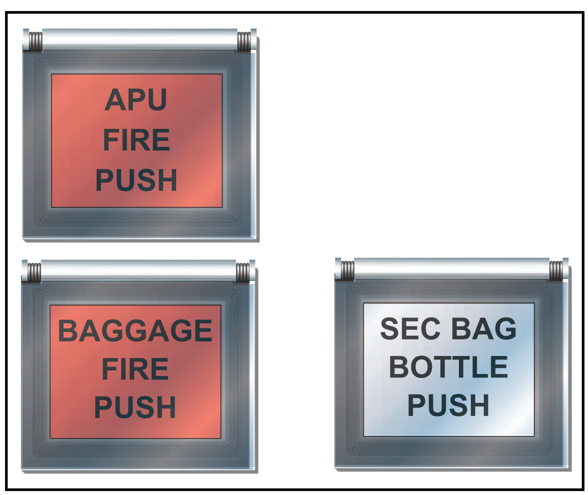


Figure 13-4: BAGGAGE FIRE and SEC BAG BOTTLE PUSH buttons

Operation

If smoke is detected in the baggage compartment, the baggage heat shutoff valve automatically closes, shutting off bleed air flow into the baggage compartment. With the baggage heat shutoff valve closed, the inlet and outlet pressure relief valve closes and airflow into and out of the compartment is minimized. If the baggage compartment shutoff valve fails to close, the amber CAS message **BAGGAGE HEAT FAIL** displays on the EICAS. Positioning the PRESS SOURCE selector to R shuts off bleed air flow to the baggage compartment by closing the left mass flow control valve.

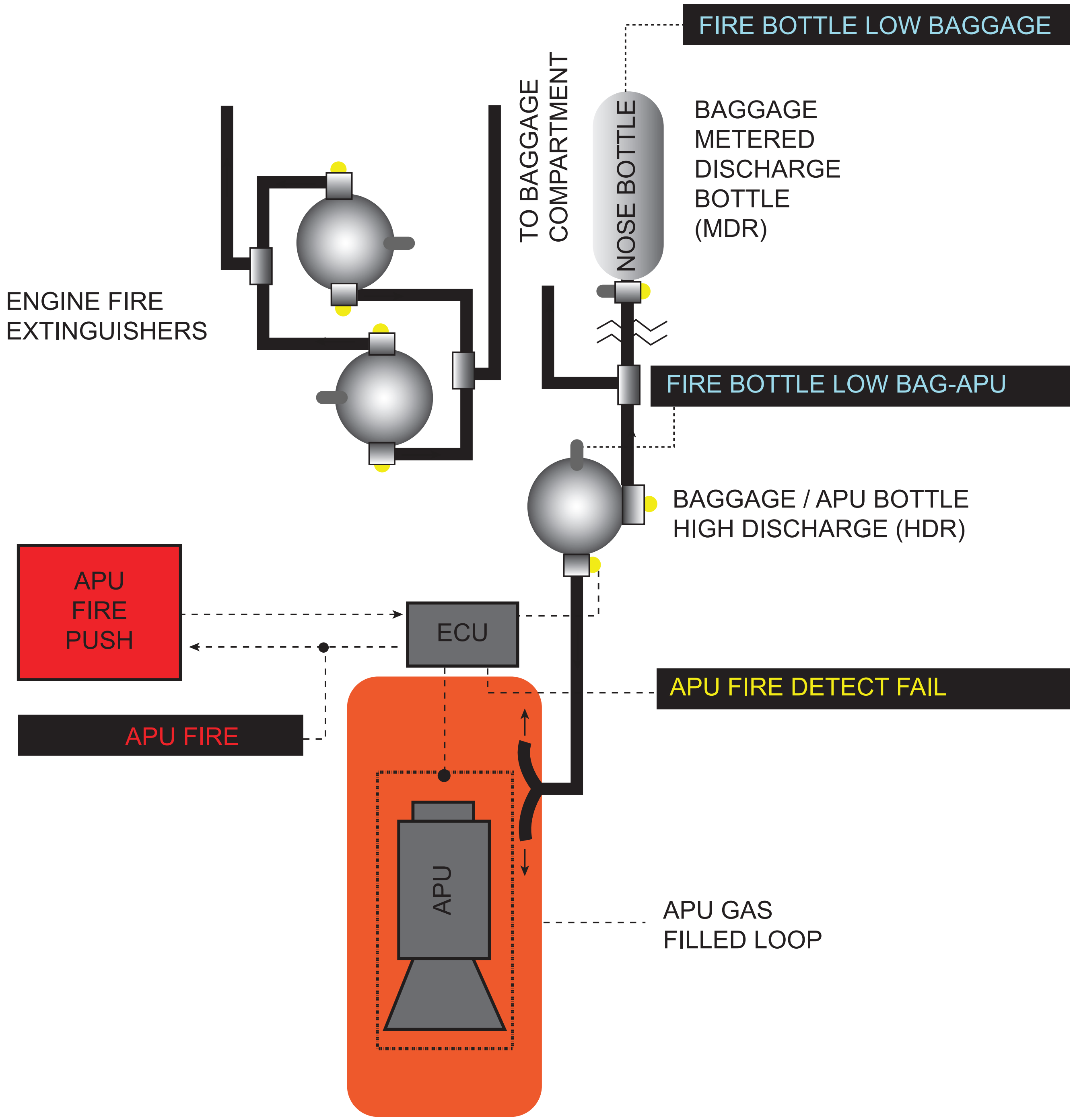
When smoke is detected, the red BAGGAGE FIRE PUSH and MASTER WARNING lights illuminate along with the associated CAS messages appearing on the EICAS. Lifting the cover and pressing the BAGGAGE FIRE PUSH button releases the extinguishing agent from the shared baggage/APU fire bottle.

The cyan CAS message **FIRE BOTTLE LOW BAG-APU** displays on the EICAS. The low-rate discharge squib of the dedicated baggage fire bottle also opens, maintaining a concentration of agent in the baggage compartment until a descent for landing can be made.

If a landing cannot be made within 15 minutes, the dedicated bottle contains enough agent for a maximum cruise time of 180 minutes before a descent for landing must be initiated.

As the descent and landing phase begins, lift the cover and press the SEC BAG BOTTLE PUSH button This opens the high-discharge rate squib of the dedicated fire bottle. If the button is not pressed, the light begins to flash when descending through FL250. Once the dedicated fire bottle pressure falls below its set value, the cyan CAS message **FIRE BOTTLE LOW BAGGAGE** message appears.

APU Fire Detection System



APU Fire Protection System

Description

The APU fire extinguishing system is installed to deploy extinguishing agent into the APU fire containment box in the event a fire is detected by the associated fire detection system. The containment box is made of titanium and stainless steel and completely encloses the APU.

Components

Fire-Detection Loop

A continuous fire detection loop surrounds the APU and monitors for excessive temperature. This element is similar in design and operation to the gas-filled engine fire detection loops. High temperature is sensed in the APU compartment, the MASTER WARNING light flashes, the red APU FIRE PUSH button illuminates along with the associated aural warnings and red CAS message **APU FIRE**.

Baggage/APU Fire Bottle

A shared baggage/APU bottle in the tailcone incorporates two discharge ports (one for the baggage compartment and one for the APU).

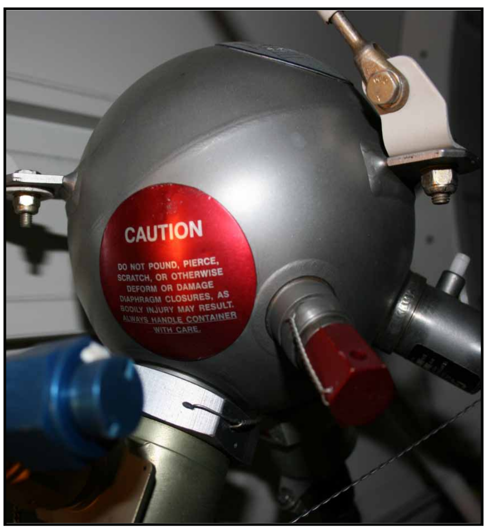


Figure 13-5: APU Fire Extinguisher Bottle

Controls and Indications

APU FIRE Button

Illumination of the APU FIRE PUSH button indicates that a high temperature has been detected around the APU. Pressing the momentary contact button activates the fire suppression system.

Operation

When an excessively high temperature is sensed by the fire loop, the red APU FIRE PUSH button illuminates and the APU automatically shuts down. The MASTER WARNING light flashes, the red CAS message **APU FIRE** appears on the EICAS, and the appropriate aural warning sounds.

Lifting the cover and pressing the illuminated APU FIRE PUSH button discharges the shared baggage/APU fire bottle into the APU compartment. Once the bottle discharges, a cyan CAS message **FIRE BOTTLE LOW BAG-APU** appears on the EICAS. Once the fire is suppressed and the fire loop cools, the APU FIRE PUSH button extinguishes along with the red CAS message **APU FIRE**.

If the APU FIRE PUSH button is not pressed within 8 seconds of illumination, the shared BAGGAGE/APU fire bottle is discharged automatically. Illumination of the cyan **FIRE BOTTLE LOW BAG-APU** message prevents the APU from operating.

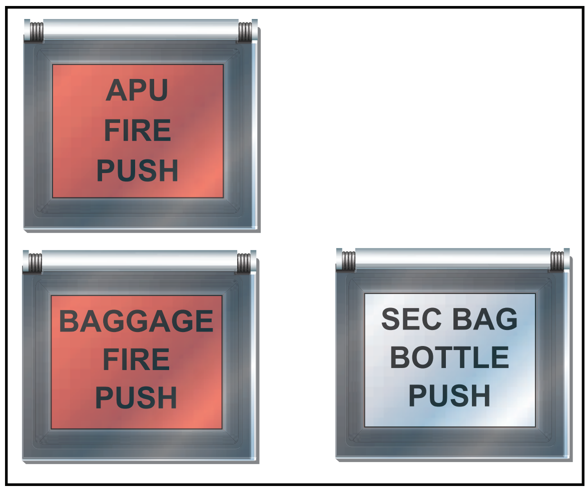


Figure 13-6: APU FIRE PUSH button

Portable Fire Extinguishers

Two portable fire extinguishers are mounted in quick-release brackets; one under the copilot's seat for easy access to the crew in flight, and a second extinguisher in the passenger compartment. The location of the portable fire extinguisher in the passenger compartment varies with installed options on the aircraft.

Each portable extinguisher is rated for Class B and C fires and contains a Halon Type 1211 extinguishing agent.

Figure 13-7: Cabin Fire Extinguisher

Figure 13-8: Cockpit Fire Extinguisher

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Preflight and Servicing Procedures

Preflight

During the preliminary cockpit inspection, check that the portable fire extinguisher under the copilot's seat is serviced and secure and that microphones, headsets, oxygen masks, and smoke goggles are aboard and properly stowed. Verify pressures on portable fire extinguishers according to NFPA or UL specifications indicated on the placard attached to each extinguisher. The pressure gauge should read in the green arc; a white mark indicates a 125 PSI charge. Check that the expiration date on the bottle placard is current.

FIRE WARN Rotary Test

Rotate the Warning Systems rotary TEST knob to the FIRE WARN position. This action tests the detection loop continuity of both engine fire loop systems and their ability to post messages. Check if both MASTER WARNING lights (flashing) and MASTER CAUTION lights (steady) illuminate. Check if both Red LH ENG FIRE and RH ENG FIRE buttons illuminate. Check if the red **ENGINE FIRE L** and **R** message and the amber **ENGINE FIRE DETECT FAIL L** and **R** messages appear.

The "Left Engine Fire" and "Right Engine Fire" aural repeats twice and a single chime sound is heard. To cancel aural warning, press the MASTER WARNING and MASTER CAUTION buttons.

APU FIRE Test

Press and hold the APU TEST button on the APU control panel. Verify the following lights illuminate on the APU SYSTEM Panel: APU SYS FAIL, BLEED VALVE OPEN, READY TO LOAD, APU RELAY ENGAGED, BLEED AIR ON/OFF, GENERATOR ON/OFF, MASTER ON/OFF, TEST, START, and STOP. Verify the digital display has values of 45-55 for APU RPM, 480-520 for APU EGT, and 0.00 for DC VOLTAGE within 10 seconds of depressing the TEST button. Check if the APU FIRE PUSH button illuminates on the right instrument panel and the appropriate double chime or APU FIRE voice is heard.

Abnormal Procedures

The following is a brief explanation of abnormal procedures that pertain to the fire protection system. Abnormal procedures include:

- Engine Fire Detection System Failure
- APU Fire Detection System Failure
- Engine Fire Extinguisher Bottle Pressure Low
- APU and/or Baggage Fire Extinguisher Bottle Pressure Low

Engine Fire Detection System Failure

Illumination of the master caution and an amber EICAS message of **ENG FIRE DETECT FAIL L** and/or **R** indicates a failure in the left or right engine fire detection warning system. If the condition occurs while on the ground, correct problem prior to flight. If condition occurs while in flight, check that the L and R FIRE DETECT CBs (LH and RH panels) are IN and monitor engine instruments for secondary indications of fire. If the fire warning system is inoperative or damaged, firewall shutoff and fire extinguisher bottles are still available if secondary indications of fire are present. Consider the possibility of using the ENGINE FIRE PUSH button to shut engine down. Land as soon as practical.

APU Fire Detection System Failure

The amber **APU FIRE DETECT FAIL** message is displayed on the EICAS when the APU SYSTEM MASTER button is selected ON and the APU fire detection system is inoperative. The APU will not start, and will automatically shut down if it is running. Confirm that the APU is shut down using normal procedures.

Engine Fire Extinguisher Bottle Pressure Low

The amber **ENG FIRE BOTTLE LOW 1** and/or **2** message is displayed on the EICAS when the respective engine fire bottle pressure is low. If on the ground, the crew should have the bottle inspected prior to flight. In flight, land as soon as possible.

APU and/or Baggage Fire Extinguisher Bottle Pressure Low

A cyan **FIRE BOTTLE LOW BAG-APU** message indicates the rapid discharge baggage compartment/APU fire bottle pressure is low because the bottle has discharged. A cyan **FIRE BOTTLE LOW BAGGAGE** message indicates the metered discharge baggage compartment fire bottle pressure is low because the bottle has discharged.

If either of these CAS messages occur on the ground, the crew should verify that the baggage compartment is empty prior to dispatch or have the fire bottle repaired and/or serviced. In flight, the baggage heat valve will automatically close, and the APU may not be available for use.

Emergency Procedures

The following is a brief explanation of emergency procedures that pertain to the fire protection system.

Engine Fire During Takeoff

If an engine fire is detected, a red **ENGINE FIRE L** and/or **R** message will be displayed on the EICAS. The red LH ENG FIRE and/or RH ENG FIRE light will also be illuminated. If an engine fire occurs during takeoff and airspeed is below V_1, abort the takeoff and accomplish the Emergency Procedures for Engine Fire, Takeoff Below V_1 or On The Ground. Evacuate the airplane if necessary.

If airspeed is above V_1, continue normally with takeoff and maintain directional control. Rotate the aircraft to V_R. and, after establishing a positive rate of climb retract the LANDING GEAR handle UP. Climb at V_2 until reaching 1,500 ft. AGL. At 1,500 ft., V_2 +10, and clear of obstacles, retract the flaps and accelerate to V_{ENR}. Move the throttle on the operating engine to MCT detent. When appropriate (at a safe altitude at or above 400 feet AGL and conditions permitting), accomplish the Emergency Procedures for Engine Fire in Flight.

Engine Fire In Flight

At a safe altitude at or above 400 feet AGL and conditions permitting, move the affected throttle to IDLE. Press the ANTI-ICE WING/STAB XFLOW button to XFLOW if bleed air anti-ice systems are on. If the ENG FIRE PUSH button is still illuminated after 15 seconds, Push the illuminated ENG FIRE PUSH button, followed by either illuminated BOTTLE ARMED PUSH button. Accomplish the Emergency Procedures for Engine Fire, Takeoff Above V_1.

If the ENG FIRE PUSH button extinguishes with the throttle at IDLE and no other engine fire indications are present, a bleed leak is the likely source of the problem. Turn off the ENG BLD AIR selector on the affectied side, and turn the BAGGAGE HEAT button OFF. Balance fuel and land as soon as practical. If in icing conditions, refer to Emergency/Abnormal Procedures, "Continued Flight in Icing Environment and Single Bleed Air Source". Refer to the CAE SimuFlite Citation Sovereign Operating Handbook or AFM checklist for other non-memory items.

Environmental System Smoke or Odor

Don the oxygen masks and goggles, and select EMER mode on the masks. Select the MASK Left and Right MIC SEL buttons. If fire source is known and away from oxygen system, select the PASS OXY knob to ON as appropriate and assure passengers are receiving oxygen. Select the PAX SAFETY ON button and determine the source of smoke or fire.

If the source of smoke is unknown, set the APU Bleed Air button to OFF. Change PRESS SOURCE selector to L, allow time to purge. Set the BAGGAGE HEAT button to OFF. For 11 or less passengers maintain FL410 maximum, or for 12 passengers maintain FL390 maximum.

If smoke is not decreasing, change the PRESS SOURCE selector to R, allow time to purge. If smoke is still not decreasing, change the PRESS SOURCE selector to EMER and control cabin temperature with the left throttle. If smoke is not decreasing, land as soon as practical.

When the source of smoke is known, change the PRESS SOURCE selector to the opposite side. Select the BAGGAGE HEAT button to OFF. For 11 or less passengers, maintain FL410 maximum, or for 12 passengers maintain FL390 maximum and land as soon as practical.

Electrical System Smoke or Fire

Don the oxygen marks and goggles, and select EMER mode on the masks. Select the MASK Left and Right MIC SEL buttons. If fire source is known and away from oxygen system, select the PASS OXY knob ON as appropriate and assure passengers are receiving oxygen. Select the PAX SAFETY ON button and determine the source of smoke or fire.

If the source of smoke is unknown, push the AP/TRIM/NWS DISC button and monitor the standby instruments. Select both GEN switches OFF and ELEC buttons to EMER mode. The SECONDARY TRIM button should be ON, and trim as required. Open the Cockpit Divider Door and exit icing environment.

If normal battery discharge is ≤30 amps per battery and smoke is clearing, set the EICAS button to OFF. Control pressurization manually and land as soon as possible.

Smoke Removal

This procedure should be accomplished after completing the applicable “Environmental System Smoke or Fire” or “Electrical System Smoke or Fire” procedure.

Don the oxygen masks and goggles, and select EMER mode on the masks. Select the MASK Left and Right MIC SEL buttons. If fire source is known and away from oxygen system, select the PASS OXY knob ON as appropriate and assure passengers are receiving oxygen. Select the PAX SAFETY ON button.

If both L and R ELEC buttons are in EMER, move the CABIN ALT lever up and descend as required. Land as soon as possible within 60 minutes. If either L or R ELEC button is in NORM, select the CABIN DUMP button. Descend as required and land as soon as possible.

EICAS System Displays

Information regarding the Fire Protection Systems is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit. Messages are displayed in cyan, amber or red, according to their urgency. The following are possible messages displayed that relate to the fire system.

Cyan Messages	Description
FIRE BOTTLE LOW BAG-APU	This message indicates the rapid discharge baggage compartment/APU fire bottle pressure is low because the bottle has discharged. The baggage heat valve will close and the APU will shut down automatically. The APU will be inhibited from starting.
FIRE BOTTLE LOW BAGGAGE	This message indicates the metered discharge baggage compartment fire bottle pressure is low because the bottle has discharged. The baggage heat valve will close.
Amber Messages	**Description**
APU FIRE DETECT FAIL	This message is displayed when the APU SYSTEM MASTER button is selected ON and the APU fire detection system is inoperative. The APU sill not start and will automatically shut down if it is running.
ENG FIRE DETECT FAIL L and/or R	This message indicates the affected engine fire detection system is inoperative.
ENG FIRE BOTTLE LOW 1 and/or 2	This message is displayed when the respective engine fire bottle pressure is low.
Red Messages	**Description**
APU FIRE	This message is displayed when a fire is detected in the APU. The APU FIRE light will also be illuminated.
BAGGAGE FIRE	This message is displayed when smoke is detected in the tailcone baggage compartment. The red BAGGAGE FIRE message may or may not clear due to lingering smoke in the baggage compartment.
ENGINE FIRE L and/or R	This message is displayed when an engine fire is detected. The red LH ENG FIRE and/or RH ENG FIRE light will also be illuminated.

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Flight Controls

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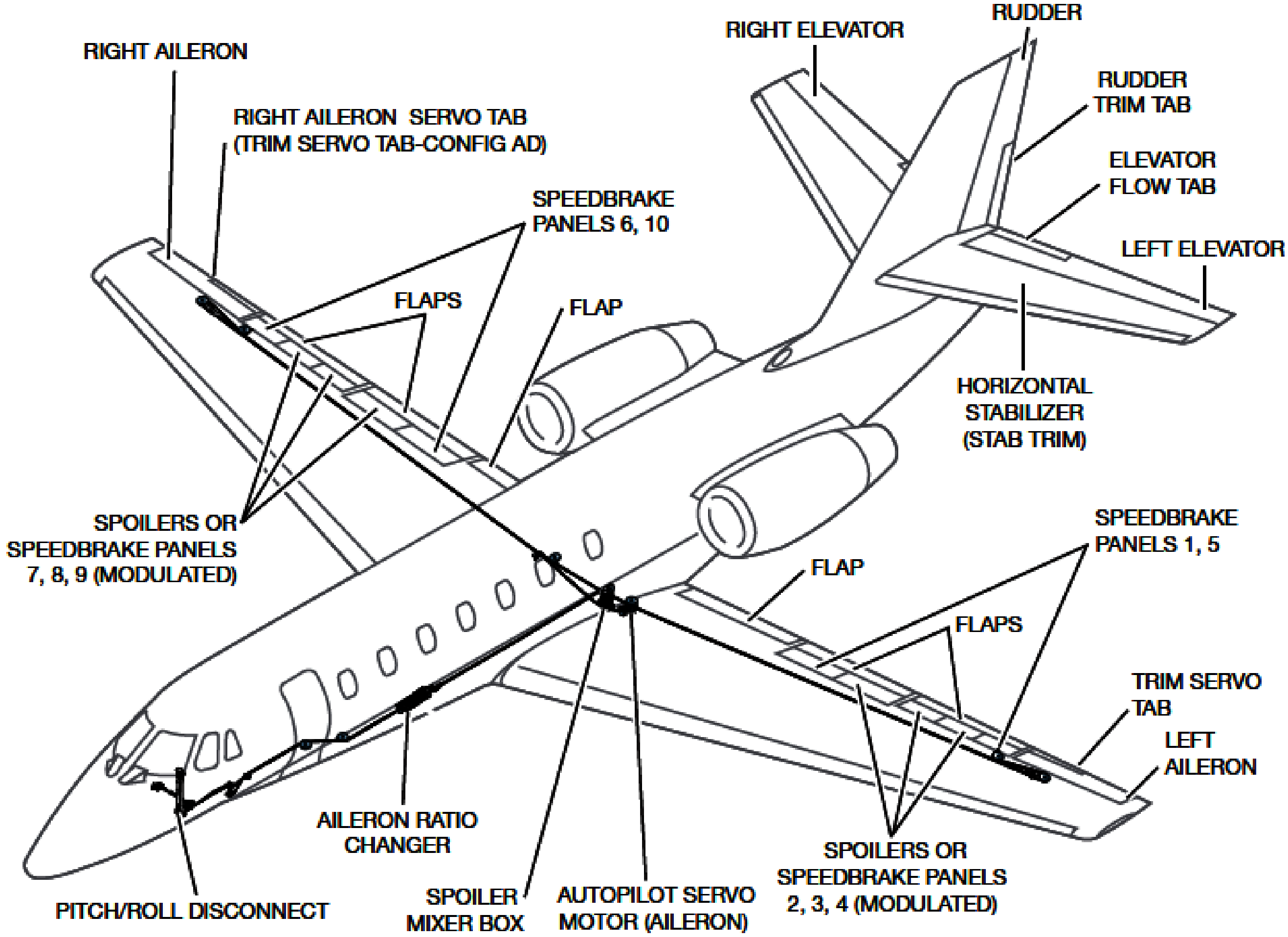
Flight Controls



Flight Controls

General

The Citation Sovereign flight controls allow the flight crew to guide the airplane in the longitudinal, vertical and horizontal axes. The primary flight controls are:

- Elevator to control airplane pitch
- Rudder to control airplane yaw
- Aileron to control airplane roll

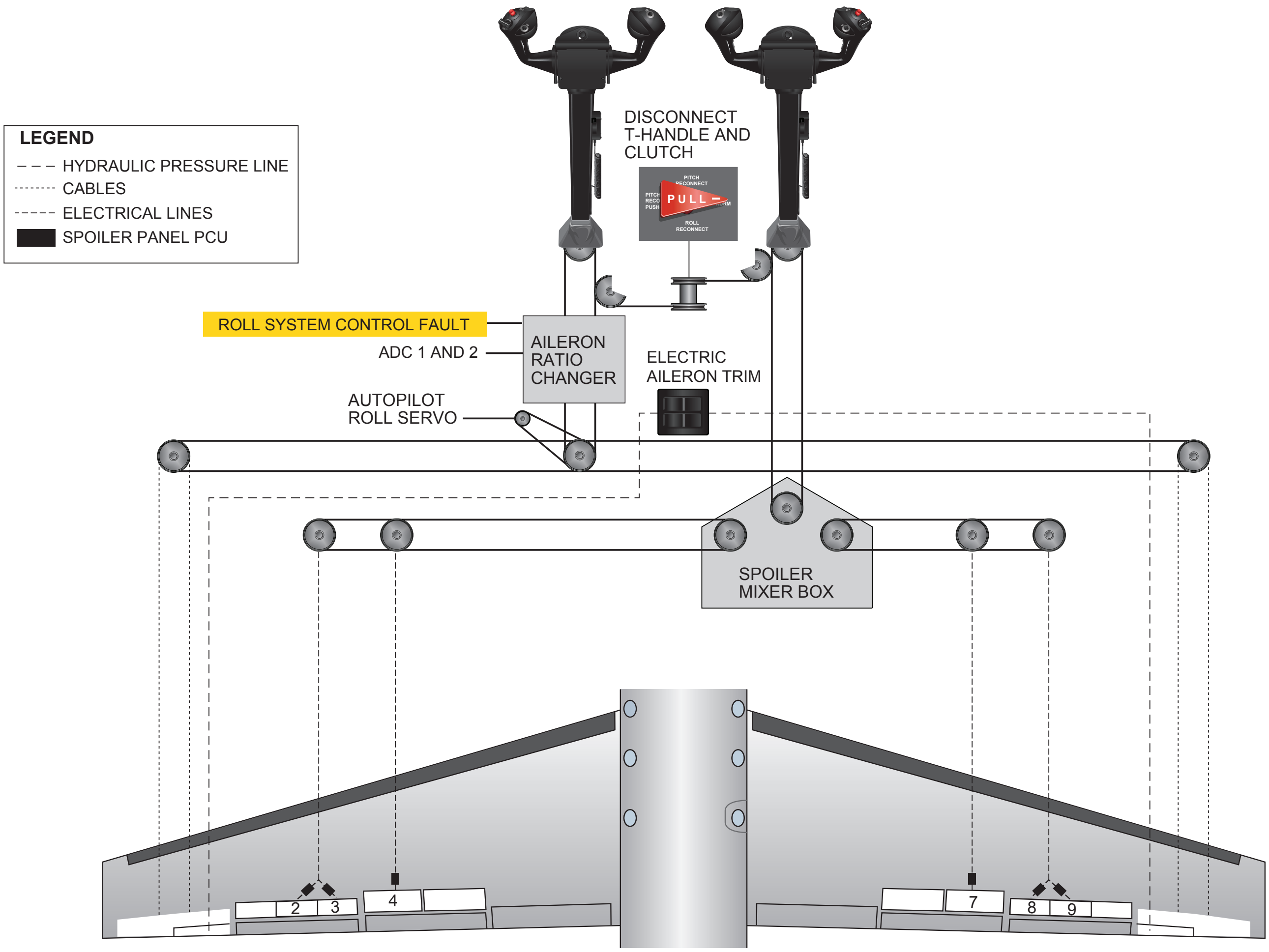
The flight control system is predominantly manual with hydraulically operated speed brakes and roll spoilers. Lateral control of the airplane is provided by the aileron and roll spoiler systems. Six roll spoilers (three on each wing) operate in conjunction with the ailerons to augment their roll control function.

Pitch control is accomplished by two mechanically actuated independent elevators attached to an electrically trimmed horizontal stabilizer. A single manually operated rudder provides yaw control. Additionally, there is a pneumatically driven rudder bias system that assists during single-engine operation.

Normally connected primary flight controls (roll and pitch) can be disconnected and operated independently during an emergency. Trim is available for all three axes via trim tabs on ailerons, rudder, and a moveable horizontal stabilizer. The flaps are electrically powered and are composed of six panels (three per wing) that move simultaneously.

The autopilot is interfaced with the primary flight controls through electric servos to move parallel cable linkages. A complete description of the Digital Automatic Flight Control System (autopilot) is included in the Avionics chapter of this manual. However, for the convenience of the reader, a tabulation of the Crew Alerting System (CAS) messages associated with the autopilot is included at the end of this chapter.

Roll Control System



ROLL SYSTEM CONNECTED

Ailerons and Roll Spoilers

The airplane is controlled on the lateral axis by a manually operated aileron system augmented by hydraulically actuated roll spoilers. The ailerons and roll spoilers each have an independent control system. The aileron control system is commanded by the pilot's control wheel, while the roll spoilers are commanded by the copilot's control wheel. During normal operation, the systems are connected which allows either control wheel to actuate both roll systems.

Figure 14-1: Aileron

Ailerons

Primary aileron control is available from a conventional control column and control wheel for the pilot. The aileron control system uses mechanical flight control components (i.e. cables, pulleys and associated linkages).

A cable running from the pilot's control wheel to each aileron wing sector provides the output to the aileron control surfaces. An automatic ratio changer is incorporated into the system to vary the aileron surface travel for a given control wheel input. Based on altitude and airspeed information from the air data computers, an electrical actuator varies the gearing ratio between the control wheel and the ailerons automatically. At lower airspeeds (i.e. approach and landing), full control wheel travel results in full aileron deflection. At higher airspeeds and altitudes, the gear ratio is reduced to increase the pilots mechanical advantage and improve roll response. The functions of the ratio changer are designed primarily for pilot control feel purposes, not for autopilot servo operation. A fault in the ratio changer (wrong position for the speed) will result in an amber **ROLL SYSTEM CONTROL FAULT** CAS message being displayed on the EICAS.

Roll Spoilers

The roll spoilers are commanded by the copilot's control wheel and column through a mixer box. A cable system driven by the copilot's control wheel provides command inputs to the hydraulic roll spoiler actuator, resulting in deflection to the appropriate roll spoiler panels. Panels 2, 3, 4 and 7, 8, 9 are modulated to perform the task of assisting the aileron system for lateral control functions. The amount of roll spoiler deflection is directly proportional to the movement of the pilot or copilot's control wheel. Panels 1, 5, 6 and 10 are non-modulated speed brakes.

Figure 14-2: Spoilers

Roll Spoiler Mixer Box

The roll spoiler mixer box uses a system of mechanical linkages and cams to transmit pilot roll input to the control arm of the roll spoiler hydraulic actuator. The cam profiles provide outputs to the spoiler actuators based on a summation of roll and speed brake control inputs. The mixer box commands each spoiler panel deployment (panels 2, 3, 4 and 7, 8, 9).

Aileron Trim

Trim tabs located on each aileron assist with aileron deflection. Air is deflected by the tab, which assists the pilot with control force inputs. Depending on the aircraft serial number, either one or both trim tabs are electrically controlled. The aileron trim system is powered by the emergency buses.

On aircraft prior to SN -0050, a single trim actuator is installed on the left aileron (Configuration AE). A split switch on the aft portion of the center pedestal moves the left trim tab when both halves of the switch are moved simultaneously. Trim tab position is indicated on the top right corner of the EICAS display. The right trim tab can be manually adjusted only by maintenance.

On aircraft SN -0050 and subsequent or aircraft with SB-680-27-02 installed, both the left and right trim tabs are adjusted by electrically powered actuators (Configuration AD). The upper half of the split switch controls the left trim tab actuator, and the lower half controls the right trim tab actuator. The EICAS display indicates the position of the left trim tab unless the RH AILERON TRIM DISPLAY button is pressed and held. Because trim is available from both tabs, the maximum fuel imbalance limitations differ from those of configuration AE. It is important to ensure that both aileron trim tabs are in the green range prior to takeoff. Once airborne, the green band is not displayed and the trim pointer remains white regardless of trim position.

With the autopilot engaged, an aileron servo directly controls the ailerons as commanded by the Digital Automatic Flight Control System (DAFCS). Aileron trim is accomplished only by the crew, not the autopilot servo.

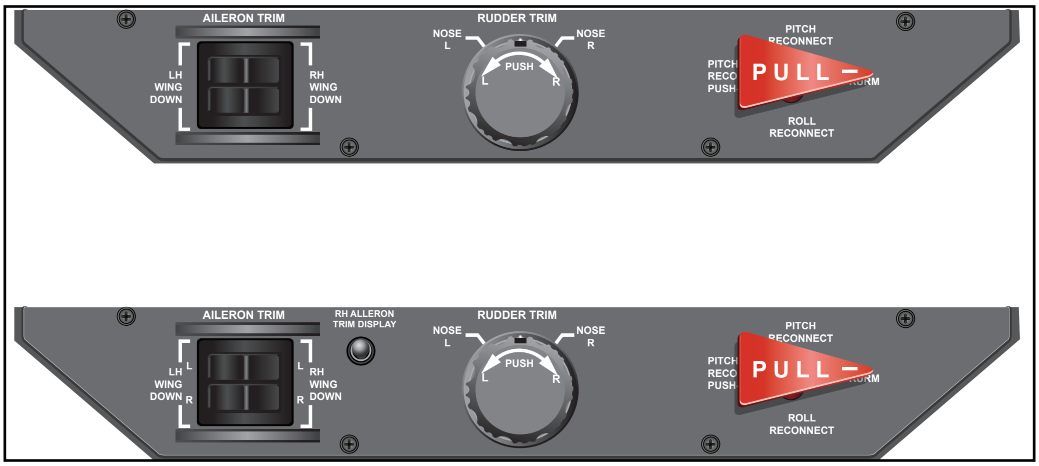
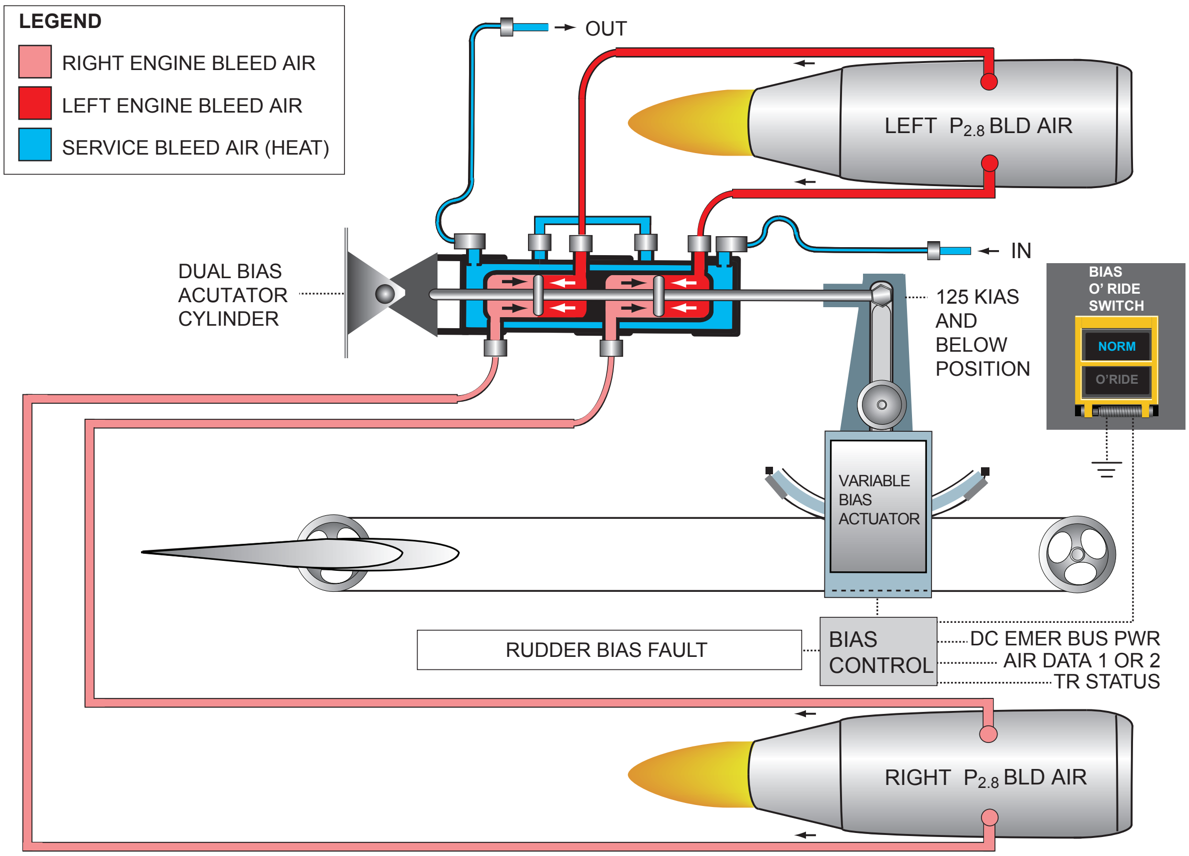


Figure 14-3: Aileron Trim Control Panel

If a malfunction causes one of the ailerons to become inoperative, the mechanical link between the two cockpit control yokes can be separated to allow independent operation of the normally functioning ailerons or roll spoilers. The flight control disconnect handle on the aft portion of the cockpit center pedestal is connected to a pin in the mechanical linkage. Pulling up on the handle retracts the pin mating the two yokes and allows full control of either the operative ailerons (pilot yoke) or the roll spoilers (co-pilot yoke). Rotating the handle counter-clockwise reconnects the elevator controls while allowing the roll controls to remain split.

Rudder Bias System



Rudder System

General

Conventional rudder pedals provide primary yaw control for each pilot. These pedals are mechanically interconnected so the pilot and copilot pedals operate in unison. The rudder system is comprised of conventional cables and pulleys, with the pedals interconnected by torque tubes. The system also incorporates a rudder bias system to assist in asymmetric thrust situations, and a yaw damper system for dutch roll reduction. Trim is accomplished electrically by a rudder trim switch on the aft center pedestal. Rudder stops are installed to limit rudder travel to the maximum trailing edge value.

Takeoff and Landing Limitation

The yaw damper and autopilot must be OFF for takeoff and landing.

Figure 14-4: Rudder

Rudder Bias

The rudder system is equipped with a pneumatically powered rudder bias system. The main function of the variable bias actuator is to compensate for an asymmetric thrust conditions. The rudder bias system is driven by a dual pneumatic actuator, which is equally supplied by dedicated bias bleed air from both the left and right engines. With both engines producing the same thrust, the bias system has no effect on rudder control.

During asymmetric thrust conditions, the rudder bias system applies a "bias" of the rudder toward the side of the higher thrust engine. Below 125 KIAS, the variable speed actuator arm is fully extended, resulting in full rudder bias deflection. As speed increases to 250 KIAS, the rudder bias arm retracts and rudder deflection decreases. Above 250 KIAS, the rudder bias actuator arm is at its fully retracted (minimum) position.

Figure 14-5: Rudder Bias Override Switch

A rudder bias override control button is located to the left of the throttle quadrant on the center pedestal. In the NORM position, the rudder bias system functions to assist the pilot in an asymmetric thrust condition. Lifting the guard and selecting the button to the O'RIDE position retracts the electric variable bias actuator, providing minimum rudder bias output.

Rudder Trim

The rudder trim system is comprised of an electric trim selector in the cockpit, an electrical trim actuator, mechanical linkages, and the rudder trim tab. The RUDDER TRIM selector knob located on the aft end of the center pedestal actuates the rudder trim electrically. To activate the trim selector, it must be depressed before any trim adjustment can be made.

Figure 14-6: Rudder Trim Control

Rotation of the trim selector left or right moves the rudder in the respective direction.

Pilot commanded rudder trim tab travel is ±3°. The rudder trim tab is a servo tab where the tab will deflect proportionally to rudder travel, which reduces pilot effort.

The rudder trim actuator is a DC-powered motor. It is similar to the aileron trim actuator, using a Rotary Variable Differential Transducer (RVDT) for position sensing and display on the EICAS.

Yaw Damper

Automatic rudder compensation for airplane yaw produced by dutch roll inherent to swept-wing airplanes is provided by the yaw damper function of the flight guidance system. The yaw damper function is engaged with the YD button located on the flight guidance panel. The yaw damper is normally engaged after takeoff, even if the autopilot is not operating. If the autopilot is engaged, the yaw damper must be engaged, since autopilot rudder commands use the yaw damper circuits to displace the rudder.

The yaw damper function is a redundant dual-channel installation. Yaw damper channels A and B are controlled by the autopilot functions hosted in processor modules in two of the Modular Avionics Units (MAUs). The autopilot processor detects an uncommanded yaw displacement and signals a rudder displacement to counter the airplane yaw. The amount of rudder displacement necessary is a function of airspeed / Mach number.

Since only one yaw damper channel is necessary for rudder control (A or B), the standby channel will automatically assume yaw damper control if the active channel fails.

Pitch System

General

The elevator control system is conventionally operated. Primary control of the system is provided through a series of cable and pulleys connected to the pilot and copilot's control column.

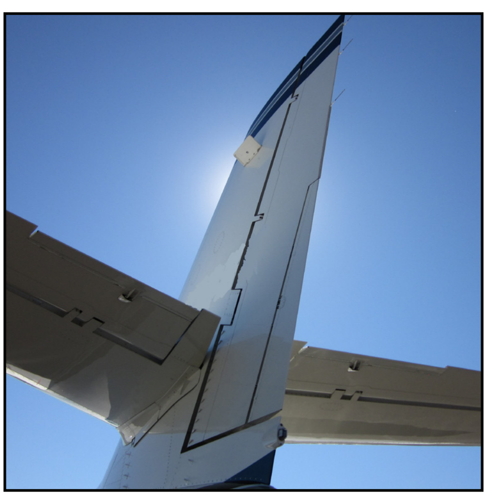
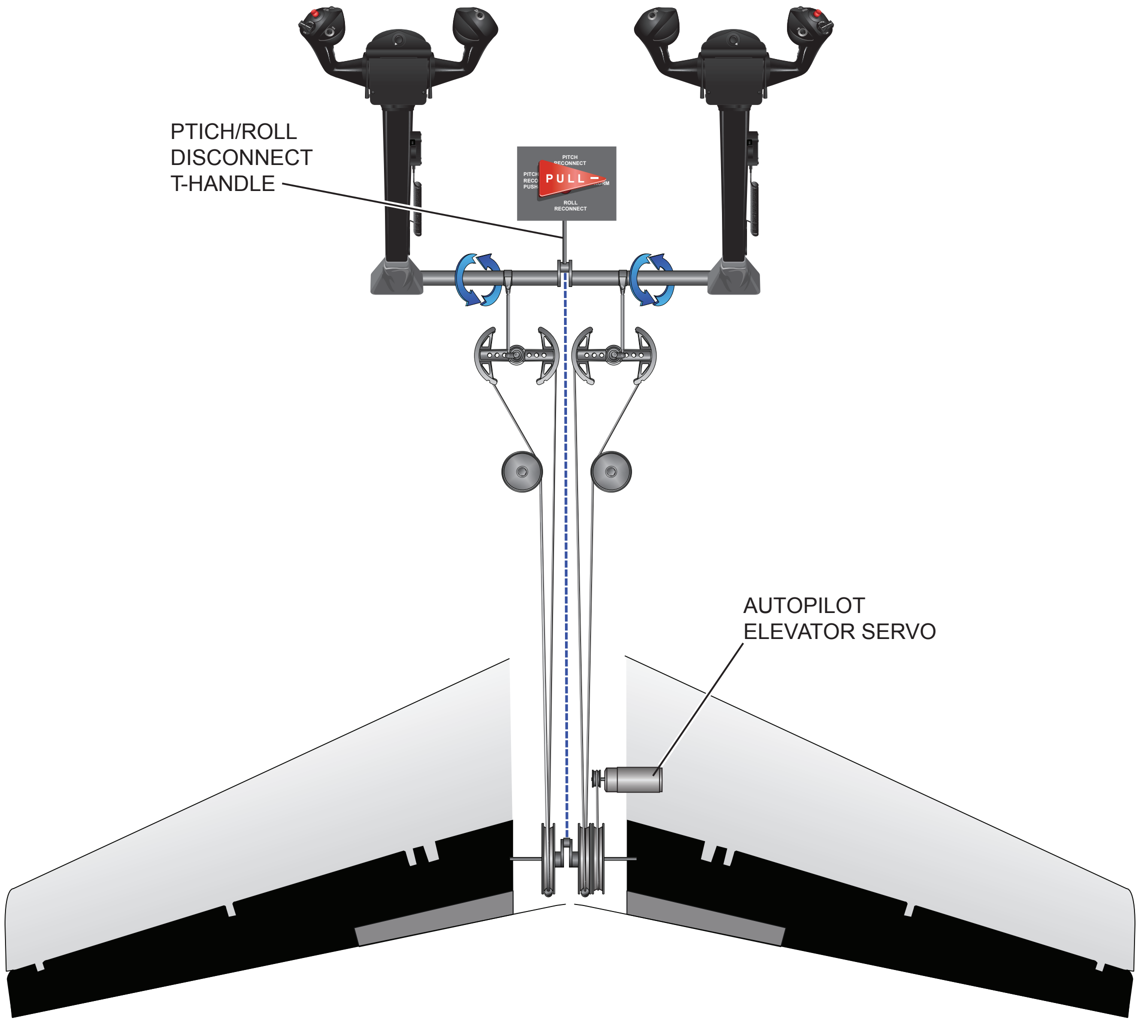


Figure 14-7: Elevators

Figure 14-8: Flight Control Disconnect Handle

Pitch System



Two sets of elevator control cables are installed in the airplane. The left cable system links the pilot's control column to the left elevator surface. The right cable system links the copilot's column to the right elevator surface. The cable system is interconnected by a torque tube that links both cockpit control columns, enabling synchronized pilot or copilot control inputs to manipulate elevator position.

If a malfunction or failure in any portion of the loop between a cockpit yoke and the corresponding elevator prevents control surface movement, the mechanical torque tube connection between the two control yokes can be separated to allow control of the airplane with the free (unjammed) elevator. This is accomplished by pulling the flight control disconnect handle located on the aft portion of the center pedestal. The autopilot is not available in single-elevator operation.

Mach Trim

The Mach trim system is designed to counteract aircraft pitch-down forces at speeds above 0.77 Mach. Mach trim is necessary because at high speed flight the center of lift on the wing transits aft with increases in speed, producing a nose down pitch moment termed Mach tuck. Inputs from the air data system adjust the elevator flow tabs as speed increases. The Mach trim system operates automatically, with or without the autopilot engaged. An amber CAS message **MACH TRIM FAIL** appears on the EICAS when a fault is detected in the system.

Mach Trim Limitation

The Mach trim system must be operational for speeds above Mach 0.77 with the autopilot disengaged.

Horizontal Stabilizer Trim

Longitudinal trim is achieved through a moveable horizontal stabilizer. The horizontal stabilizer trim system is comprised of a primary stab trim actuator, actuator control unit, pilot and copilot control wheel switches, a secondary stabilizer trim actuator, and a secondary trim ON/OFF button. Elevator tabs are linked to the horizontal stabilizer trim system, and adjust with leading edge movement up or down. Horizontal stabilizer movement is obtained electrically through either a primary pitch trim system, secondary pitch trim system or a flap-stabilizer interconnect.

Primary Pitch Trim System

The primary stab trim tab actuator is installed at the base of the vertical fin, forward of the horizontal stabilizer. The horizontal stabilizer pivots at the aft attach-point of the vertical stabilizer.

A takeoff range switch is incorporated into the primary trim actuator. This switch is connected to the NO TAKEOFF warning system to ensure that the horizontal stabilizer is in takeoff position prior to takeoff. Additionally, a red STAB NO TAKEOFF annunciator light is installed in the center of the cockpit panel above the Standby Flight Display (SFD).

During the external preflight inspection, the stabilizer tab linkage must be checked to ensure that it is in the full leading edge down position (-6.9). Markings are provided on the left side of the vertical stabilizer forward of the horizontal stabilizer to indicate proper position. Prior to takeoff, pitch trim is set within the green band on the EICAS display in accordance with takeoff center-of-gravity (CG) limits.

Primary trim is activated by trim switches located on each control yoke. The yoke trim switches are comprised of split halves. Both halves must be moved in the same direction to move the stabilizer trim. The split switch design helps to prevent accidental trim input.

Figure 14-9: Horizontal Stabilizer

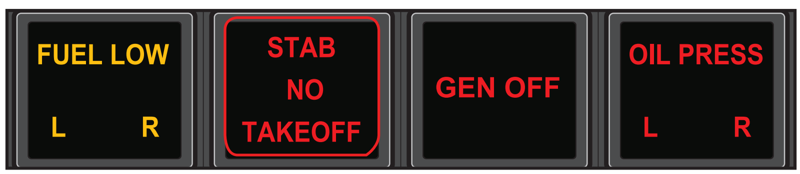


Figure 14-10: STAB NO TAKEOFF Annunciator

Secondary Pitch Trim System

A secondary pitch trim system is installed for use if primary trim is inoperative. The secondary trim actuator receives power from the airplane's DC emergency bus. A guarded cover button located on the center pedestal allows for the secondary trim system to be activated. Pitch trim changes for the secondary trim system are available using the NOSE UP/NOSE DOWN trim control next to the secondary trim power button. With the secondary pitch trim in the ON position, the primary trim actuator becomes disengaged. Activation of the secondary trim also removes power from the control wheel pitch adjustment switches and disengages the autopilot. Autopilot commanded trim is not available while operating the secondary trim. EICAS indications remain available during secondary trim operation.

Figure 14-11: Primary Trim Switch

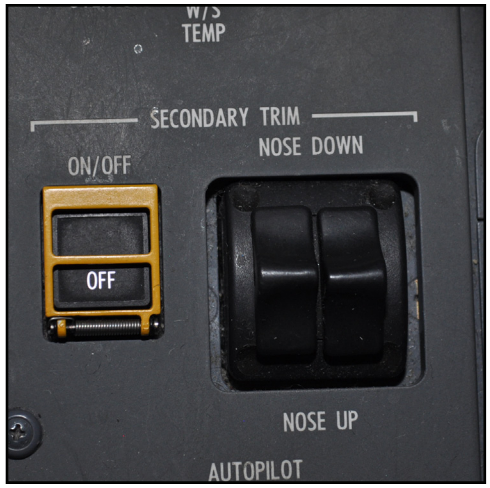


Figure 14-12: Secondary Trim Switch

Trim Clacker

An audio clacker signal will be heard over the cockpit headsets and speakers under three sets of circumstances.

The clacker will be heard when:

- Trim is commanded by the autopilot for more than 1 second.
- Secondary trim is commanded for more than 1 second.
- Uncommanded trim actuator movement is detected for more than 1 second.

The clacker will not be heard when trim is commanded from the split control wheel switches.

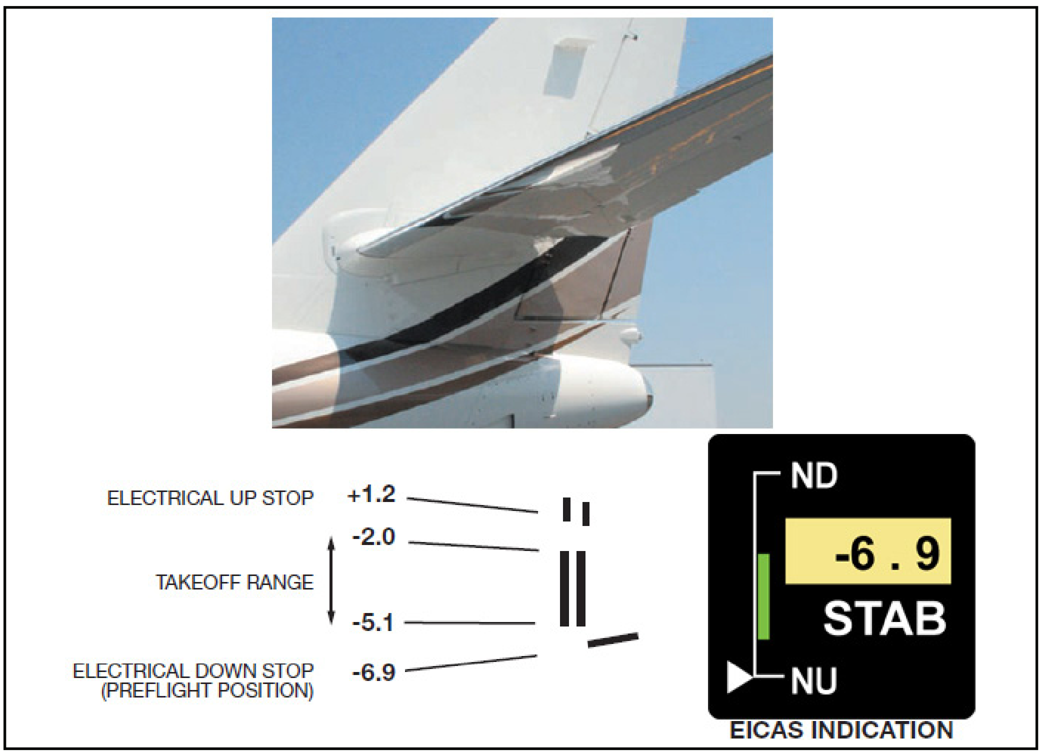


Figure 14-13: Stabilizer Trim

Stall Warning System

The Stall Warning System (SWS) provides the flight crew with visual indications of deteriorating airspeed and high angles of attack, and a physical warning of an impending stall by activation of an electrically powered stick shaker. The SWS functions are hosted in the autopilot (AFCS) processor modules of the Modular Avionics Units (MAUs). The system uses data inputs from Angle-of-Attack (AOA) sensors, Flap Controller, Attitude and Heading Reference System (AHRS) and Air Data Systems (ADS).

Because an airplane stall is an aerodynamic condition caused by separation of the boundary layer of airflow over the wing at high angles of attack, AOA data is more accurate than airspeed in determining the onset of a stall. Airspeed is closely related to AOA, but is subject to indication and compressibility errors. However, since airspeed is the standard reference used by flight crews to control angle of attack, the airspeed indication displayed on the Primary Flight Display (PFD) provides the best cues to the onset of a stall condition.

Since the display of actual AOA would not be meaningful to the flight crew due to the change in significance of the values with flap setting, the software in the SWS computes a normalized value for AOA. The normalized value uses a format of zero (0) to one (1) with the indication shown to one (1) decimal place, where 0.0 indicates zero lift on the wing and 1.0 indicates the point of maximum wing lift.

Normalized AOA information is displayed on each PFD to the left of the HSI display, and can be selected from the MCDU main menu page under DISP SETUP. The vertical arc is color coded white, amber, and red and provides the following data:

- White - Represents normal operating speeds in the calibrated range of 0.1 (near zero lift) to 0.63. The narrow white box represents optimum landing approach speeds (V_{APP} or V_{REF}).
- Amber - Represents a caution range where the aircraft is approaching a critical AOA (0.63 to 0.85).
- Red - Represents the warning zone (0.85 to 1.0) with 1.0 indicating a full stall condition. With an AOA indication of approximately 0.79 to 0.88, the stick shaker systems activate.

Pitch/Roll Disconnect

A T-handle located at the aft end of the center pedestal allows the flight crew to disconnect or reconnect the ailerons and roll spoilers as well as the elevators. Pulling the handle UP to disconnect will cause the ailerons and roll spoilers to be operated independently. The elevator systems will also be disconnected. The aileron system will be controlled by the pilot and roll spoilers by the copilot. Pitch inputs by the pilot or copilot will operate independent of each other. The pilot will control the left elevator and copilot will control the right elevator.

Figure 14-14: Pitch/Roll Disconnect T-Handle

Rotating the T-handle 90° clockwise from the NORM position to ROLL RECONNECT will reconnect the roll spoilers and ailerons. Moving the handle 90° counterclockwise from NORM to PITCH RECONNECT will cause the elevator to re-engage.

To reset the system, rotate the T-handle 180° in either direction to the PITCH/ROLL RECONNECT PUSH-RESET position. Push the handle down and rotate to NORM to rearm the pitch/roll disconnect mechanisms.

An inadvertent reconnection of a jammed control can be remedied by rotating the handle to the PITCH/ROLL RECONNECT PUSH-RESET position, pushing the handle down and rotating the handle to the NORM position. Pulling the handle up then disconnects all controls and the unjammed controls can be reconnected.

Flaps

Flap Limitations

Maximum flap speeds:

Flaps 7° - 250 KIAS
Flaps 15° - 200 KIAS
Flaps 35° - 175 KIAS

A three-segment Fowler-type flap is installed on the trailing edge of each wing. Fowler flaps, when extended, move aft and down from the wing trailing edge, increasing wing area to generate additional lift for low speed flight. Fowler flaps have a cross-section similar to wing airfoils, and by deploying aft of the wing trailing edge, open up a gap between the wing and flap allowing additional airflow over the flap.

The flaps are mechanically controlled and driven by a single DC electric Power Drive Unit (PDU). Three flap panels are installed on the trailing edge of each wing. A common torque shaft system from the PDU drives pairs of mechanical actuators on all flap panels. A flap handle located on the center pedestal is used to select flap position. Monitoring of the flap system is performed electronically, and is displayed on the Engine Indicating and Crew Alerting System (EICAS) display.

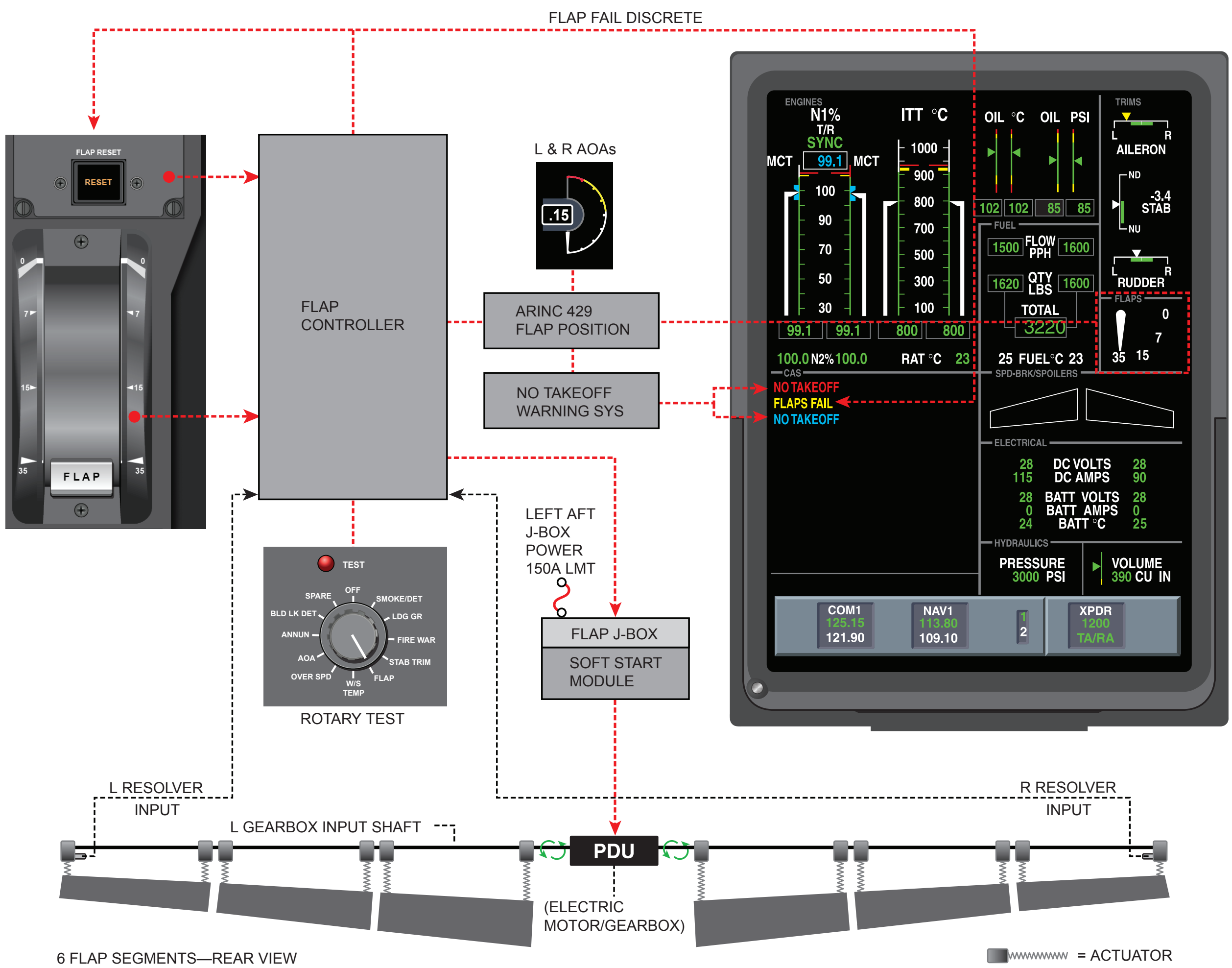


Figure 14-15: Flap System

Figure 14-17: Flaps

Figure 14-16: Flap Control Lever

The flap control lever, located on the center pedestal, provides a method of extension and retraction of the flaps. Four flap detent positions are marked on the left and right side of the control handle. The positions are 0°, 7°, 15°, and 35°. Flap position is electronically monitored and displayed in the FLAPS portion of the EICAS display. Flaps may only be set in the slotted positions on the flap handle.

Flap Limitation

Maximum altitude for flying with the flaps extended is 18,000 feet MSL.

In the event of a flap malfunction, the flap controller will automatically stop flap movement.

If the flap controller senses a fault (such as a flap asymmetry malfunction, flaps not moving as commanded, or handle not set in a detent) and disables the flaps, an amber **FLAPS FAIL** CAS message will appear on the EICAS. If this occurs, a FLAP RESET button on the center pedestal can be pressed to attempt resetting the controller. If the condition has not cleared, the amber **FLAPS FAIL** message will reappear on the EICAS.

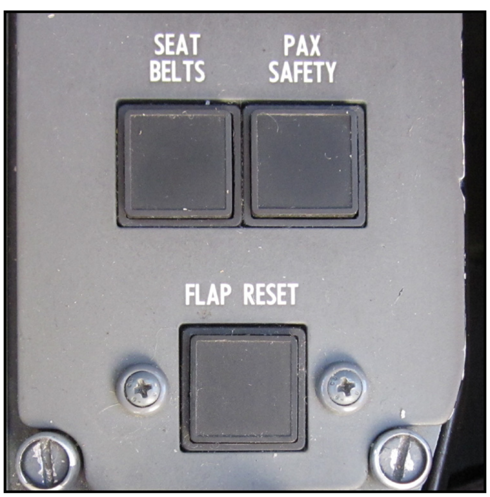


Figure 14-18: Flap Reset Button

A flap/stabilizer interconnect trims the horizontal stabilizer through the primary trim system when the flaps are in motion between 15° and 35°, to aid the pitch change created by the flap movement. This occurs either with or without the autopilot engaged.

Gust Lock

The flight controls gust lock secures the airplane moveable surfaces in stabilized positions to prevent damage to the surfaces and attached control linkages from high winds or jet blast. A gust lock T-handle located underneath the pilot tilt panel is connected through a system of cables, pulleys and rods to hooks or latches that engage the mechanical linkages of flight controls to prevent movement. The control surfaces are locked in positions that offer the best protection to the airplane.

Figure 14-19: Gust Lock T-Handle

To engage the lock, neutralize the controls and pull the handle. To release, turn the handle 90° clockwise and push in.

The throttles can be used for start and taxi with the lock engaged. Throttles are limited to travel approximately midway between the IDLE and CRU detents.

If the gust lock is selected ON, a cyan message GUST LOCK ON will appear on the EICAS. This message contributes to the NO TAKEOFF warning system.

NOTE: The gust lock is effective in preventing flight control movement during wind speeds up to sixty knots (60 kts). If weather conditions are forecast to include stronger winds, consideration should be given to securing the airplane within a hangar or other suitable shelter.

Speed Brakes

There are two dedicated speed brake panels installed on each wing of the Citation Sovereign, numbered 1, 5, 6, and 10. Three additional panels on each wing serve a dual role of roll spoilers and speed brakes. The speed brake system is hydraulically actuated through the use of Power Control Units (PCUs) combined with a mixer assembly that combines inputs from the copilot's wheel and the speed brake lever located on the center pedestal in the cockpit.

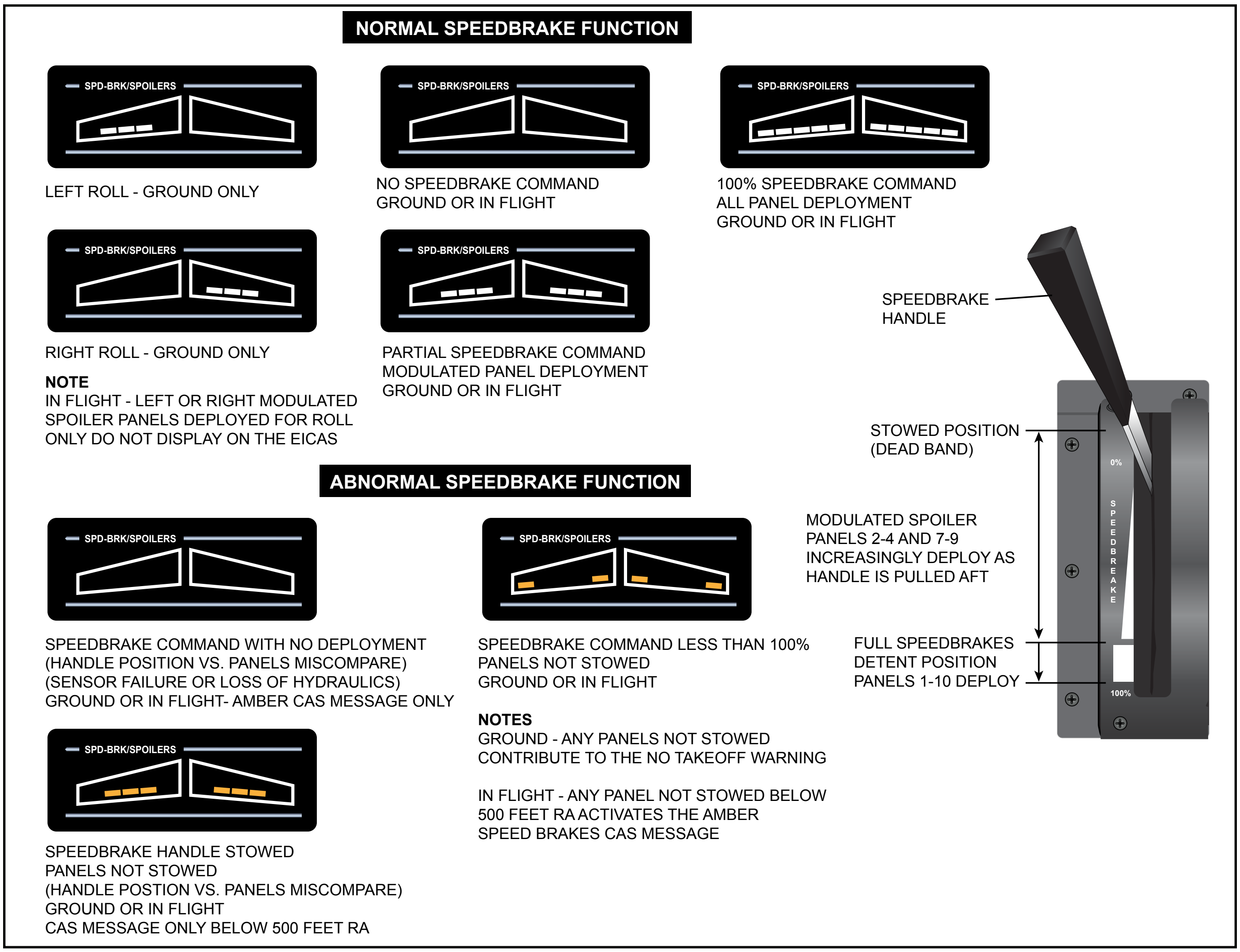


Figure 14-20: Speedbrake EICAS Display

Figure 14-21: Speedbrake Handle

The speed brake control lever moves aft to deploy the speed brakes and forward to stow. As the lever is moved aft from 0% towards the detent, the spoiler panels (2,3,4,7,8 and 9) are progressively deployed in relation to handle position. Moving the handle farther aft past the detent to the 100% position will additionally deploy the dedicated speedbrake panels (1,5, 6 and 10).

Speed Brakes Limitation

Except where otherwise specified by AFM procedures, speed brakes must be stowed prior to 500 feet AGL for landing.

Deployment of the speed brakes is displayed on the EICAS display as white bars corresponding to the ten separate speed brake panels. On the ground the modulated panel will show deployment for speed brake system response, as well as roll system response. In the air, with no weight on wheels, the modulated panels indicated will only show speed brake system response. The non-modulated panels will show an EICAS indication if the airplane is on the ground or in the air.

Preflight and Procedures

Preflight

During the exterior inspection, check the position of the flaps. Check the condition of aileron/flaps/spoilers/trailing edge on the left and right wings. Check for free rotation of the Angle-of-Attack (AOA) probe. Check the condition and position of the elevators and tabs, and ensure that there is full deflection of tabs and that the trailing edge is down. Check the condition of rudder and tab. Check the condition of the horizontal stabilizer and ensure that the position of the leading edge is full down on the left side.

During the pre-flight cockpit preparation, ensure the following:

1. FLAP rotary test position shows correct indications, testing the flap controller and its fault monitoring system.
2. SECONDARY TRIM button is OFF.
3. RUDDER BIAS button is NORM.
4. PITCH/ROLL DISCONNECT handle is NORM/DOWN.
5. FLAP handle is set to 7° or 15°. Check the FLAP handle indication.
6. Stabilizer and speed brakes indication is checked.
7. Stabilizer position is set to -6.9° for the exterior preflight inspection.
8. Stabilizer trim is tested. Check the SECONDARY TRIM switch position and ensure it is OFF. Check the primary trim and ensure that it is set for takeoff.

> ***NOTE:*** The trim clacker will sound if the secondary trim is activated for more than one second.

9. Aileron and rudder trim is checked and set for takeoff. For airplanes with Configuration AD, ensure that both aileron trim tabs are centered.

When checking the flight controls prior to taxi, press and hold the AP/TRIM/NWS DISC button to prevent "scrubbing" the nose wheel while moving the rudder pedals. All flight control surfaces (including speed brakes) are checked for full range and freedom of movement.

The rudder bias system is checked during taxi. Verify that each rudder pedal moves forward as the respective throttle is advanced to approximately 50% N_1.

Abnormal Procedures

The following is a discussion of abnormal procedures pertaining to the flight control systems. For list of specific procedural steps, please refer to the CAE SimuFlite Operating Handbook.

Aileron Trim Inoperative

If the aileron trim is inoperative and not centered, an amber **RETRIM L** and/or **R WING DOWN** message may be displayed with the autopilot engaged. The autopilot will continue to function normally with this message displayed, When the autopilot is disconnected, expect some lateral control force. Press the AP/TRIM/MWS DISC button and apply opposite roll input as required. Trim the rudder as required for ½ sideslip indicator deflection to reduce roll control forces. Consider creating a fuel imbalance of up to 400 pounds to assist roll control. Land as soon as practical.

Rudder Trim Inoperative

If the rudder trim is inoperative and not centered, an amber **RETRIM L** and/or **R WING DOWN** message may be displayed with the autopilot engaged. The autopilot will function normally with this message displayed. Expect some lateral control force when the autopilot is disconnected. Push the AP/TRIM/NWS DISC button, and apply opposing rudder control input as required. Use opposing aileron and aileron trim as required. If time permits, consider creating a fuel imbalance up to 400 pounds to assist in reducing roll control forces. Land as soon as practical.

Uncommanded Rudder Movement

A large movement in the rudder pedals and no out-of-trim indications on the EICAS indicates a rudder bias bleed line failure. Apply opposite control input with the rudder, and select the RUDDER BIAS button to O'RIDE. This drives the variable bias actuator arm to the minimum position. If operating single-engine, rudder pedal force required will increase significantly. Use rudder trim as necessary to keep the slip/skid indicator centered, and land as soon as practical.

Jammed Rudder

If the rudder is jammed and is not centered, apply opposing aileron control input and trim as required. Consider creating up to a 400-pound fuel imbalance to assist in reducing roll control forces. It is recommended that the copilot fly the approach and landing so that the pilot can use the nosewheel steering tiller for directional control on landing rollout as required. If possible, land with a crosswind opposite the rudder jam (i.e., rudder jammed right, land with a crosswind from the left). Avoid landing with a crosswind component in excess of 10 knots.

Jammed Stabilizer Trim System

If the stabilizer is jammed at +1.2° to -1.9° (typical high speed cruise):

In this situation, aft pressure on the control yoke will be required to maintain control of the aircraft. Maintain an airspeed that allows trimmed flight for as long as possible. If time permits, shift passengers to the aft most seats. Land as soon as practical, using flaps 15° for landing. During the approach, maintain 150 KIAS minimum until landing is assured. Additionally, the speedbrakes can be used to reduce control forces as airspeed is decreased for approach and landing.

If the stabilizer is jammed at -2.0° to -5.0° (typical low speed cruise/approach configuration):

In this situation, forward pressure on the control yoke will be required to maintain control of the aircraft. Maintain an airspeed of 140 KIAS maximum. Land as soon as practical, using flaps 15° for landing.

If the stabilizer is jammed at -5.1° to -6.9° (typical landing configuration):

In this situation, excessive forward pressure on the control yoke will be required to maintain control of the aircraft. Do NOT extend the speedbrakes in flight or for landing. Land as soon as practical.

WARNING
An abrupt release of the control column force may cause the aircraft to abruptly pitch up and stall.

Speedbrakes Deploy Asymmetrically

If speedbrakes deploy asymmetrically when selected, adjust the SPEEDBRAKE handle to achieve zero roll. If the speedbrakes are still not retracted, land as soon as practical. Refer to the checklist procedure, Speedbrakes Fail To Retract.

Speedbrakes Fail to Retract

If the speedbrakes fail to retract, ensure that the speedbrake handle is at 0% (or adjusted to achieve zero roll if asymmetrical condition exists). Plan on a flaps 15° landing, and land as soon as possible. If enroute, consider effect on range.

NOTE: The amber **SPEED BRAKES** CAS message and the MASTER CAUTION will illuminate at 500 ft. AGL with speed brakes not retracted.

Landing with Failed Primary Flight Control

A failed flight control is defined as a flight control surface that does not respond to control input. The most probable cause would be a severed flight control cable. This condition typically results in the control surface trailing to the neutral position.

If the rudder will not respond to control input, trim for coordinated flight. Land as soon as practical. Consideration should be given to landing on a runway that is not less than 150 feet wide. Avoid the use of thrust reversers during landing rollout. Use of differential braking and/or the nosewheel steering tiller may be required for directional control upon landing. Maximum crosswind limit is 10 knots.

If both the ailerons and roll spoilers fail, use the rudder for directional and lateral control. Do not use aileron trim except for gross adjustments. Limit bank angles to 15° maximum, and do not engage the yaw damper. Land as soon as practical, using flaps 15° for landing. Minimize crosswinds if able and establish a long, straight-in final. Minimize maneuvering.

If the elevator fails, the stabilizer trim can be used in small increments to augment pitch control. Make small pitch and power changes, and set up the landing configuration early. Land as soon as possible, using flaps 15° for landing.

Emergency Procedures

Jammed Pitch or Roll Control System

With a jammed elevator or aileron, the immediate action required to maintain control of the aircraft is to first actuate the stabilizer trim switch to establish the desired pitch attitude. Relax pressure on the control wheel, then pull the PITCH/ROLL RECONNECT handle up until it is latched. Identify the free control wheel and recover the airplane attitude.

WARNING
STABILIZER TRIM MUST BE USED TO ROTATE TO A TAKEOFF ATTITUDE AND/OR ARREST PITCH RATE IF JAM OCCURS DURING TAKEOFF, LANDING, OR OTHER CRITICAL PHASE OF FLIGHT.

At this point, both the ailerons and elevator will be disconnected. The pilot's control column controls ailerons and left elevator. The copilot's control column controls roll spoilers and right elevator. When the pitch/roll disconnect handle is pulled, the autopilot, if engaged, will automatically disengage and will not re-engage. Do NOT push the disconnect handle down unless rotated to the PITCH/ROLL RECONNECT (9 o'clock) position. Apply force on the rudder pedals as required to produce desired roll response, and trim as required.

If the pitch control is jammed, turn the PITCH/ROLL RECONNECT handle CLOCKWISE to ROLL RECONNECT. Land as soon as possible. If only one elevator is jammed, minimize large elevator inputs and minimize the landing sink rate to less than 600 feet per minute due to reduced elevator authority.

If the roll control is jammed, turn the PITCH/ROLL RECONNECT handle COUNTERCLOCKWISE to PITCH RECONNECT. If the jammed control is not centered, the remaining control authority will be limited in one direction. Use rudder control to assist in producing roll response. If an aileron is jammed, aileron trim may be ineffective. Rudder trim may improve controllability. Keep in mind that roll spoilers have a dead band around neutral. Make small, smooth inputs and return to neutral. Rudder control may also be used to assist in producing roll response. The autopilot will not re-engage. Land as soon as possible, using flaps 15° for landing. If the roll spoilers are jammed, maximum crosswind limit is 10 knots.

Aileron Trim Runaway

If an aileron trim runaway occurs, immediately press and hold the AP/TRIM/NWS DISC button. Pull the aileron trim circuit breaker on the left CB panel, then release the AP/TRIM/NWS DISC button. Land as soon as practical.

Rudder Trim Runaway

A rudder trim runaway is indicated by a small movement in the rudder pedals and an uncommanded movement of the rudder trim indicator on the EICAS display. Press and hold the AP/TRIM/NWS DISC button, and pull the RUDDER TRIM circuit breaker on the right CB panel while holding the button in. Once the circuit breaker is pulled, release the AP/TRIM/NWS DISC button. Land as soon as practical.

Primary Pitch Trim Runaway

If a primary pitch trim runway occurs, immediately push and hold the AP/TRIM/NWS DISC button. Select the SECONDARY TRIM button ON and trim as required. Release the AP/TRIM/NWS DISC button. The primary trim can be completely disabled by pulling the PRI STAB TRIM CONT circuit breaker on the left CB panel. Land as soon as practical, using flaps 15° for landing.

CAUTION
Do not extend the flaps beyond 15° with primary pitch trim failure.

Secondary Pitch Trim Runaway

If a secondary pitch trim runaway occurs, turn OFF the SECONDARY TRIM button and land as soon as practical.

Uncommanded Roll

WARNING
DO NOT PULL THE PITCH/ROLL DISCONNECT HANDLE UNTIL DIRECTED TO DO SO IN THE EMERGENCY PROCEDURE. IF SPEED BRAKES ARE THE SUSPECTED CAUSE OF THE UNCOMMANDED ROLL CONDITION, DO NOT USE SPEED BRAKES FOR THE REMAINDER OF THE FLIGHT.

If an uncommanded roll condition occurs, immediately apply opposite aileron and rudder as required to maintain control of the aircraft. Disconnect the autopilot and trim as required. Decrease airspeed to minimum practical speed in order to reduce control forces. Land as soon as practical.

If the uncommanded roll occurred as the speedbrakes were extended, return the speedbrake handle to 0%. Do not exceed FL410. Land as soon as practical.

If the uncommanded roll occurred as the speedbrakes were being retracted, leave the handle in the previous position and land as soon as practical.

If the uncommanded roll occurred as the flaps were being extended or retracted, return the flap handle to its previous position, and land as soon as practical using partial flaps, if applicable.

If the uncommanded roll is due to a possible roll spoiler extended asymmetrically, visually inspect the wing to determine if this is the case. If a roll spoiler is deployed, the PITCH/ROLL RECONNECT handle can be pulled and then turned counterclockwise to PITCH RECONNECT while the left seat pilot is flying the airplane. Apply and hold opposite input to balance the spoilers, and land as soon as practical using flaps 15°. Do not exceed a crosswind component of 10 knots.

EICAS System Displays

Information pertaining to the flight control and hydraulic systems is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit.

Messages are displayed in cyan, amber or red, according to their urgency. The following are possible messages displayed that pertain to flight control and related systems.

Cyan Message	Description
AP FAIL A and/or B	This message indicates the autopilot has failed. A loss of the guidance panel, aileron servo or elevator servo will also cause the message to be displayed. The AFCS will automatically select the other side if it is available.
GUST LOCK ON	This message indicates that the flight control and throttle gust lock is engaged. This message will trigger the NO TAKEOFF warning system.
NO TAKEOFF	This message is displayed on the ground if any of the no takeoff items are active. This message will turn red when the throttles are advanced.
YD FAIL A and/or B	This message indicates the respective yaw damper system has failed. A loss of the guidance panel or rudder servo will also cause the message to be displayed.
Amber Message	**Description**
AOA HEAT FAIL L and/or R	This message is displayed when the ANTI-ICE PITOT/STATIC buttons are selected ON and current is not detected at the respective AOA probe.
AOA/STALL WARN FAIL L and/or R	This message is displayed when the AOA and/or stick shaker function has failed.
AP STAB TRIM INOP	This message is displayed when autopilot control of the horizontal stabilizer trim is inoperative.
FLAPS FAIL	This message is displayed when the flaps have failed. The amber FLAPS RESET light will also illuminate and the flap position indicator will be amber. Flap position may not match flap handle.
MACH TRIM FAIL	This message is displayed when the Mach trim system has failed.
PITCH/ROLL DISCONNECT	This message is displayed when the PITCH/ROLL RECONNECT handle has been pulled up or stowed incorrectly.
PRIMARY STAB TRIM FAIL	This message is displayed on the ground until a satisfactory preflight check of the primary stabilizer trim system has been accomplished and in flight if the primary stabilizer trim system has failed.
ROLL SYSTEM CONTROL FAULT	This message is displayed when the roll system module detects a fault in the aileron ratio changer.
RETRIM L or R WING DOWN	This message is displayed when the autopilot is detecting a lateral mistrim as indicated by a sustained aileron servo current.
RETRIM NOSE UP or DOWN	This message indicates the autopilot is detecting a longitudinal mistrim as indicated by a sustained elevator servo current.

Amber Message	Description
RUDDER BIAS FAULT	This message is displayed when a failure of the variable rudder bias system is detected.
SECONDARY STAB TRIM FAIL	This message is displayed when secondary trim is commanded and there is no resulting stabilizer position feedback or the resulting stabilizer position feedback is in the wrong direction.
SPEED BRAKES	This message is displayed if a sensor or hydraulic system failure is detected or when the airplane is below 500 ft. radio altitude with speedbrakes deployed and steep approach mode is not selected.
STAB TRIM MONITOR WARNING	This message is displayed when a degradation of the no-back brake in the stabilizer actuator is detected.
Red Message	**Description**
NO TAKEOFF	This message is displayed on the ground only when one or more of the No Takeoff conditions is detected with the engines running and throttles in or past the CRU detent.

15

Fuel System

Contents

EICAS System Displays

Fuel System

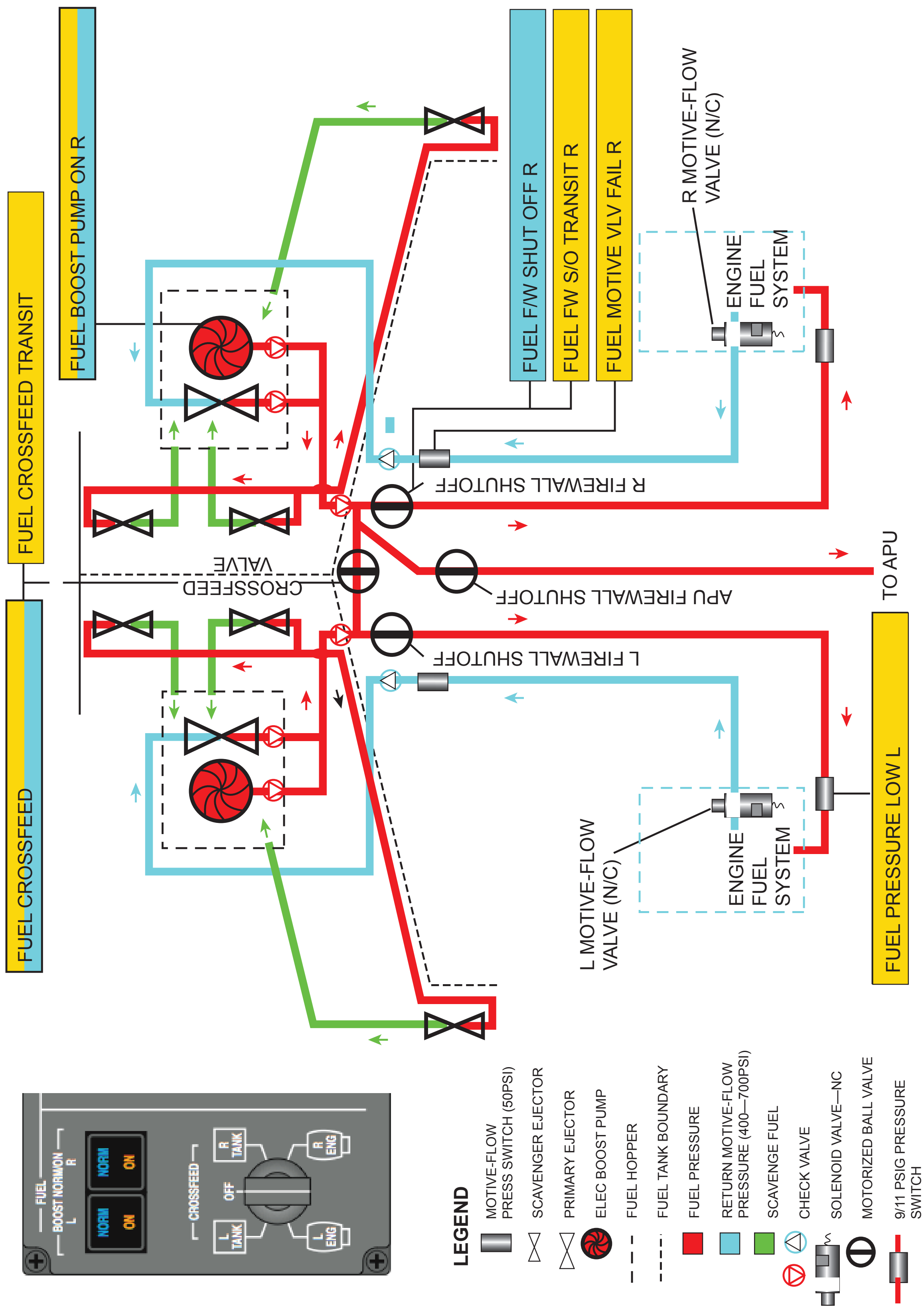
General

The Citation Sovereign fuel system consists of two integral wing fuel tanks, a series of pumps and lines to supply fuel to the engines and APU, and indicators to monitor the airplane fuel state.

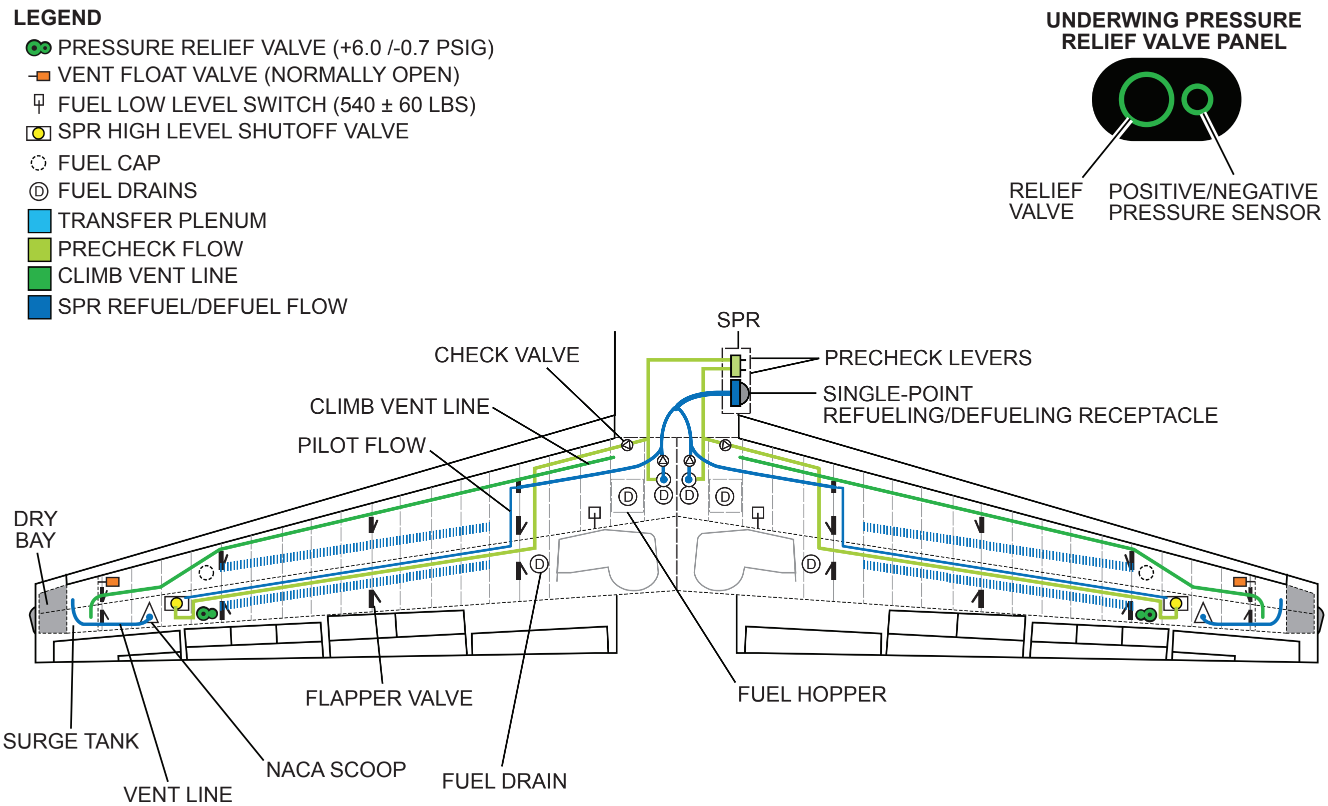
The total usable capacity of fuel tanks is 11,223 pounds, or 837 U.S. gallons per tank at a standard fuel weight of 6.75 pounds per gallon. The international equivalent is 5,091 kilograms or 3,168 liters.

The fuel tanks can be filled from a single-point pressure fueling adapter or through tank fill openings on top of each wing. Fuel is drawn from the tanks and pressurized for distribution to the airplane engines and/or APU by boost pumps mounted near the lowest point of each tank. Sensors mounted within the fuel tanks provide information for cockpit display windows, enabling the flight crew to monitor fuel quantity and fuel tank temperature.

Fuel System


FUEL BOOST PUMP ON R
FUEL CROSSFEED TRANSIT
FUEL CROSSFEED
FUEL F/W SHUT OFF R
FUEL FW S/O TRANSIT R
FUEL MOTIVE VLV FAIL R
R MOTIVE-FLOW VALVE (N/C)
ENGINE FUEL SYSTEM
R FIREWALL SHUTOFF
CROSSFEED VALVE
APU FIREWALL SHUTOFF
TO APU
L FIREWALL SHUTOFF
L MOTIVE-FLOW VALVE (N/C)
ENGINE FUEL SYSTEM
FUEL PRESSURE LOW L
FUEL
BOOST NORM/ON
L
R
NORM
ON
NORM
ON
CROSSFEED
OFF
L TANK
R TANK
L ENG
R ENG
LEGEND
MOTIVE-FLOW PRESS SWITCH (50PSI)
SCAVENGER EJECTOR
PRIMARY EJECTOR
ELEC BOOST PUMP
FUEL HOPPER
FUEL TANK BOUNDARY
FUEL PRESSURE
RETURN MOTIVE-FLOW PRESSURE (400—700PSI)
SCAVENGE FUEL
CHECK VALVE
SOLENOID VALVE—NC
MOTORIZED BALL VALVE
9/11 PSIG PRESSURE SWITCH

Fuel System



LEGEND
PRESSURE RELIEF VALVE (+6.0 /-0.7 PSIG)
VENT FLOAT VALVE (NORMALLY OPEN)
FUEL LOW LEVEL SWITCH (540 ± 60 LBS)
SPR HIGH LEVEL SHUTOFF VALVE
FUEL CAP
FUEL DRAINS
TRANSFER PLENUM
PRECHECK FLOW
CLIMB VENT LINE
SPR REFUEL/DEFUEL FLOW
UNDERWING PRESSURE RELIEF VALVE PANEL
RELIEF VALVE
POSITIVE/NEGATIVE PRESSURE SENSOR
SPR
CHECK VALVE
PRECHECK LEVERS
SINGLE-POINT REFUELING/DEFUELING RECEPTACLE
CLIMB VENT LINE
PILOT FLOW
DRY BAY
FLAPPER VALVE
FUEL HOPPER
SURGE TANK
NACA SCOOP
FUEL DRAIN
VENT LINE

Description

System operation is fully automatic throughout the normal flight profile. Fuel system control and monitoring is available through the FUEL BOOST buttons, CROSSFEED selector, fuel quantity and flow indicators, Flight Management System (FMS) MCDU, and EICAS information that will warn of abnormal system operation. A low fuel level warning system functions independently of the normal fuel quantity indicating system.

Figure 15-1: Fuel Control Panel

Components

Fuel Tanks

The airplane wing fuel tanks are integral to the wing structure. Fuel is contained within most of the interior of the wing, with the tank dimensions defined by the front wing spar, rear wing spar and the upper and lower wing skin. The interior of the wing is coated with a sealant during manufacturing to prevent fuel leakage.

The shape of the wing accommodates the installations necessary for efficient operation of the fuel system. The tank area near the wing root has the largest volume and houses the fuel boost pumps and fuel feed lines. With wing dihedral, fuel within the wing will always flow towards the wing root, ensuring that the fuel boost pump inlets will be adequately supplied until all usable fuel has been consumed. To prevent the outward movement of fuel during flight maneuvers involving turns, wing ribs within the tank that form the contour of the wing are fitted with baffles hinged to open only in the direction of the wing root. A transfer plenum allows fuel to flow between the wing ribs during refueling operations.

Engine Feed Hopper

Each wing tank has a internal compartment at the wing root, termed a hopper, at the lowest point of the tank. The integral engine feed hopper contains a 28 VDC powered electric boost pump and a motive flow operated ejector pump. Fuel from the main wing tanks enters the hoppers through one-way flapper valves and three scavenge ejector pumps. The intake lines supplying the boost pumps are installed along the bottom of the hoppers, ensuring that all possible fuel can be extracted from the tanks.

Electric Boost Pumps

The airplane fuel tanks are equipped with two electrically-driven boost pumps, one in each tank. The boost pumps are located within the tank hoppers to ensure a positive supply of fuel to the pumps. The boost pump intakes are covered with filter screens to prevent the ingestion of foreign objects or particles that could damage the pumps.

The pumps provide fuel pressure for engine starting and fuel crossfeed operations, and activate automatically when a low fuel pressure condition is detected. The pumps receive main DC bus power through circuit breakers located on the cockpit CB panels and the aft J-box.

The pressure produced by the boost pumps is also used to provide fluid flow through three scavenge ejector pumps in each tank. The ejector pumps incorporate a small diameter line from the pressurized boost pump manifold plumbed to extend back into the tanks to a position in front of the intake baffles to the tank hopper. Each ejector directs a stream of high pressure fuel into the mouth of a wider opening plumbed back into the hopper. The velocity of the fuel ejected from the pump induces the flow of a larger volume of fuel into the hopper, thus assisting in the movement of fuel into the boost pump intakes. When the electric boost pumps are not in operation, the scavenge pumps receive pressurized fuel directed into the manifold from a separate primary ejector pump driven by the engine boost pump.

Primary Ejector Pump

The primary ejector pump in each engine feed hopper provides a continuous supply of fuel to the respective engine-driven pump. The ejector pumps are powered by high-pressure motive flow from the engine-driven pumps. Primary ejector pumps have no moving parts and require no electricity.

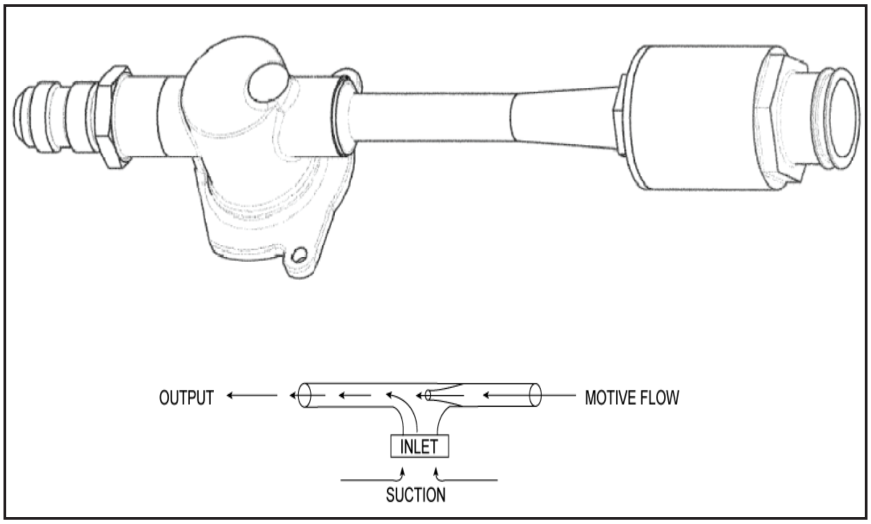


Figure 15-2: Ejector Pump

Flapper Valves

Flapper valves are designed to dampen fuel movement during turns to prevent fuel flow from the wing root to the outboard section of the wing. The valves will allow fuel to freely move inboard through sealed ribs towards the wing root. Flapper valves in each wing are mounted on ribs near the center of the wing, and feed tubes are located in the outboard wing area. Hopper tank flapper valves direct the fuel flow into the hopper sump areas where the electric boost pump and primary ejector fuel pump are located.

Vent System

The left and right wing fuel tanks have separate vent systems that serve to vent the fuel tanks during flight maneuvers and single-point refueling/defueling operations. The fuel vent system contains a vent tube that is installed through the fuel cells from the inboard area of the wing to the wing tip area. A second vent tube is also found in the wing tip area. This tube is connected on one end to the vent scoop and is open to the wing tip fuel cell on the other end. A vent float valve is installed between the last two fuel cells. The vent float valve is open under normal conditions and closed when the fuel is at a level high enough to actuate the float. A positive/negative relief valve is installed in the outer part of the wing to operate as another relief valve to protect the wing if the other parts of the vent system are inoperable, and is added as a safety feature to protect the wing from damage caused by pressure changes in the fuel cells.

Climb Vent Line

A climb vent line is installed to provide fuel tank venting in a steep climb and/ or wing low flight condition. It also provides additional wing tank venting during portions of the refuel/defuel operations. This vent line terminates in a climb vent standpipe near the upper wing skin within the vent surge tank.

Vent Surge Tanks

The surge tank, which functions as a fuel collector, is vented to the atmosphere through a flush, non-icing, NACA scoop. This vent scoop is connected to the vent surge tank with an open-ended standpipe located at a high point of the surge tank to prevent fuel from siphoning or spilling overboard.

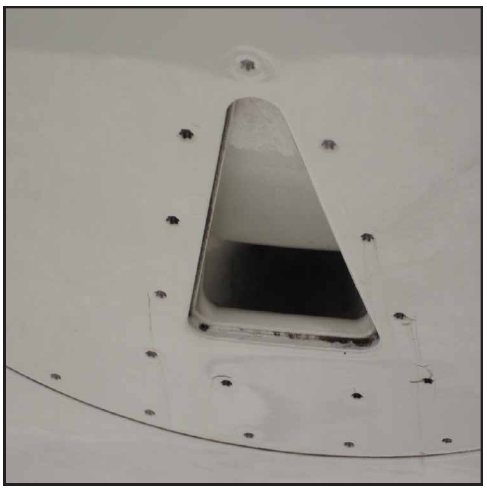


Figure 15-3: NACA Vent Scoop

Relief Valves

Each wing tank incorporates a relief valve, which prevents excessive positive or negative tank pressures during single point refueling or if the normal vent system fails, closes, or is blocked. Pressure relief is set to occur when internal tank pressure reaches +6.0 PSIG or -0.7 PSIG.

Drain Valves

Six wing tank drains (three for each wing) are installed in the lower skin of the wing. Four drains are located in the center of the wing and the remaining two are located at the outside of each wheel well. The drains are operated manually and serve to drain any water that has infiltrated the airplane fuel due to rain seepage or contamination (any water would accumulate at the bottom of the fuel tank since the specific gravity of water is heavier than the specific gravity of petroleum based fuels).

Figure 15-4: Drain Valves

Firewall Shutoff Valves

The left and right ENG FIRE PUSH buttons are located on the glareshield panel. These buttons allow the firewall shutoff valves in the fuel tank area to close when pushed. Selection of either ENG FIRE PUSH button also shuts off fuel at the respective engine's Hydromechanical Fuel Control Unit (HFCU).

Operation

Normal operation of the fuel system allows each engine to receive fuel from its respective wing tank. During engine start, the electric fuel boost pump is automatically turned on to provide engine start fuel until sufficient engine RPM is achieved for the engine driven fuel pump to provide high pressure flow to the primary ejector pump. The electric boost pump will then automatically shut down with the annunciator button in the NORM position.

During APU starting, the right fuel boost pump automatically turns on. If the APU is running independently, the right fuel boost pump will remain on. If the right engine is running and supplying motive flow pressure, the fuel boost pump will automatically shut off after an APU start.

Crossfeed Operation

Either engine can be provided with fuel from the opposite wing tank. To initiate crossfeed operations, position the FUEL CROSSFEED selector, located on the lower left of the cockpit instrument panel, to either the left (L TANK) or right (R TANK) position and verify that the fuel boost pump button located directly above the crossfeed control is illuminated with an amber ON indication. In the L TANK \ R ENG position, both engines receive fuel from the left wing tank. If the fuel CROSSFEED selector knob is turned to the R TANK / L ENG position, fuel is supplied to both engines from the right wing tank.

When fuel crossfeed is selected, the corresponding electric fuel boost pump is energized and the crossfeed valve receives power and opens. 3 seconds later, the motive-flow valve on the engine receiving crossfeed fuel closes.

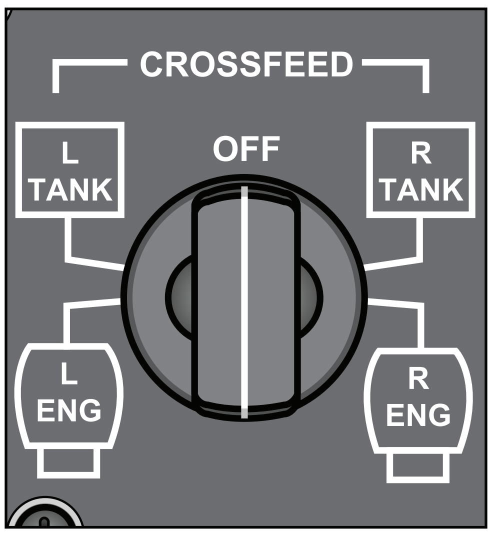


Figure 15-5: Crossfeed Selector

To terminate crossfeed operation, the FUEL CROSSFEED selector is placed in the OFF position. The following sequence of events occurs once the CROSSFEED selector is turned to the OFF position:

- The motive-flow valve opens.
- After three seconds the crossfeed valve closes and the respective electric boost pump is shuts off.

Single-Point Refuel (SPR)/Defuel System

General

The single-point refueling system is used to pressure refuel and defuel the left and right wing tanks from a single refuel/defuel adapter. This adapter is located just forward of the wing fairing on the right hand side of the fuselage. Normal system operation is by fuel level and positive (refuel) or negative (defuel) pressure. A system precheck is incorporated to test the high level automatic shutoff prior to fueling completion. No electrical power is required for the SPR system to operate.

Figure 15-6: Single-Point Refuel and Defuel Panel

Single-Point Refueling

Fuel Limitation

Single-point refueling operations must be accomplished per the procedures contained on the placard installed on the single-point refueling access door. Minimum refueling pressure is 10 PSI and maximum is 55 PSI. The maximum defueling pressure is -10 PSI.

Single-point refueling is accomplished by the connection of refueling equipment to the refuel/defuel adapter and applying positive pressure for refueling. Each wing tank receives fuel through a common manifold to each tank's fuel shutoff valve. Fuel pressure opens the spring-loaded shutoff valves and delivers most of the fuel to the wing tanks, with a small amount bypassed to the high level pilot valve. A float-operated needle valve will seat and close the pilot flow once the fuel level reaches the high level pilot valve; this builds pressure on the backside of the fuel shutoff diaphragm. The resulting force imbalance closes the shutoff valve, and fuel flow is stopped to prevent an over-filling of the respective tank. If one tank has already received a full load of fuel, the remaining tank will continue to receive fuel until it receives a full load of fuel.

The wings can be refueled together or independently. The opening of a precheck valve of the respective wing prevents refueling of a wing. This causes precheck flow to be sent directly to the high-level pilot valve, causing the float operated needle valve to close and shutoff fuel flow to the wing as in a full fuel condition.

CAUTION

Refueling should be accomplished with wings level laterally and nose in normal ground attitude. Refueling with one wing lower than the other may result in a fuel imbalance condition.

Verify main fuel vents are open and unobstructed prior to single point refuel/defuel operations.

Figure 15-7: Precheck Levers Normal

Figure 15-8: Precheck Levers Extended

Single-Point Defueling

Single-point defueling is accomplished using the same refuel/defuel adapter and applying negative fuel pressure to the fuel tanks. Fuel level and the negative pressure from the defueling equipment control defueling. Opening of the respective precheck valve and applying negative pressure through the refuel/defuel adapter accomplish the defueling operation of one or both tanks. A check valve in the precheck line to the high level pilot valve closes, allowing the defuel actuation port of the defueling valve to see negative pressure. This negative pressure releases the float in the defuel valve and unseats the needle valve. When the needle valve is unseated, negative fuel pressure is applied to the backside of the diaphragm which opens the defuel valve poppet and defueling begins. As one wing tank empties first, the float drops, causing that wing's defuel valve to close, but allows the wing tank with fuel remaining to complete the defueling process.

> ***NOTE:*** Prior to defueling the airplane into a fuel truck, ensure that the capacity of the truck will accommodate the amount of fuel to be removed from the airplane.

GROUND AIRCRAFT, GROUND SUPPLY, BOND AIRCRAFT TO SUPPLY DURING FUEL SERVICING.

REFUELING

1) ATTACH AND LOCK NOZZLE.
2) CAUTION: FLOW MUST BE MONITORED DURING PRECHECK OPERATION. IF TOTALIZER DOES NOT SHOW ZERO TO SIX GPM FUEL FLOW WITHIN 30 SEC. OF PRECHECK, CEASE FUELING AND NOTIFY CREW.
3) LIFT LEFT AND RIGHT PRECHECK LEVERS. NOTE: FAILURE TO ACTUATE BOTH LEVERS MAY HINDER FUELING OPERATION.
4) FOLLOWING A SUCCESSFUL PRECHECK, DEPRESS PRECHECK LEVERS FOR TANKS TO BE FUELED.
5) WHEN SELECTED TANKS ARE FULL, FUEL FLOW WILL AUTOMATICALLY CEASE. SHUT DOWN SUPPLY AND REMOVE NOZZLE.
6) REINSTALL CAP. CLOSE AND SECURE DOOR.

DEFUELING

1) ATTACH AND LOCK NOZZLE.
2) LIFT THE PRECHECK LEVER OF THE TANK(S) TO BE DEFUELED TO THE HORIZONTAL POSITION.
3) START FUEL FLOW.
4) WHEN SELECTED TANKS ARE EMPTY, FUEL FLOW WILL AUTOMATICALLY CEASE. SHUT DOWN DEFUEL SOURCE AND REMOVE NOZZLE.
5) REINSTALL CAP. CLOSE AND SECURE DOOR.

USABLE FUEL

OVERWING	SPR REFUEL
LH SIDE: 837 US GAL/3168 LITERS	LH SIDE: 800 US GAL/3028 LITERS
RH SIDE: 837 US GAL/3168 LITERS	RH SIDE: 800 US GAL/3028 LITERS

MAX REFUELING PRESSURE	55 PSIG (345 KPAG)
MIN REFUELING PRESSURE	10 PSIG (–69 KPAG)
MAX DEFUELING PRESSURE	–10 PSIG (–69 KPAG)

NOTE: SEE AIRPLANE FLIGHT MANUAL FOR APPROVED FUELS AND REFUELING PROCEDURE.

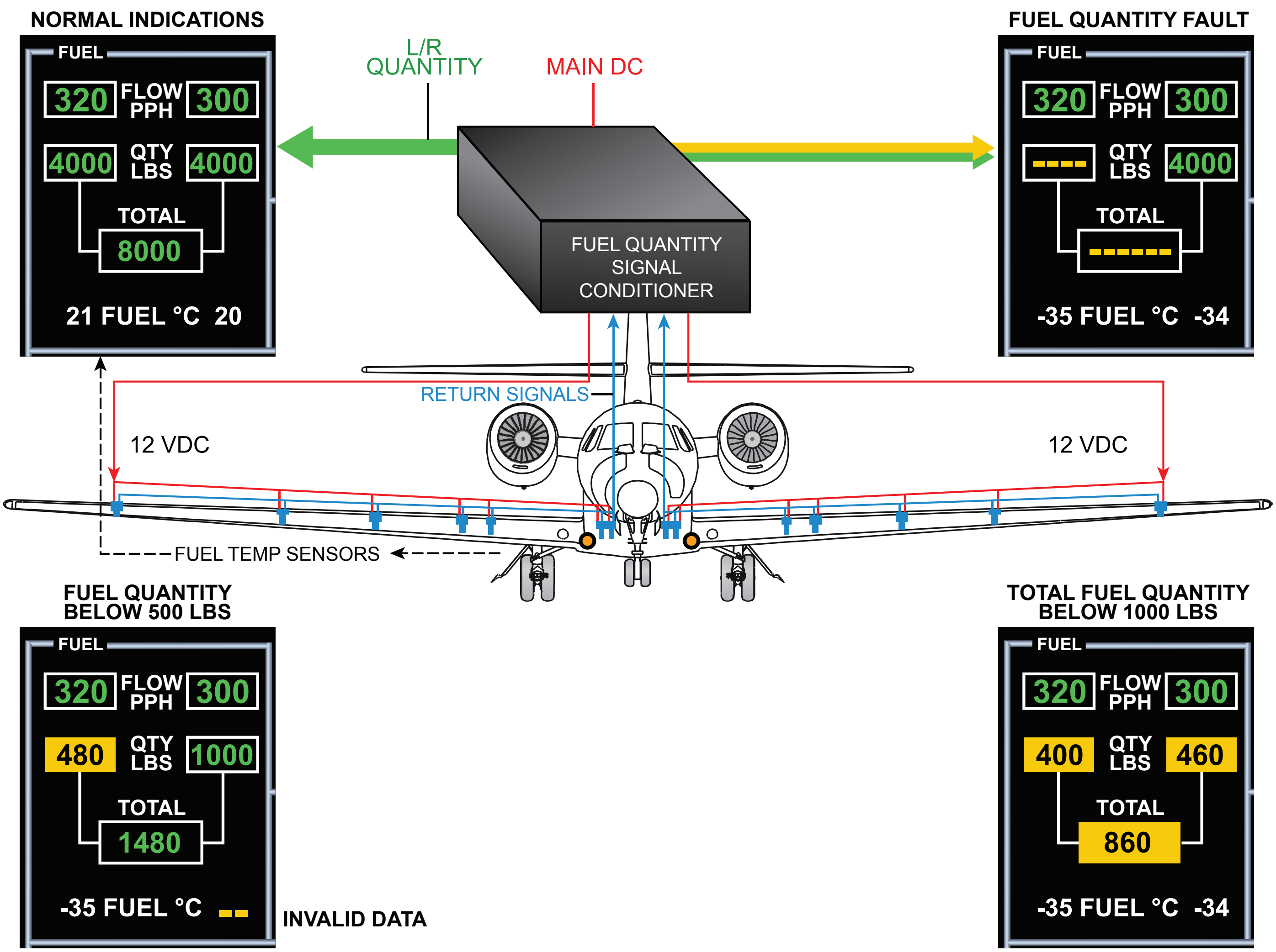
Figure 15-9: SPR Placard

Overwing Fueling

Over-the-wing fueling is accomplished through a standard fuel cap on each wing. The fuel caps incorporate a keyed locking mechanism for security purposes. Over-wing fueling is considered a back-up method to single-point refueling.

Figure 15-10: Over-wing Fuel Cap

Fuel Quantity Measurement System



Fuel Flow Indicators

A fuel flow transmitter in the fuel inlet to the engine measures fuel flow rate. Fuel flow is presented in pounds per hour in the FUEL portion of the EICAS.

Figure 15-11: EICAS Display

Fuel Quantity Indicators

Fuel Limitation

Although the Honeywell Primus EPIC system is capable of displaying fuel quantity in metric units in some installations, configuring the airplane displays to metric fuel and weight units is prohibited.

The Fuel Quantity Measurement System (FQMS) measures the amount of fuel onboard. The quantity is displayed in the FUEL portion on the EICAS display. Fuel quantity information is provided to the EICAS by a compensated capacitance gaging system consisting of 7 probes for each wing tank and a dual channel signal conditioner. Each wing fuel tank has an independent channel for fuel quantity measurement.

Each probe has an integrated electronic module that converts the capacitance of the fuel probe to a current signal. This module regulates a current signal supplied by the Fuel Quantity Signal Conditioner (FQSC). The regulated electrical signal is then returned to the signal conditioner as a function of the wing tank fuel level. When probe #1 in either tank is fully covered with fuel, it will act as a fuel density compensator. When this probe is not fully covered, reversion to a default density value occurs. Individual fuel probes return a modulated current between 0.5mA for a dry probe to 5.0mA for a completely immersed probe. The FQSC processes the output signals from all the probes in the tank to provide a total fuel quantity indication.

The signal conditioner is a microprocessor-based unit with a left and right channel corresponding to the respective wing tank. These channels are electrically isolated but perform identical functions. Each channel of the signal conditioner supplies an ARINC 429 signal to the airplane system for display of fuel quantity on the EICAS. The EICAS will display amber dashes in the digital readout for an invalid fuel quantity value or a probe failure in either tank. The EICAS digits turn from green to inverse amber video if an individual tank is less than 500 pounds, or if the total quantity is less than 1,000 pounds. This condition does not activate a CAS message.

NOTE: Maximum fuel imbalance limitations vary with aircraft serial number, depending upon the aileron trim configuration. Refer to the AFM or Quick Reference chapter of this manual for specific fuel limitations. A lateral fuel imbalance of 800 pounds has been demonstrated for emergency return.

Standby Annunciator

A standby FUEL LOW L and/or R annunciator is located on the center instrument panel. It receives power from the emergency bus and is independent of the main fuel quantity indicating system. A separate fuel float switch just outboard of each hopper will trigger the standby annunciator when the fuel quantity is low.

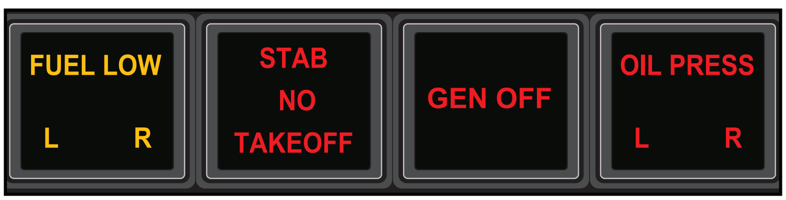


Figure 15-12: Standby Annunciators

Fuel Temperature Indicators

Fuel temperature is measured by temperature sensors in each fuel tank. The temperatures are displayed in white on the EICAS. Because temperature limitations vary depending on altitude and the type of fuel used, fuel tank temperature indications on the EICAS do not monitor for temperatures out of limits. Refer to the AFM or Quick Reference chapter of this manual for maximum and minimum fuel temperature limitations.

FMS Fuel Quantity Indications

Fuel quantity and fuel flow can be displayed on various pages in the FMS MCDU. The FMS fuel management data is advisory information only. It must not be used in lieu of the primary fuel flow indicator display of the aircraft. Fuel on board is displayed at the 2L position on the PERF INIT 5/5 page. The values are displayed in small font if fuel is sensed by the fuel quantity system (gauge value), and large font if a pilot has entered the data. Entering *DELETE* returns the display to the sensed fuel flow if one is available.

The FMS fuel weight is equal to the gauge value when the aircraft is on the ground. This is the case when either no engines or one engine is running. Upon completion of engine start for both engines, the FMS fuel weight is set equal to the gauge value. This value is then decremented by the sensed fuel flow. This method allows for fuel leak detection. The FMS computes fuel weight based upon the sensed fuel flow to the engines. The gauges provide the sensed fuel weight based upon engine usage and leakage (if a leak exists). The FMS displays the scratchpad message **COMPARE FUEL QUANTITY** when the FMS fuel weight differs from the gauge value by more than 2% of the BOW.

This message is inhibited if the fuel quantity has been manually entered on the PERFORMANCE INIT 5/5 page. Entering a manual fuel flow can cause significant differences between the FMS fuel quantity and the actual fuel quantity. For this reason, it is recommended that no entry of fuel be made unless the sensed fuel flow is not available.

Servicing and Procedures

Preflight

During the preflight inspection, check fuel quantity and balance. Take fuel samples from each sump drain. Visually check the samples for signs of contamination or water. Due to fuel's lack of color, water detection is extremely difficult. Dispose of fuel samples properly, do not dump fuel on the ground. Visually check that the fuel filler caps are secure and that all vents are clear of any obstruction.

Always refer to the Aircraft Flight Manual (AFM) for approved fuel grades, specifications and additives.

Refer to Maintenance Manual, Chapter 12, Servicing for specific fueling and defueling procedures and precautions.

To eliminate static discharges and reduce the risk of fire, ground the aircraft and the fuel truck.

Pressure Fueling

Pressure fueling is accomplished through the fueling access door. There is a fuel cap, which must be removed before attaching and locking the nozzle to the adapter. Flow must be monitored during the precheck operation. When both pre-check levers are extended, the fuel totalizer on the truck must stop within 30 seconds or fueling must be stopped.

When both tanks are full, fuel flow will automatically cease. Shut down the supply and remove nozzle. Reinstall fuel cap. Close and secure the fueling door.

CAUTION
When refueling the airplane at locations where the fuel vendor may be unfamiliar with airplane requirements, review the AFM fuel system limitations prior to fueling.

Abnormal Procedures

The following is a discussion of abnormal procedures pertaining to the fuel system. Please refer to the CAE SimuFlite Operating Handbook for a detailed checklist.

Fuel Filter Bypass

The amber CAS message **FUEL FILTER BYPASS L** and/or **R** indicates impending bypass of the fuel filter due to fuel contamination. It is possible that contaminated fuel could have been introduced into both fuel tanks. Monitor opposite engine, restrict crossfeed and consider possible partial or total loss of thrust from both engines. Land as soon as practical and inspect filters after landing.

Low Fuel Level

The amber CAS message **FUEL LEVEL LOW L** and/or **R** indicates that the affected tank fuel quantity is less than 540 (±60) pounds. EICAS fuel quantity digits for each wing tank will turn amber at less than 500 pounds remaining and the total fuel quantity digits will turn amber at less than 1,000 pounds remaining. Select the affected FUEL BOOST button to ON and land as soon as possible.

Low Fuel Pressure

The amber CAS message **FUEL PRESSURE LOW L** and/or **R** is displayed when the fuel pressure supplied to the engine is low. The engine could run irregularly or stop altogether. If the respective FUEL BOOST button is selected to NORM, a below normal fuel pressure condition should automatically turn on the respective fuel boost pump.

The corresponding amber **FUEL BOOST PUMP ON** CAS message should appear along with the respective amber ON light in the FUEL BOOST button. When the fuel boost pump restores fuel pressure, the amber **FUEL PRESS LOW** CAS message should extinguish.

The FUEL BOOST button annunciates amber ON when the fuel boost pump automatically turns on due to low fuel pressure. Pressing the button to the ON position matches the switch to the condition.

If the amber message illuminates, select the FUEL BOOST button on the affected side to ON. If the amber **FUEL BOOST PUMP ON** CAS message does NOT display with the button selected, this indicates that the fuel boost pump is inoperative. If fuel pressure is low and the boost pump has failed, the engine may flame out. Avoid rapid throttle movements and land as soon as practical.

WARNING
Do not reset the FUEL BOOST circuit breakers.
Do not attempt to crossfeed from the tank on the side with low pressure and a failed boost pump.

EICAS System Displays

Information regarding the fuel system is displayed in the message area of the EICAS display unit. Messages are displayed in cyan or amber according to their urgency. The following are possible messages displayed that relate to the fuel system.

Cyan Messages	Description
FUEL BOOST PUMP ON L and/or R	This message is displayed when the fuel pump is on in normal operation (i.e., FUEL BOOST L or R button selected ON by the crew, or automatically comes on during an engine start).
FUEL CROSS FEED	This message is displayed when the fuel cross-feed valve is open and fuel is flowing from the tank with more fuel.
FUEL FW SHUTOFF L and/or R	This message is displayed when the fuel firewall shutoff valve is fully closed.
Amber Messages	**Description**
FUEL BOOST PUMP ON L and/or R	This message, and the respective amber ON light in the FUEL BOOST button, is displayed when the pump is activated by the low pressure switch.
FUEL CROSS FEED	This message is displayed when the crossfeed valve is open and flow is in the wrong direction with an imbalance more than 60 pounds (27 kg).
FUEL CROSS FEED TRANSIT	This message is displayed when the crossfeed valve is neither fully open nor closed.
FUEL FILTER BYPASS L and/or R	This message is displayed when there is an impending bypass of the fuel filter due to fuel contamination.
FUEL FW S/O TRANSIT L and/or R	This message is displayed when the fuel firewall shutoff valve is neither fully open nor closed.
FUEL LEVEL LOW L and/or R	This message is displayed when the affected tank fuel quantity is less than 540 ± 60 pounds. EICAS fuel quantity digits for each wing tank will turn amber at less than 500 pounds remaining and the total fuel quantity digits will turn amber at less than 1,000 pounds remaining.
FUEL MOTIVE VLV FAIL L and/or R	This message is displayed when crossfeed is selected and the opposite side motive flow pressure failed to drop because the respective shutoff valve has failed to close.
FUEL PRESSURE LOW L and/or R	This message is displayed when the fuel pressure supplied to the engine is low.

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16

Hydraulics

Contents

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Hydraulics

General

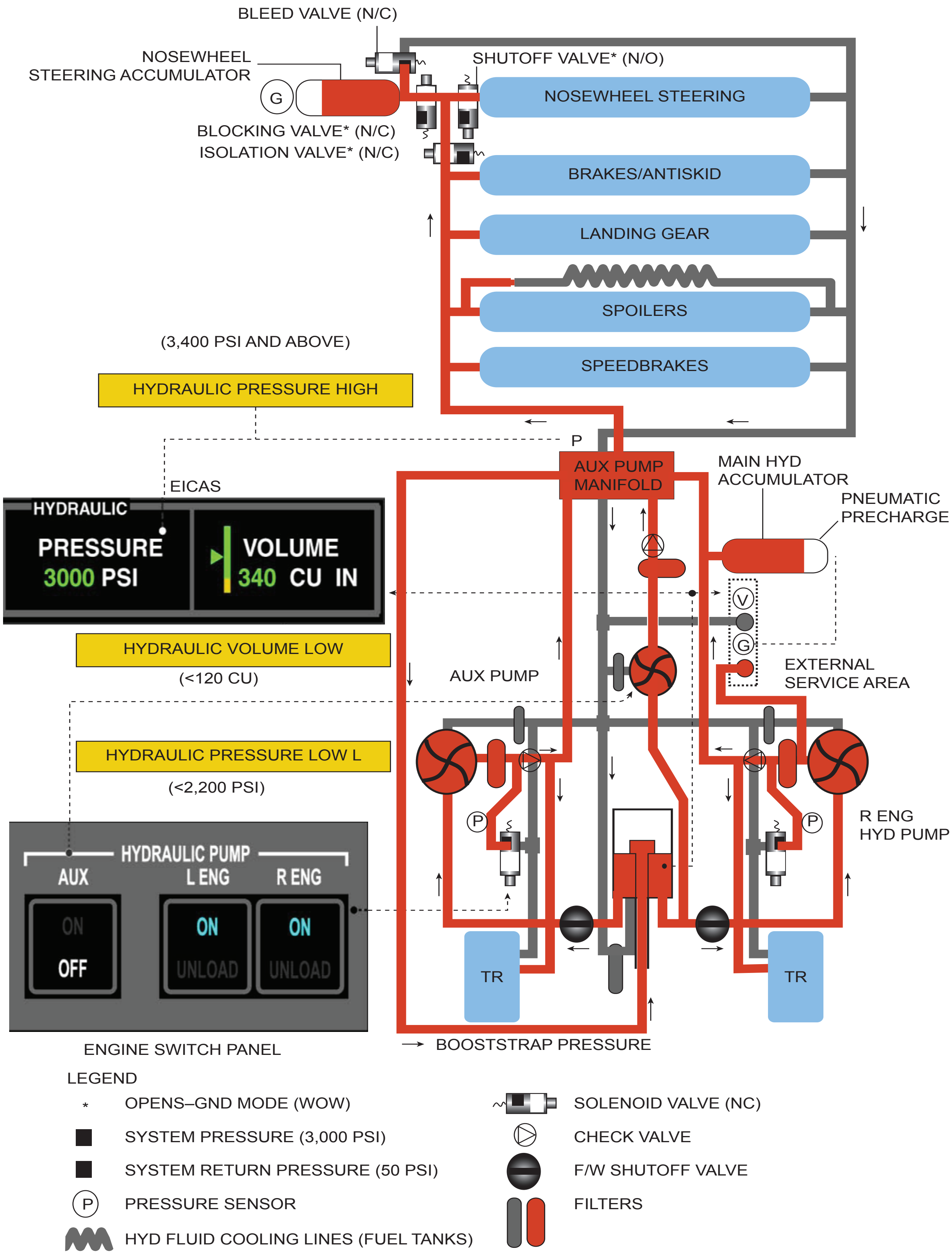
The aircraft's hydraulic system is comprised of a single, closed center system with two variable displacement engine driven pumps. These pumps provide hydraulic power at 3,000 PSI to actuate the following systems:

- Roll Spoilers
- Landing Gear
- Speed Brakes
- Thrust Reversers
- Nosewheel Steering
- Main Wheel Brakes

The system is designed to use MIL-PRF-87257 fire-resistant hydraulic fluid and synthetic rubber O-rings. Hydraulic fluid operating temperature is -40°C (-40°F) to 135°C (275°F). The ambient temperature operating range is from -53.8°C (-65°F) to 54.4°C (130°F).

An electrically powered auxiliary hydraulic pump is installed for ground use only, and is used primarily to set the parking brake when the engines are not running.

Hydraulic System



Reservoir and Ground Service Panel

The hydraulic fluid reservoir is installed in the upper tailcone of the airplane. Maximum capacity of the reservoir is 3.0 U.S. gallons. Normal service volume is 1.5 U.S. gallons of MIL-PRF- 87257 fluid (approximately 340 cubic inches) with a reservoir pressure of approximately 50 PSI. Either engine driven hydraulic pump or the electric auxiliary pump provides pressurization of the reservoir. In the event of overfill or overpressurization, fluid is vented overboard through the reservoir relief valve.

The relief valve is capable of discharging maximum inlet flow to the reservoir while maintaining the maximum allowable pressure. Manual opening of the relief valve may be accomplished by pulling the reservoir bleed valve handle located on the ground service panel in the aft right hand tailcone fairing. This bleed valve handle is generally used only for system maintenance and servicing; it is not for normal crew use.

Servicing of the hydraulic system can be accomplished through the ground service panel located in the right hand aft tailcone fairing. Ground service ports located in the ground service panel on the right aft fuselage connect to the aircraft hydraulic system in the right hand pylon control manifold for the pressure connection, and on the return filter manifold for the fluid return connection.

A hydraulic service unit is connected to these service ports to operate the airplane hydraulic pumps, reservoir, and return filter for ground operation of the system. The hydraulic reservoir can be serviced with the hydraulic service unit ground service connections. On aircraft S/N -0001 through -0050, a reservoir fill handle and manual fill port is incorporated into the service panel.

Figure 16-1: Ground Service Panel

Actuators

The landing gear, spoilers and speed brakes, and thrust reversers are powered by double acting hydraulic actuators. Hydraulic power is supplied or removed from the actuators based on pilot input and limit switches.

Landing Gear Actuators

The landing gear actuators have internal mechanical locks that are engaged as the landing gear reach the fully extended position. The landing gear are mechanically locked in the up position by external locks. A hydraulic actuator/ sequence valve releases these locks. The main landing gear circuit incorporates a regenerative flow path to reduce pump demand during gear extension and to improve the ability of the gear to free-fall to the down and locked position.

Speed Brake Actuators

The speed brake actuators are equipped with an internal mechanical lock that holds the speed brake in the stowed position. This prevents speedbrake panel "float" if hydraulic pressure is lost. Speed brakes are held in the extended position by hydraulic pressure.

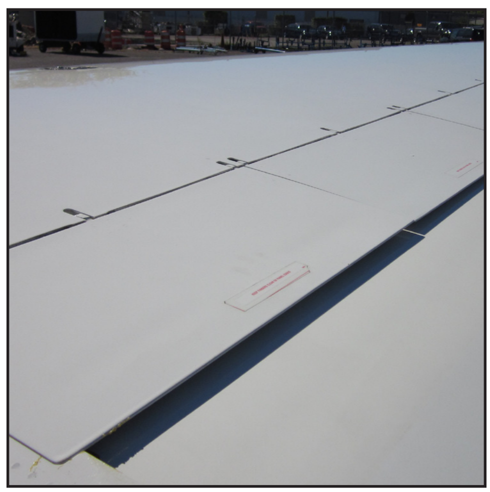


Figure 16-2: Speed Brakes

Nosewheel Steering Actuator

The nosewheel power steering unit is a hydraulically powered rack and pinion unit. During gear retraction, hydraulic pressure to the nose gear actuator is routed through the power steering unit and automatically centers the nosewheel prior to gear retraction.

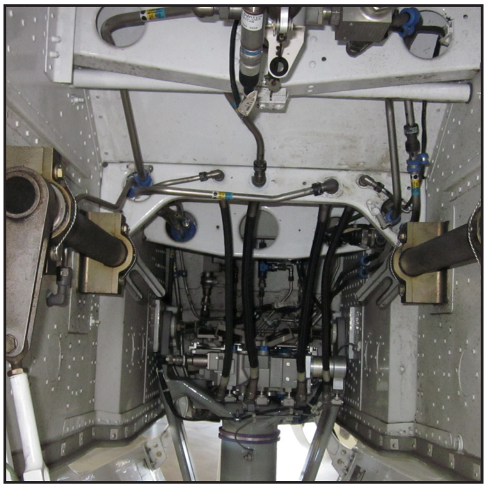


Figure 16-3: Nose Landing Gear Hydraulic Lines

Thrust Reversers

The thrust reversers are mechanically locked in the stowed position. These mechanical locks are hydraulically released for deployment. Hydraulic pressure maintains the reversers in the deployed position until commanded by the flight crew to stow. A complete description of the Thrust Reverser system can be found in the Powerplant chapter of this manual.

Figure 16-4: Thrust Reverser

Pumps

Engine Driven Pumps

Two variable displacement pressure compensated engine driven pumps (one mounted on each engine accessory gearbox) provide primary fluid flow at 3,000 PSI. When the engine and pump begin to turn, suction is generated in the supply line to the pump.

The supply line connects the pump to the hydraulic reservoir located in the tail compartment of the aircraft. The pumps have been sized such that either pump can handle any normally anticipated hydraulic system demand. Both pumps are located in the engine fire zones.

In the event of an engine fire, a means for stopping the hydraulic fluid flow is provided by a motor driven ball firewall shutoff valve located in the inlet line of each pump. The respective hydraulic firewall shutoff valve closes when the LH and/or RH ENG FIRE button is activated. The valves are emergency bus powered.

Auxiliary Hydraulic Pump

The auxiliary hydraulic pump is powered by the main DC electrical system. It is for ground use only, and is used primarily to set the parking brake when the engines are not running.

Accumulators

Two pneumatically charged hydraulic accumulators are incorporated into the hydraulic system. One accumulator is incorporated into the main system and the other is for backup hydraulic power to the nosewheel steering system.

Figure 16-5: Nose Wheel Steering Accumulator

The main system accumulator, located on the right pump output line, assists with the supply of short-term high flow demands and dampens pressure pulsations to the system.

The nosewheel steering accumulator allows for backup hydraulic pressure to power the nosewheel steering in the event of main system pressure loss. It stores sufficient charge for at least two full sweeps (center to full right or left and back) of the nose wheel.

Controls and Indications

Hydraulic pressure is controlled by the crew using buttons on the bottom of the ENGINE panel, labeled HYDRAULIC PUMP. Two buttons labeled ON (cyan) and UNLOAD (amber) control the engine-driven pumps. A third button labeled ON (cyan) and OFF (white) controls operation of the auxiliary hydraulic pump.

Figure 16-6: Hydraulics Panel

Engine Pump Buttons

The L and R ENG buttons on the HYDRAULIC PUMP sub-panel control the position of their respective hydraulic unloading valves. Selecting either button to the UNLOAD position opens the respective engine hydraulic pump pressure via the return lines to the reservoir. During normal operations, the buttons are left in the ON position. There are instances during abnormal or emergency operations that call for one or both buttons to be selected to UNLOAD.

Auxiliary Pump Button

The AUX button on the HYDRAULIC PUMP sub-panel selects the auxiliary hydraulic pump ON. The pump requires main DC power for operation. The AUX button is normally selected ON momentarily prior to engine start, in order to set the parking brake. The aux hydraulic pump is capable of supplying 3,000 PSI of pressure to the system, but at a much slower flow rate than that of the engine-driven hydraulic pumps.

Hydraulics Limitation

Use of the auxiliary hydraulic pump is prohibited in flight.

EICAS Display

The hydraulic area of the EICAS is located on the lower right side of the display. The digits represent total system pressure and hydraulic volume. If either of the values are out of range, the digits turn inverse video amber, and an associated amber CAS message will be displayed. There is no monitoring or display of hydraulic fluid temperature. Reference the EICAS System Displays portion of this chapter for a description of the CAS message indications.

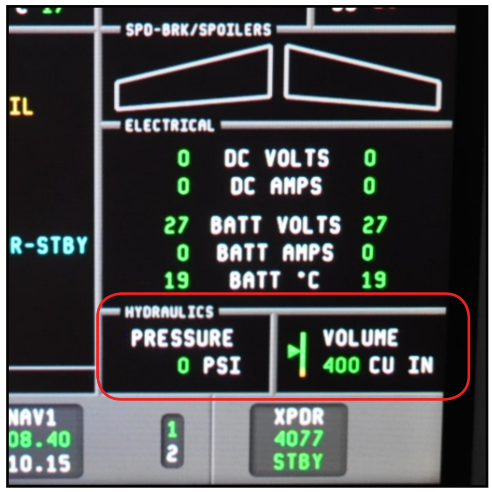


Figure 16-7: Hydraulics Visual Indications

Preflight and Procedures

Servicing

Servicing can only be performed by qualified mechanics because of the equipment, pressures, and type of fluid involved. The only approved hydraulic fluid for hydraulic power systems is MIL-PRF-87257.

Refer to the Aircraft Maintenance Manual, Chapter 12 for correct servicing procedures.

Preflight

During the exterior inspection, check the hydraulic reservoir accumulator pressure as per the placard on the service door. Correct pressure varies with temperature. Secure the hydraulic service door. Ensure there are no visible hydraulic leaks around the aircraft.

> ***NOTE:*** The hydraulic quantity is a digital display on the EICAS. The digits will be green when the volume is 120 to 700 cubic inches. The digits will be amber (thus requiring service) when the volume is less than 120 cubic inches. Quantity can also be read on the hydraulic servicing panel, but DC power must be connected and operating for gauge operation.

During the cockpit preparation, ensure that the HYDRAULIC PUMP AUX button is selected OFF. Ensure that both HYDRAULIC PUMP ENG buttons are selected ON. Use the auxiliary hydraulic pump to set the parking brake if needed.

> ***NOTE:*** Use of the auxiliary hydraulic pump is prohibited when the ground operating temperature is below -40°C (-40°F). Use of the auxiliary hydraulic pump is prohibited in flight.

Abnormal Procedures

The following is a discussion of abnormal procedures for the hydraulic system. Please refer to the CAE SimuFlite Operating Handbook for a detailed checklist.

Hydraulic Pressure High

When the **HYDRAULIC PRESSURE HIGH** amber CAS message is displayed, the hydraulic pressure in the system is greater than or equal to 3,400 PSI. If this occurs, unload the left hydraulic pump by pressing the HYDRAULIC PUMP L ENG button. If the message does not clear, turn the left hydraulic pump ON and unload the right engine pump. If the message still does not clear, land as soon as possible. Due to the fact that each pump has a self-regulating circuit as well as a mechanical relief of the unloading valve at 3,200 PSI, a HYDRAULIC PRESSURE HIGH situation is unlikely to be experienced.

Hydraulic Pressure Low L and/or R

If only one side of the hydraulic system's operating pressure is low, all hydraulically powered systems will continue to operate normally. If the amber **HYDRAULIC PRESSURE LOW L** and/or **R** CAS message illuminates, check that both HYDRAULIC PUMP ENG buttons are ON. If only one message is displayed (L or R), unload the affected side and land as soon as practical.

If both hydraulic pumps have failed (as evidenced by an amber **HYDRAULIC PRESSURE LOW L-R** CAS message), land as soon as practical. Speedbrakes, roll spoilers, thrust reversers, landing gear, nosewheel steering, and brakes will not operate using normal procedures. Be prepared to use alternate or emergency systems. Landing distance will be increased. Refer to the CAE SimuFlite Operating Handbook for complete Before Landing and After Landing abnormal procedures.

Hydraulic Volume Low

A loss of fluid in the hydraulic system (reservoir volume less than 120 cubic inches) is indicated by the amber **HYDRAULIC VOLUME LOW** CAS message. The abnormal procedures associated with this CAS message are similar to those used if both engine-driven hydraulic pumps have failed. Alternate or emergency systems must be used prior to and after landing for hydraulically-powered sub-systems. Landing distance will be increased.

Refer to the CAE SimuFlite Operating Handbook for detailed abnormal procedures.

Engine In-Flight Restart

During attempted in-flight restart of a failed engine, the HYDRAULIC PUMP ENG button on the affected side is selected to UNLOAD. This will assist the engine in obtaining a minimum N_2 rotation speed of 9%, which is required for either a starter-assisted re-start or a windmill start. If the affected engine hydraulic pump is not unloaded, it may not be possible to obtain 9% N_2 on the engine. Once the engine is successfully restarted, the HYDRAULIC PUMP ENG button is returned to its normal ON position.

EICAS System Displays

Cyan Messages	Description
AUX HYDRAULIC PUMP ON	This message indicates that the HYDRAULIC PUMP AUX button has been selected ON.
Amber Messages	**Description**
HYDRAULIC PRESSURE HIGH	This message is displayed when the hydraulic pressure is greater than or equal to 3,400 PSI for longer than 10 seconds.
HYDRAULIC PRESSURE LOW L and/or R	This message is displayed when one or both hydraulic pumps are not operating due to failure or crew selection.
HYDRAULIC VOLUME LOW	This message is displayed when the hydraulic reservoir volume is less than 120 cubic inches.

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17

Ice and Rain Protection

Contents

EICAS System Displays

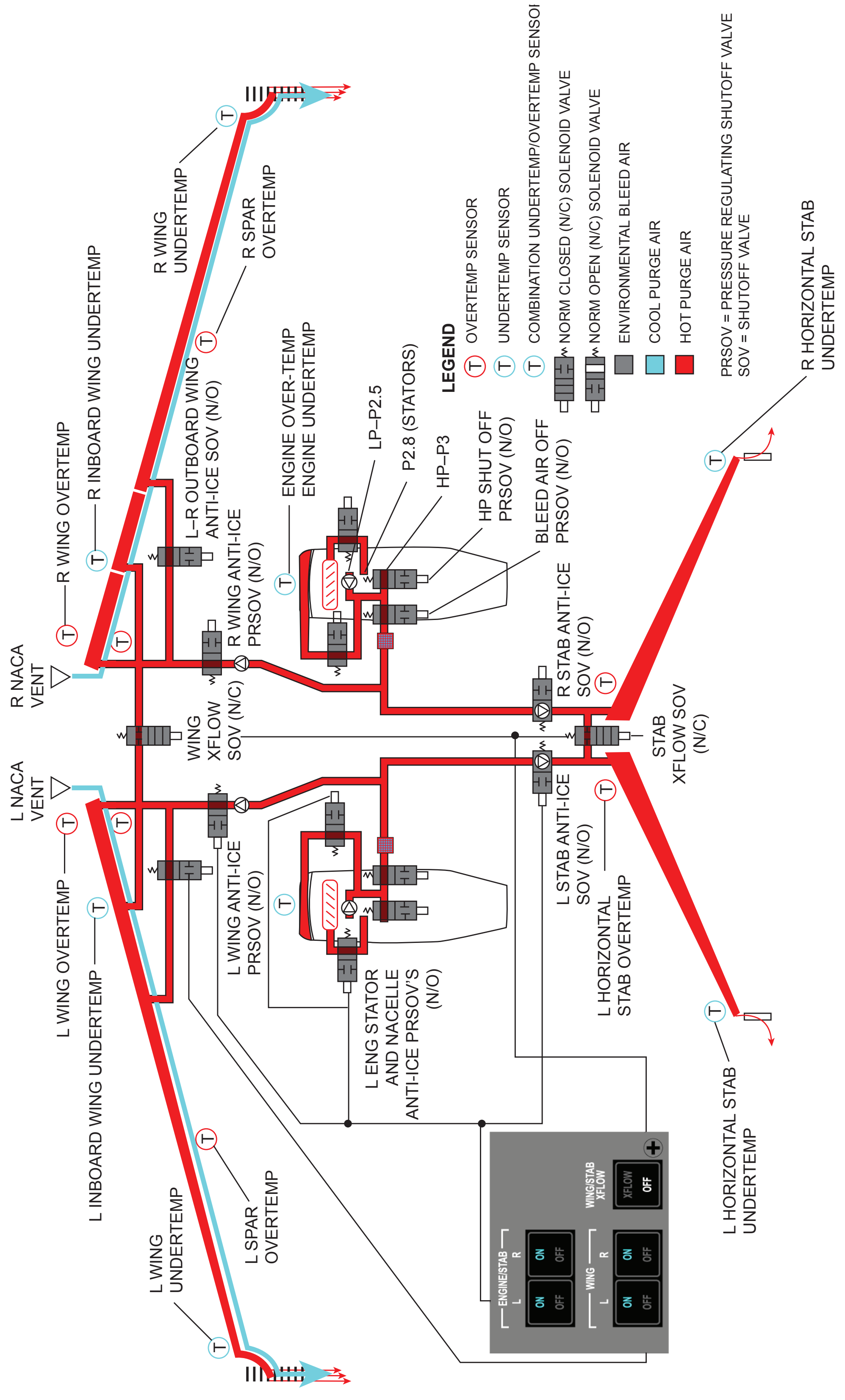
Ice and Rain Protection

General

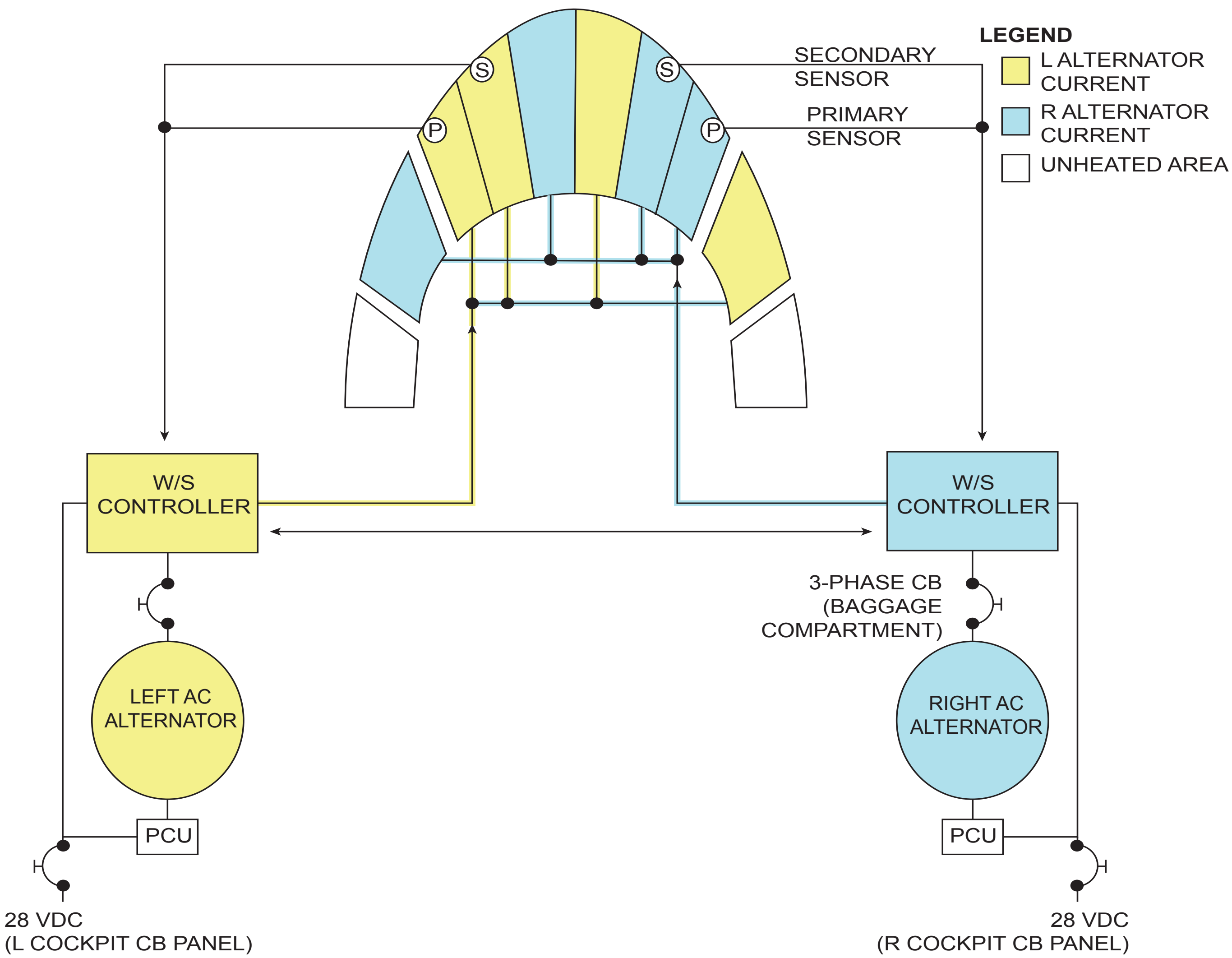
Ice protection systems on the Citation Sovereign employ either warm engine bleed air or heat generated by electrical resistance to prevent the formation of ice on critical structures and installations. During rain, flight crew forward visibility is enhanced during takeoff by a forced air blower that clears rain from the cockpit windshield until higher airspeeds prevent the accumulation of water.

The Citation Sovereign, with properly operating anti-ice equipment, is approved to operate in maximum intermittent and maximum continuous icing conditions as defined by FAR 25, Appendix C. Icing conditions exist any time the indicated ram air temperature (RAT) is 50°F (10°C) or below, and visible moisture in any form is present.

Anti-Ice System



Windshield Heat System



Ice Detection System

The Citation Sovereign relies primarily on visual cues for ice detection. Ice formation is first noticed on the windshield near the center post or on the leading edges of the wings. For night operations, ice detection and wing inspection lights help the crew detect ice formation on the windshield and wing leading edges, respectively.

Components

Windshield Ice Detection Lights

Two windshield ice detection lights are mounted on the forward glareshield and are aimed at the windshield. A red light is reflected onto the windshield when ice begins to form. The red lights are not visible to the crew when the windshield is clear of ice. The windshield ice detection lights are powered on any time the instrument lights DAY/NIGHT button is selected to the NIGHT position.

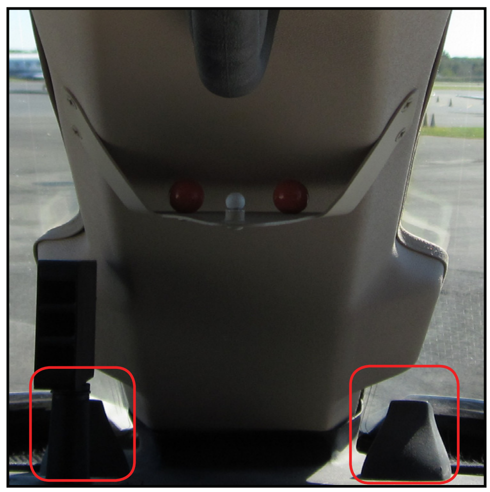


Figure 17-1: Windshield Ice Detection Lights

Wing Inspection Lights

Wing inspection lights are provided to illuminate the outboard portion of the wing leading edge, allowing the pilot to visually inspect for the formation of ice.

The wing inspection lights are turned on by the anti-ice WING INSP LTS button located on the anti-ice tilt panel. Each wing inspection light has a maintenance adjustable gimbal fixture for precise aiming of the cone of illumination.

Figure 17-2: Wing Inspection Lights

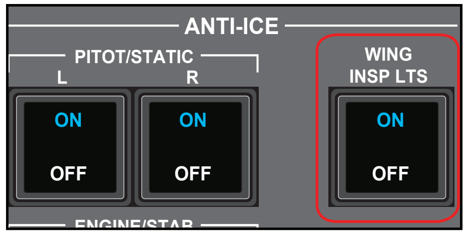


Figure 17-3: Wing Inspection Lights Button

Windshield Rain Removal System

Although the exterior of the windshields are coated with a sealant to promote water runoff, a blower system can be used to increase visibility through the cockpit windshields if rain accumulates on the outer surface.

A two-speed electric windshield rain removal fan is mounted in the nose avionics bay. The anti-ice W/S FAN button on the anti-ice tilt panel controls the fan. It normally runs at low speed, functioning as a cooling fan for the nose avionics bay.

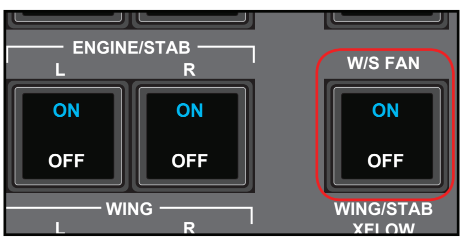


Figure 17-4: Windshield Fan Button

When the W/S FAN button is selected ON, it runs at high speed to direct high velocity air onto both windshields to aid in clearing rain. The system is primarily for ground use, but does provide a small increase in rain removal in flight. The primary rain removal in flight is caused by the natural action of the treated windshield surface and the windshield shape. If visibility deteriorates on a part of the windshield, it may be that the treated surface has deteriorated. The surface can be re-treated and restored to its original condition.

Figure 17-5: Windshield

> ***NOTE:*** Do not apply unauthorized rain repellent coating or compounds to the electrically heated glass windshield or associated heated glass side windows. Surface Seal™ is the only authorized rain repellent coating. Apply only with windshield manufacturer authorization and instructions.

Anti-Ice Systems

The anti-ice systems are designed to prevent ice formation on the pitot tubes, static ports, angle-of-attack probes, ram air temperature (RAT) probes, engines, wings, wing roots, horizontal stabilizer leading edges, windshields, and overboard water drain lines. The various anti-icing systems use electrical heating elements or hot engine bleed air, and are activated by buttons on the instrument panels.

CAUTION
If operating in actual or anticipated icing conditions, review AFM Section III, Flight Into Icing and AFM Section VI, Advisory Information, De-Icing Procedures. Specific attention should be paid to the large increase in runway length requirements for takeoffs and landings on contaminated runways. Minimum airspeed for sustained flight in icing conditions (except approach and landing) is 180 KIAS.

Electrically Heated Systems

Electrical heat for components can be activated at any time regardless of the presence or absence of ice since no performance degradation is associated with electrical heating. The only requirement is the presence of sufficient airflow to prevent overheating.

Pitot-Static System Heat

Electric elements heat the pilot and copilot pitot tubes, static ports, AOA vanes, and standby pitot/static system. The L and R PITOT/STATIC ANTI-ICE buttons on the ANTI-ICE panel (copilot's forward tilt panel) control the heating elements for the electric heat components. Selecting either button activates the heat for the pitot tubes, static ports and AOA vanes.

Anti-Ice Limitation

Limit ground operation of the pitot-static heat to 2 minutes.

If power is lost to the pitot heaters, static port heaters, or when a heater fails, an amber **PITOT/STATIC COLD L-R-STBY** CAS message will illuminate on the CAS portion of the EICAS display. The amber message will also display if either button is selected OFF and the throttles are advanced for takeoff. A cyan message is displayed on the ground when the buttons are selected OFF.

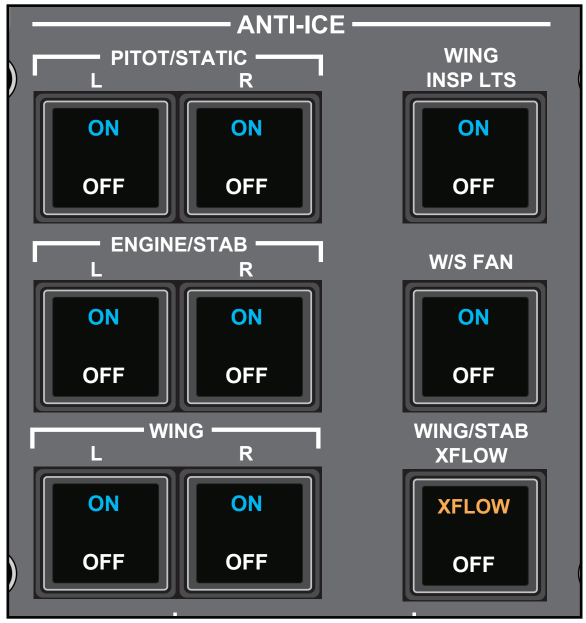


Figure 17-6: Anti-Ice Control Panel

Figure 17-7: Pitot Tube

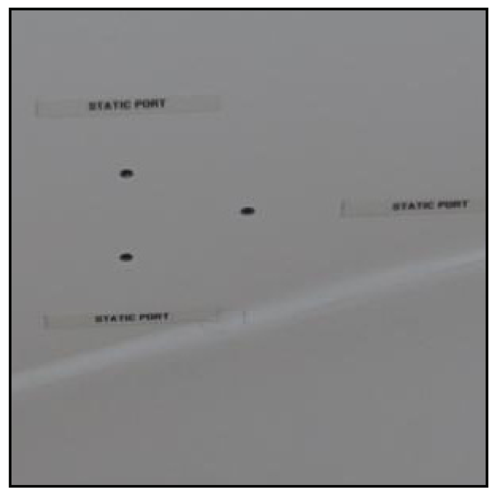


Figure 17-8: Static Ports

Angle-of-Attack System Heat

The left and right AOA vane heaters are electrically powered and are controlled by the respective side PITOT/STATIC L or R button. Heat is applied to the two AOA vanes, one located on each side of the fuselage below the cockpit side windows.

If an AOA heater fails, the respective amber **AOA HEAT FAIL L** and/or **R** CAS message will illuminate. Heat is applied to the AOA cases separately, anytime the avionics buttons are ON.

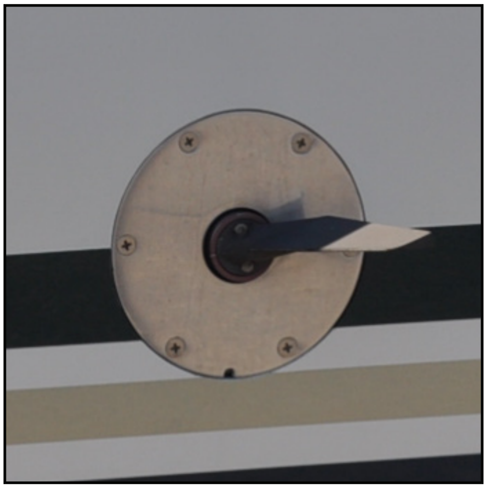


Figure 17-9: Angle-of-Attack (AOA) Vane

Engine Anti-Ice System

General

Engine anti-ice designed as a preventative system. Its use should be anticipated and the system actuated any time the airplane is operated in snow or freezing precipitation on the ground or when flight in visible moisture, with RAT temperatures 10°C to -35°C (50°F to -31°F) either occurring or imminent.

Operation

Anti-icing of the engine inlet lip and starter/generator inlet duct is provided by a piccolo tube that sprays bleed air onto the inside surface of the inlet lip skin. Bleed air for the engine inlet is taken upstream of the precooler. The air is delivered to the inlet skin at nearly bleed port temperatures. After the air passes through the piccolo tube, it is then ducted aft through holes in the forward inlet bulkhead to louvers in the forward engine inlet skin that discharge the air overboard. The engine spinner and stator vanes are anti-iced by P2.8 bleed air supplied internally to the engine.

Engine Anti-Ice Limitation

ENGINE/STAB L-R anti-ice must be selected ON (and operating) during ground or in-flight operations with temperatures between +10°C to -35°C in visible moisture.

The portion of the wing leading edge which is located in front of the engine is also considered a part of the engine anti-ice protection system. It is heated by precooled engine bleed air anytime the anti-ice ENGINE/STAB L and R buttons are selected ON.

Additionally, the two RAT probes located in each engine inlet are electrically heated anytime that the engine anti-ice system is activated.

Figure 17-10: Engine Inlet

Controls

The engine anti-ice is controlled by the anti-ice ENGINE/STAB L and R buttons located on the anti-ice tilt panel, which control the engine nacelle pressure regulating shutoff valves.

Selection of the ENGINE/STAB L and R buttons to ON also permits heating of the inboard wing and horizontal stabilizer. These components are discussed later in this chapter.

Indications

Cyan **ENG ANTI-ICE COLD L-R** and amber **ENG ANTI-ICE O'TEMP L-R** CAS messages monitor engine inlet anti-ice temperature. RAT probes are monitored for electrical current, and a failure will result in an amber **RAT HEAT FAIL L-R** CAS message being displayed on the EICAS. If the engine surfaces do not reach a predetermined temperature within the allotted time, or if an under-temperature is sensed, a message will appear in amber on the EICAS.

CAUTION
Ice accumulation on engine cowls cannot be detected from the cockpit. Air entering the engine intake is subject to rapid acceleration due to the suction created by the engine fan blades and the curvature of the air inlet. The increase in speed causes water vapor in the air to condense and freeze on the engine cowling at temperatures not ordinarily associated with icing. Review the appropriate AFM sections covering limitations, cold weather operations and performance adjustments when operating in temperatures at or below +10°C (+50°F).

Wing Anti-Ice System

General

The wing anti-ice system consists of the bleed air heated outboard wing leading edge. The left and right wing leading edge sections are anti-iced with engine bleed air supplied to two piccolo tubes, one each side, located in the left and right wing leading edge. The air is exhausted through louvers underneath each wing tip. The wing anti-ice systems should be selected on when the airplane is operated in snow or freezing precipitation on the ground or anytime the airplane is flown in visible moisture with RAT temperatures +5°C to -35°C (41°F to -31°F). Use of wing anti-ice is not permitted above FL410.

Figure 17-11: Wing Anti-Ice System

Operation

Wing anti-ice temperature is monitored by amber **WING ANTI-ICE COLD L-R** and **WING ANTI-ICE O'TEMP L-R** CAS messages. The temperature sensors monitor the wing leading edge skin and the wing front spar. The wing leading edges are heated by precooled engine bleed air whenever the respective wing anti-ice is selected on. If an amber **WING ANTI-ICE O'TEMP** CAS message is displayed, the wing anti-ice valve will automatically close until the over-temperature has cleared. Once the wing has cooled, the system will automatically re-open the valve. This message and automatic protection are active at all times.

On the ground, the cyan **WING ANTI-ICE COLD** CAS message will display immediately after selecting wing anti-ice on until the system passes the pre-flight check and the respective surface has heated to a safe temperature for takeoff.

Speed Limitation

Minimum speed for sustained flight in icing conditions (except takeoff and landing) is 180 KIAS.

Components

The normally closed wing crossover valve, located in the crossover duct between the left and right wing, isolates the left and right wing anti-ice systems. With the crossover valve open, either or both engines can supply either wing anti-ice system. Check valves located in the wing supply tube at the forward end of the wing prevent bleed air from the right system from entering the left system and vice versa. Heat from the wing leading edge is isolated from the wing structure and the fuel barrier by a heat shield. In case of complete electrical power failure, the fail-safe position of the wing crossover valve is to the closed position. It is powered open, and upon electrical power failure will close.

Figure 17-12: Wing Anti-Ice Exhaust

Controls

The anti-ice WING L-R buttons located on the anti-ice tilt panel control these systems. Wing anti-ice operation also requires that anti-ice ENGINE/STAB L and R buttons be selected ON. The ENGINE/STAB buttons open the inboard wing anti-ice valves and allows bleed air to flow to the outboard anti-ice valves, which remain closed until the WING L-R buttons are selected ON.

Indications

Wing anti-ice temperature is monitored using the amber **WING ANTI-ICE COLD L-R** and **WING ANTI-ICE O'TEMP L-R** CAS messages.

Horizontal Stabilizer Anti-Ice System

General

Anti-ice air to the horizontal stabilizer comes from the bleed air duct system. The bleed air is sprayed onto the inside surface of the horizontal stabilizer leading edge from a piccolo tube and is exhausted overboard through a vent on the outer portion of each horizontal stabilizer. Two pressure regulating shutoff valves, one for the left side of the stabilizer and one for the right, control the air individually. Check valves built into the pressure regulating shutoff valves prevent cross flow from the left engine to the right engine and vice versa. A cross flow valve is provided so the bleed air can be provided to both horizontal stabilizers from either engine.

Figure 17-13: Horizontal Stabilizer Anti-Ice System

Controls

The horizontal stabilizer anti-ice is controlled by the anti-ice ENGINE/STAB L and R buttons located on the anti-ice tilt panel, which control the horizontal stabilizer anti-ice pressure regulating shutoff valves. The horizontal stab cross flow valve is actuated by the anti-ice WING/STAB XFLOW button on the anti-ice tilt panel.

Anti-Ice Limitation

Anti-ice systems must not be used to deice surfaces prior to takeoff.

Indications

An amber **STAB ANTI-ICE COLD L-R** CAS message will be displayed in flight if the stabilizer anti-ice has not reached the required temperature after the time delay has expired.

On the ground, the cyan **STAB ANTI-ICE COLD L-R** CAS message will display immediately after selecting the respective anti-ice ENGINE/STAB L or R button ON until the system passes a pre-flight system check and the respective surface has heated to a safe temperature for flight. These messages are inhibited in the air for a period of time to allow for the surfaces to reach operating temperature without generating a nuisance message.

If an amber **STAB ANTI-ICE O'TEMP L-R** CAS message is displayed, the stab anti-ice valve will automatically close until the over-temperature has cleared. This message and automatic protection are active at all times.

Windshield Anti-Ice

The front windshields and side windows of the cockpit are heated to prevent the formation of ice and prevent fogging when operating at the low outside air temperatures associated with high altitudes or during conditions of high humidity. The front windshields are a composite sandwich made up of layers of chemically strengthened glass, urethane and polyvinyl butyral films. The side windows are composed of two layers of stretched acrylic separated by a vinyl film. A transparent but electrically conductive chemical oxide coating is applied to the inner face of the outer layers of both the windshield and side windows. When alternating current (AC) is applied to the conductive coating, the resistance of the coating causes an increase in heat. The amount of heat produced within the windshield and side window layers is controlled by maintaining the resistance within a specified range. The rear cockpit windows are not part of the windshield anti-ice system and are de-fogged by cockpit air.

AC power is supplied by two engine-driven alternators that provide power to two DC windshield heat control units anytime that the engines are running. The left alternator supplies AC power to the two outboard panels on the left windshield, the inboard panel on the right windshield, and the right forward side window. AC power from the right alternator is supplied to the opposite panels and windshields. Loss of a single alternator will not result in a complete loss of heat to either front windshield due to this design.

Windshield temperature sensors provide continuous monitoring to the windshield heat control units. These sensors are tested with the rotary TEST knob selected to the W/S TEMP position.

Indications

The windshield anti-ice is monitored by the amber **WINDSHIELD HEAT INOP L-R** and **WINDSHIELD O'TEMP L-R** CAS messages and the cyan **AC BEARING L-R** CAS message. The amber **WINDSHIELD HEAT INOP** CAS message indicates a fault or failure of the controller to supply power to the windshield. The amber **WINDSHIELD O'TEMP** CAS message indicates that the controller has detected an overtemperature condition, which automatically shuts the affected windshield off until the overtemperature condition clears. The cyan **AC BEARING L-R** CAS message indicates that the alternator bearing has approximately 20 hours of life remaining.

Heated Drains

Electrically heated drains prevent ice formation that might impair normal drainage of water from the aircraft. The left forward refreshment center is equipped with heated drains that operate on main DC power.

The location of the heated drains varies depending upon aircraft interior outfitting. Power is supplied to the drain heaters any time that the left PITOT/STATIC button is ON.

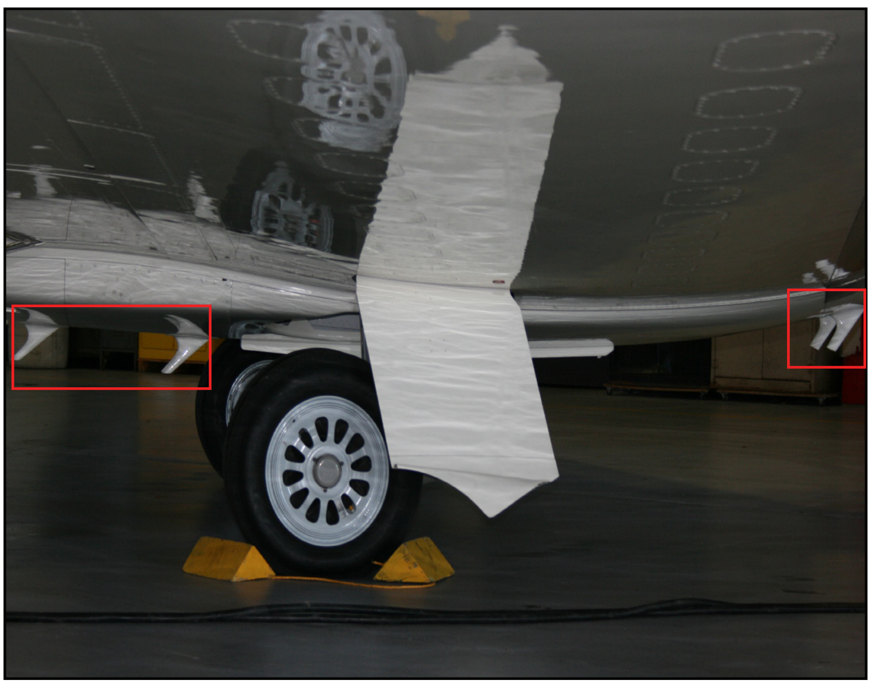


Figure 17-14: Heated Drains

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Preflight and Procedures

Preflight

Prior to flight into known icing, a ground preflight check of the engine, wing and stabilizer anti-ice protection systems is required per AFM procedures.

After engine start and prior to taxi, set both engines at 70 to 75% N_2. Turn the anti-ice ENGINE/STAB L and R and WING L and R buttons ON.

Immediately after selecting these buttons ON while on the ground, the cyan **ENG ANTI-ICE COLD L-R**, **INBD WING ANTI-ICE COLD L-R**, **WING ANTI-ICE COLD L-R** and **STAB ANTI-ICE COLD L-R** CAS messages will be displayed on EICAS. The bleed air monitor boards monitor respective temperature sensors for each of these leading edge surfaces for 2 minutes. If during that time period the sensor detects an increase in temperature by 10°C (18°F) for the inboard wing, outboard wing or stabilizer and that temperature is above the under-temperature set point, the associated cyan **COLD** CAS message will extinguish. Similarly for the engine anti-ice system, if during that time period the sensor detects a temperature increase by 40°C (72°F), the cyan **ENG ANTI-ICE COLD L-R** CAS message will extinguish. The bleed air monitor board will latch the successful completion of this preflight check until power is cycled to the bleed air monitor board or until the squat switches cycle into the air mode.

Ant-Ice Limitation

Except for the ground preflight check, maximum SAT for operation of bleed air anti-ice systems with the throttles above idle is +20°C.

This allows the crew to only run and pass this check once per flight. If anti-ice is selected on again after passing this preflight check, no message will be displayed if the leading edge surfaces are above their respective cold set point. If the sensor detects the system has warmed by 10°C (18°F) for the inboard wing, and stab or 40°C (72°F) for the engine inlet, but the temperature is still below the respective under temperature set point, the **ANTI-ICE COLD** CAS message will change from cyan to amber for the appropriate surface until the system has reached the safe temperature. If the bleed air monitor detects that the system has not warmed by 10°C (18°F) for the inboard wing, and stab or 40°C (72°F) for the engine inlet in the 2 minute timeframe, the cyan **ENG ANTI-ICE COLD L-R** CAS message will change to amber 2.5 minutes after button selection. This is intended to indicate a failure within the indicated anti-ice system.

Takeoff

Takeoff is prohibited with frost, ice, snow or slush adhering to the wings, control surfaces, engine inlets, or other critical surfaces. Takeoff is limited to flaps 7° when Type II, III, or IV fluid is used.

A visual or tactile check of the wing leading edges is required when SAT is less than +10°C or if it cannot be determined that the wing fuel temperature is above 0°C, and visible moisture is present.

It is recommended that flight crews re-familiarize themselves seasonally with anti-ice and deice procedures. Additional information can be found in the Airplane Flight Manual, Section VII, Ground Deice/Anti-Ice Operations.

CAUTION
To prevent possible engine damage from ingestion of ice, do not chip or scrape ice or snow from the engine inlet. Deice these areas prior to start.

Windshield Surface Seal Protection System

Rain removal can be accomplished using the windshield blower system or a serviceable surface seal coating. The coating is sensitive to abrasive cleaners which degrade the ability of the coating to provide a clear view through the windshields during rain encounters. The surface seal coating has been demonstrated to provide satisfactory forward visibility in all precipitation encounters.

In static conditions during preflight operations and during taxi operations at low ground speed, mist conditions have been demonstrated to not impair forward visibility. If the windshield is covered with ice, starting engines to enable the windshield heat ON is the best course of action for clearing the windshield.

If flight conditions such as volcanic ash, hail, dust/sand storms or salt spray are encountered, degradation of the surface seal may occur. Such encounters should be entered in the airplane log book for possible maintenance action. Note that the use of mechanical means to clean ice off the windshield will degrade the surface seal. Normal cleaning of the windshields is accomplished using a mixture of isopropyl alcohol and de-mineralized water (same solution used to clean the cockpit displays) and a soft cloth. Rubbing alcohol may be substituted for isopropyl alcohol. If neither is available, use a ¼ cup (2 oz or 60 ml) of mild dish detergent in a gallon (3.785 liters) of water to clean the windshield. The use of commercial cleaning products is discouraged.

Abnormal Procedures

The following is a discuss of abnormal procedures pertaining to the Ice and Rain Protection systems. Refer to the CAE SimuFlite Operating Handbook for specific procedural steps.

Continued Flight in Icing Environment with a Single Bleed Air Source

Set the anti-ice WING/STAB XFLOW button to XFLOW. Set the throttle (inoperative bleed air side, if engine is operative) to IDLE until clear of the icing environment. Maintain a minimum airspeed of 180 KIAS until clear of the icing environment. Exit icing environment. Turn the anti-ice WING/STAB XFLOW, WING and ENGINE/STAB buttons OFF after leaving icing conditions. Land as soon as practical.

If landing with known or suspected ice on wing leading edge, refer to Abnormal Procedures, Landing With Ice on Wing Leading Edge.

If no ice on wing leading edge and if operating single-engine, refer to Abnormal Procedures, Single-Engine Approach and Landing. If operating multi-engine, use flaps 15° for landing.

Refer to Abnormal Procedures, Flaps Not in Landing Position (35°).

Engine, Stabilizer or Wing Cold

An amber **ENG**, **STAB** or **WING ANTI-ICE COLD L** and/or **R** message will illuminate on the CAS if the respective surface has not achieved adequate temperature for anti-icing, or if the preflight check has failed. If the message is present after a satisfactory preflight check, then the surface is cold and can be cleared by continuing to wait for the surface to warm up. Increase thrust to a maximum of 81% N_2 in an attempt to warm the surface.

In flight, the amber messages are inhibited for 2.5 minutes after turning the system on to allow the surface to achieve adequate temperature for anti-icing. Verify that the respective ANTI-ICE buttons are ON, and increase engine power in an attempt to clear the message. If the message does not clear, select HP on the affected side ENG BLD AIR selector. If the message still does not clear, exit icing conditions. Refer to the appropriate procedure for additional considerations with ice on the wing or stabilizer leading edge.

Engine, Stabilizer or Wing Over-Temperature

An amber **ENG**, **STAB** or **WING ANTI-ICE O'TEMP L** and/or **R** message will illuminate on the CAS if an over-temperature condition of the respective surface is detected. The system automatically closes the respective anti-ice shutoff valve. After the surface has cooled, the system will automatically restore normal operation. Over-temperature monitoring is active at all times regardless of the position of the ANTI-ICE buttons. An over-temperature indication with the system OFF indicates either a failure of the monitoring system or failure of the respective anti-ice valve.

If any amber **O'TEMP** message occurs, reduce thrust on the affected side (if practical). Monitor for reoccurrence. If the message does not clear or re-occurs, select LP on the affected side ENG BLD AIR selector. Maintain FL410 maximum (FL390 maximum with 12 passengers). If the message does not clear, exit icing environment. Refer to the specific procedure for additional considerations with ice on stabilizer or wing leading edge.

Operations In Severe Icing Conditions

WARNING

Severe icing may result from environmental conditions outside of those for which the airplane is certified. Flight in freezing rain, freezing drizzle, or mixed icing conditions (supercooled liquid water and ice crystals) can result in ice build-up on protected surfaces exceeding the capability of the ice protection system, or can result in ice forming aft of the protected surfaces. This ice may not be shed when using the ice protection systems and may seriously degrade the performance and controllability of the airplane. Runback ice extending approximately 12 inches to 18 inches aft of the heated leading edge on the upper surface of the wing is normal in some icing conditions, has been evaluated to verify satisfactory performance and controllability, and is not an indication of severe icing.

During flight, severe icing conditions that exceed those for which the airplane is certified shall be determined by the following visual cues:

1. Unusually extensive ice accumulation on the airframe and windshield in areas not normally observed to collect ice.
2. Accumulation of ice on the upper surface of the wing aft of the protected area extending more than 12 inches to 18 inches aft of the heated leading edge.

If one or more of these visual cues exist, immediately request priority handling from Air Traffic Control to facilitate a route or altitude change to exit the icing environment.

EICAS System Displays

Information regarding the Ice and Rain Protection system is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit.

Messages are displayed in cyan, amber or red, according to their urgency. The following are possible messages displayed that relate to the Ice and Rain Protection systems.

Cyan Message	Description
ANTI-ICE ON ALL	This message is displayed when all anti-ice is selected ON.
ANTI-ICE ON ENGINE/STAB	This message is displayed when engine/stab anti-ice (ANTI-ICE ENGINE/STAB L and R buttons) is selected ON and either wing anti-ice (ANTI-ICE WING L or R button) is selected OFF.
ENG ANTI-ICE COLD L and/or R	On the ground, this message is displayed cyan when the respective engine anti-ice (ANTI-ICE ENGINE/STAB L or R button) is selected ON and the inlet lip surface is cold (below 60°C). In flight, this message is displayed cyan if the inlet lip surface is cold (below 60°C) due to automatic shutoff from an engine anti-ice overheat condition.
PITOT/STATIC COLD L and/or R and/or STBY	This message is displayed on the ground with the ANTI-ICE PITOT/STATIC buttons selected OFF.
STAB ANTI-ICE COLD L and/or R	On the ground, this message is displayed cyan when the respective stabilizer anti-ice (ANTI-ICE ENGINE/STAB L or R button) is selected ON and the surface is cold (below 10°C). In flight, this message is displayed cyan if the surface is cold (below 10°C) due to automatic shutoff from a stabilizer anti-ice overheat condition or a stabilizer bleed leak condition.
WING A/I CROSSFLOW OPEN	This message is displayed when the ANTI-ICE WING/STAB XFLOW button has been selected to XFLOW and the wing crossflow valve is open.
WING ANTI-ICE COLD L and/or R	On the ground, this message is displayed cyan when the respective outboard wing anti-ice (ANTI-ICE WING L or R button) is selected ON and the surface is cold (below 16°C). In flight, this message is displayed cyan if the surface is cold (below 16°C) due to automatic shutoff from a wing anti-ice overheat condition or a wing bleed leak condition.

Amber Message	Description
AOA HEAT FAIL L and/or R	This message is displayed when the ANTI-ICE PITOT/STATIC buttons are selected ON and current is not detected at the respective AOA probe..
BLEED AIR O'TEMP L and/or R	This message is displayed when the bleed air temperature from the respective precooler has exceeded 293°C for more than 20 seconds or 316°C instantly. If the ANTI-ICE WING/STAB XFLOW button is selected to XFLOW, then this message is displayed when the bleed air temperature from the respective precooler has exceeded 310°C for more than 20 seconds or 343°C instantly.
BLEED SELECT NOT NORM L and/or R	This message indicates the bleed air selector is not in the normal position with the aircraft on the ground. This message is cyan in the air.
ENG ANTI-ICE COLD L and/or R	On the ground, This message is displayed when either the preflight check has failed, the stator anti-ice valve is not open, or the surface has not achieved adequate temperature for anti-icing. In flight, this message is displayed when an undertemperature condition of the engine inlet is detected or the engine stator anti-ice valve has not opened fully.
ENG ANTI-ICE O'TEMP L and/or R	This message is displayed when an overtemperature condition of the engine inlet is detected.
INBD WING A/I COLD L and/or R	On the ground, this message is displayed when either the preflight check has failed or the surface has not achieved adequate temperature for anti-icing. In flight, this message is displayed when an undertemperature condition of the inboard wing is detected.
PITOT/STATIC COLD L and/or R and/or STBY	This message is displayed when either ANTI-ICE PITOT/STATIC button is ON and no current is flowing to the probe or static port, when either button is OFF and a throttle is in the TO detent, or either button is OFF and the aircraft is airborne.
RAT HEAT FAIL L and/or R	This message is displayed when current is not detected at one or both of the respective RAT probes with the ANTI-ICE ENGINE/STAB button ON.

Amber Message	Description
STAB ANTI-ICE COLD L and/or R	On the ground, this message is displayed when either the preflight check has failed or the surface has not achieved adequate temperature for anti-icing. In flight, this message is displayed when an undertemperature condition of the horizontal stabilizer exists.
STAB ANTI-ICE O’TEMP L and/or R	This message is displayed when an overtemperature condition of the respective horizontal stabilizer is detected.
STAB BLEED LEAK	This message is displayed when a bleed leak in the vertical or horizontal stabilizer anti-ice bleed air supply system is detected.
WINDSHIELD HEAT INOP L and/or R	This message is displayed when the windshield heat has failed.
WINDSHIELD OVERTEMP L and/or R	This message is displayed when the windshield controller has detected an overheat situation which could result in damage.
WING A/I CROSSFLOW OPEN	This message is displayed when the wing anti-ice crossflow valve has failed to fully close.
WING ANTI-ICE COLD L and/or R	On the ground, this message is displayed when either the preflight check has failed or the surface has not achieved adequate temperature for anti-icing. In flight, this message is displayed when an undertemperature condition of the outboard wing is detected.
WING ANTI-ICE O’TEMP L and/or R	This message is displayed when an overtemperature condition of either the inboard or outboard section of the respective wing is detected.
WING BLEED LEAK L and/or R	This message is displayed when a bleed leak in the inboard or outboard wing anti-ice supply line is detected.

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18

Landing Gear and Brakes

Contents

Landing Gear and Brakes

General

The Citation Sovereign has an electrically-controlled and hydraulically-actuated conventional tricycle type landing gear system. This consists of two dual wheel Main Landing Gear (MLG) assemblies and a dual wheel Nose Landing Gear (NLG) assembly.

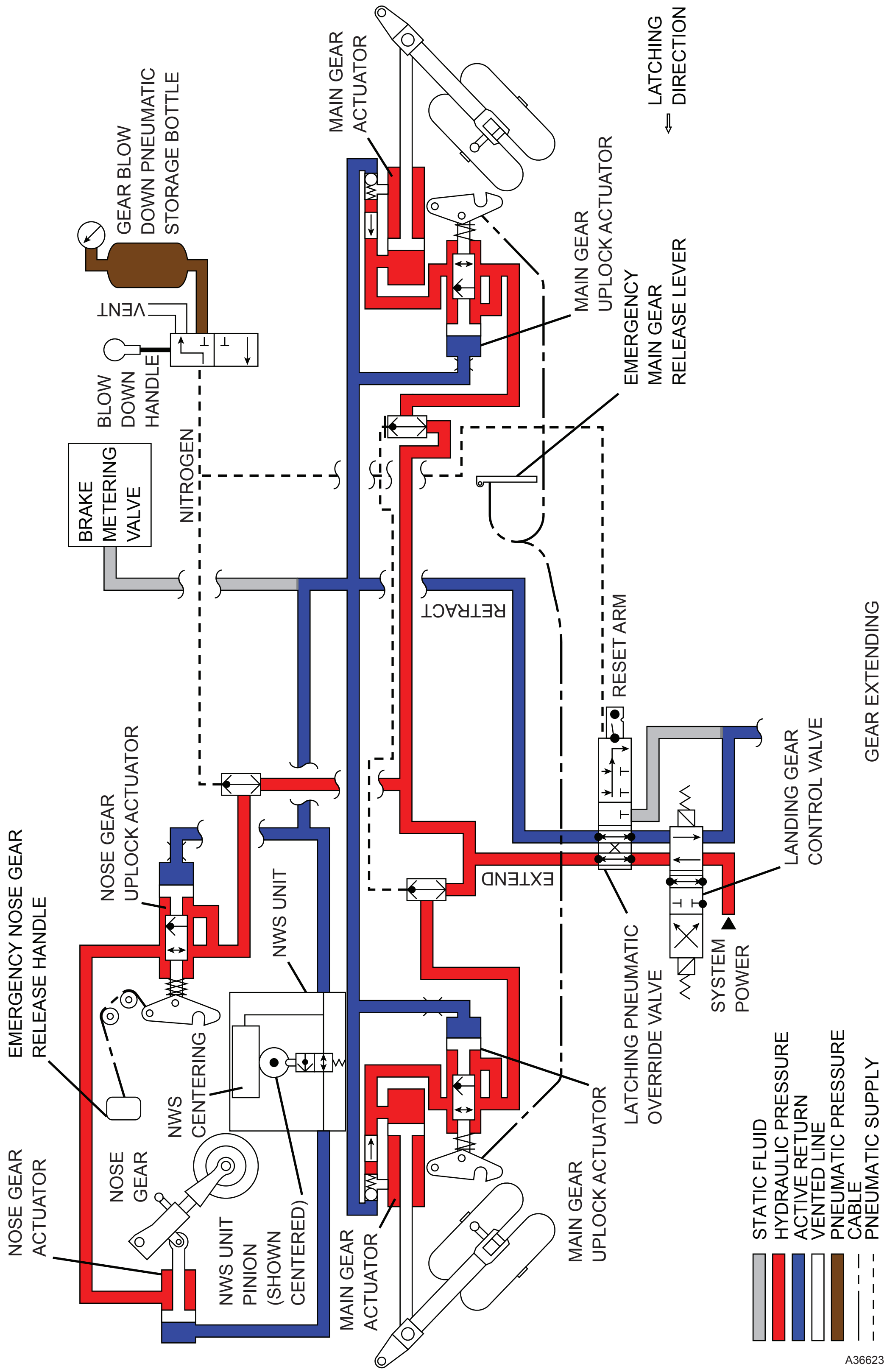
A pneumatic extension system is installed to allow extension of the landing gear in the event of lost hydraulic pressure. A free fall gear actuation system using manual uplock releases is also available as an additional backup.

The aircraft's brake system has rudder pedal operated multiple disc brakes on the MLG wheels. A mechanically-controlled and hydraulically-operated system provides power for normal operation of the brakes. A pneumatic system can supply pressure for braking if the hydraulic system fails.

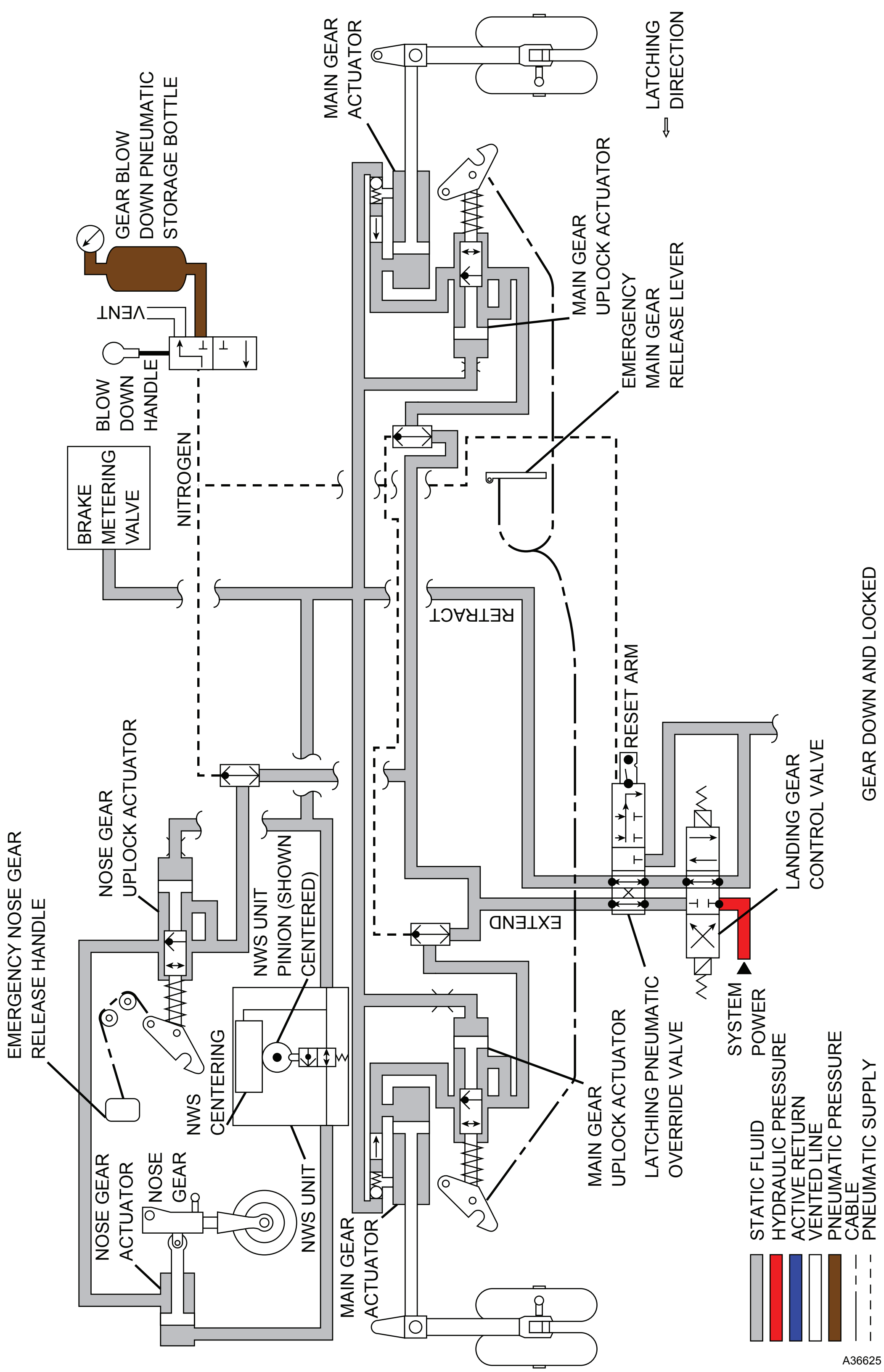
An electrically controlled anti-skid system provides maximum braking efficiency on all runway surfaces.

Nosewheel steering (NWS) is hydraulically actuated through a hand wheel (tiller) or the rudder pedals. An accumulator allows limited steering in the event of a hydraulic failure.

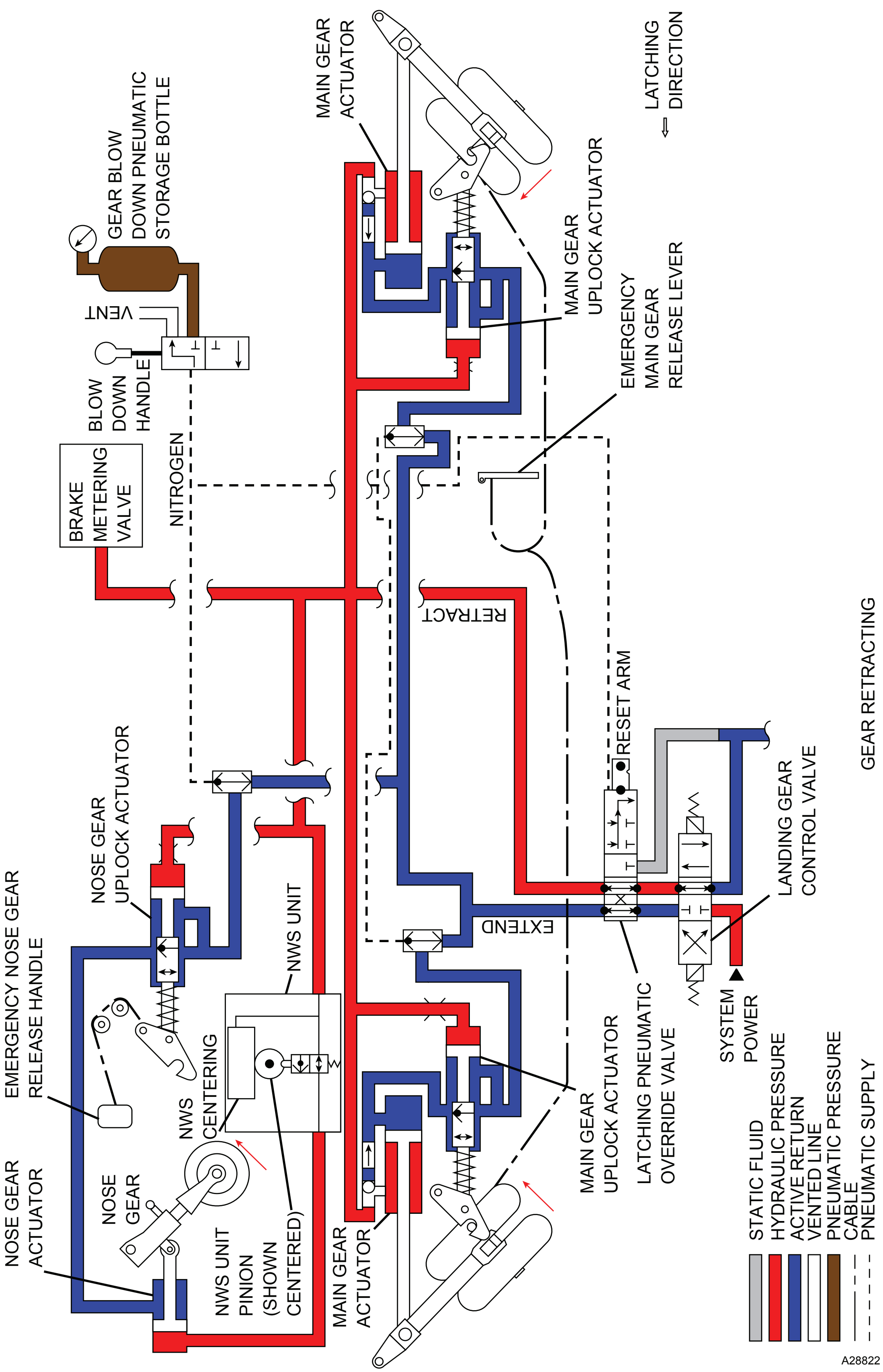
Landing Gear Extending



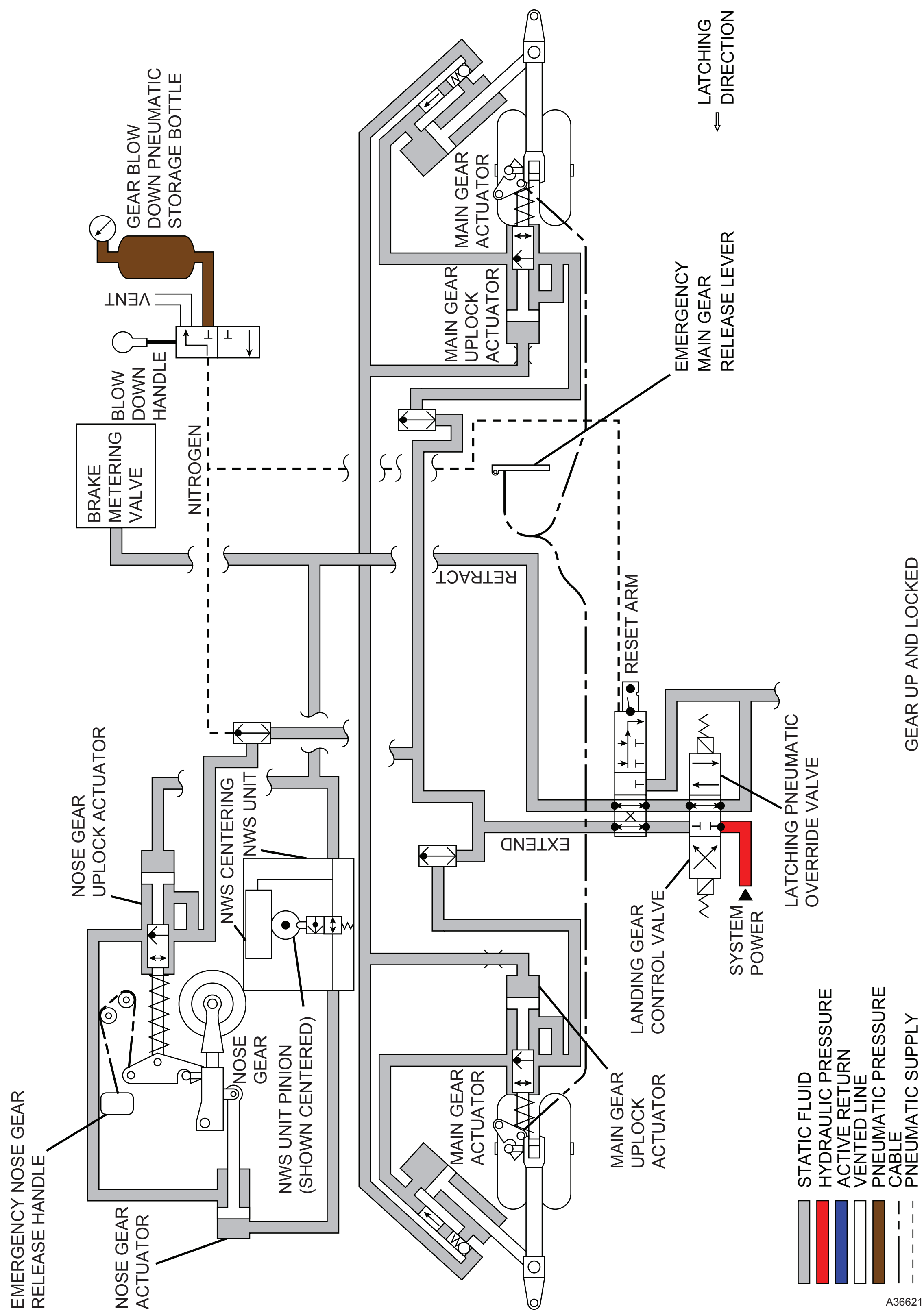
Landing Gear Down and Locked



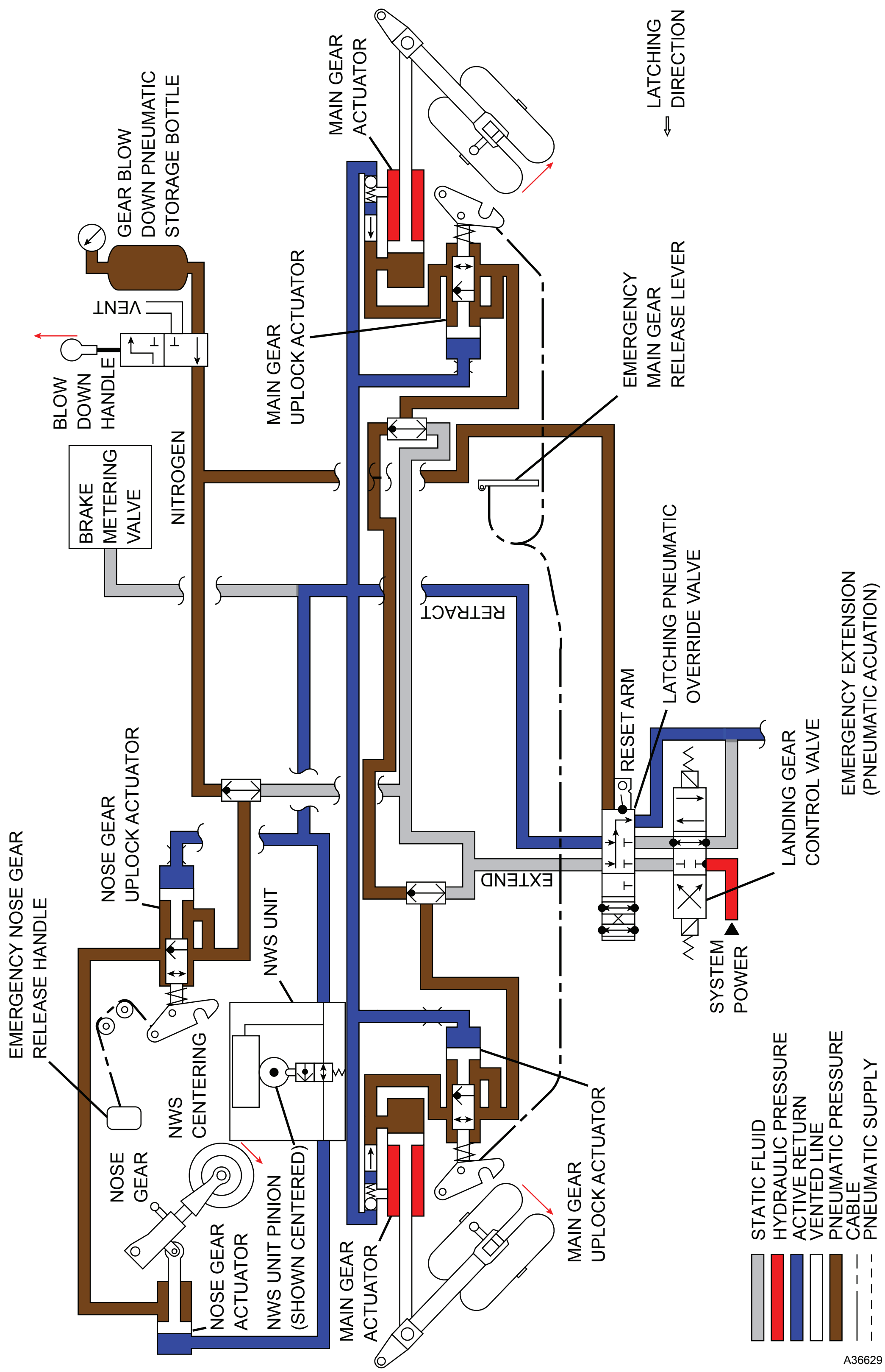
Landing Gear Retracted



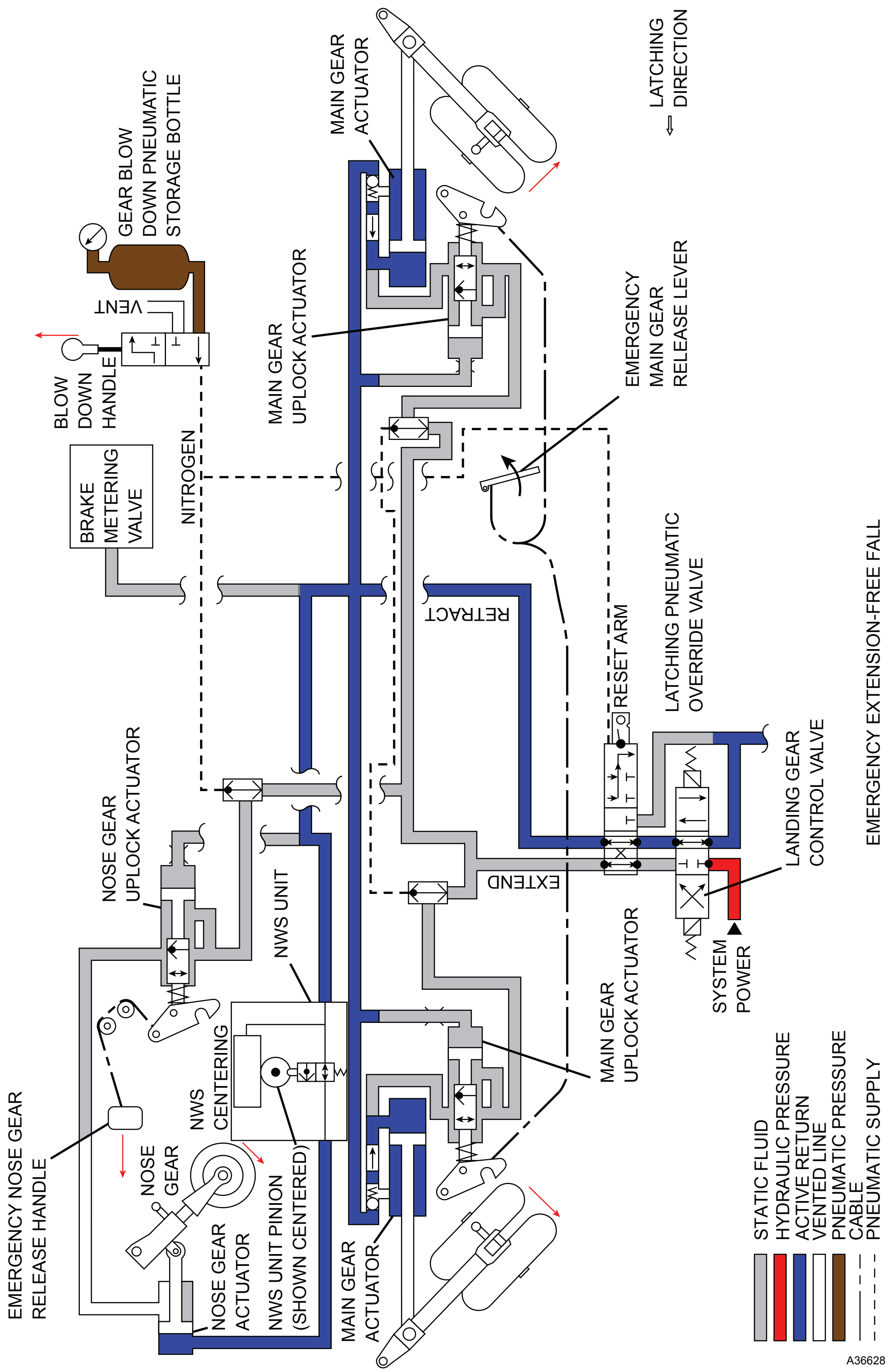
Landing Gear Up and Locked



Landing Gear Emergency Extension



Landing Gear Emergency Extension - Free Fall



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Landing Gear System

General

The landing gear on the Citation Sovereign consists of a dual wheel Nose Landing Gear (NLG) and dual wheel Main Landing Gear (MLG). The landing gear retraction system is electrically controlled and hydraulically actuated. Each MLG is a trailing link type and retracts inboard into the wing and belly fairing. The NLG automatically centers while retracting forward into the nose and, when retracted, is enclosed by doors. Single chined tires are used on the NLG for water and slush deflection.

Landing Gear Limitation

The maximum landing gear operating/extended speed (V_{LO}/V_{LE}) is 210 KIAS.

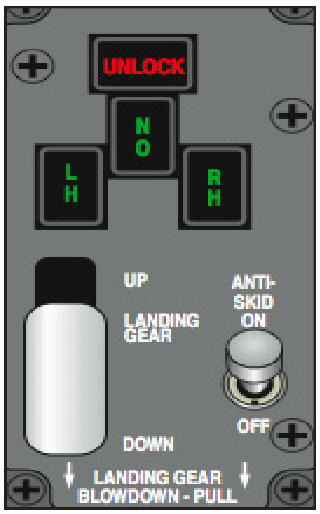

Figure 18-1: Landing Gear Control Panel

Two separate emergency gear extension methods are provided: a pneumatic blow-down system (independent bottle in nose) and manual gear release handles. In the event of both hydraulic and pneumatic failures, the uplocks may be unlocked and released mechanically through a cable system. Squat switches on the nose and MLG actuate circuits for various aircraft electrical systems. The switches provide sensing information to aircraft systems and sub-systems that operate only in the air or only on the ground.

Gear Handle

The landing gear is extended by the gear handle located in the cockpit. The handle must be pulled out toward the pilot before it can be moved up or down into the selected detent, where a spring maintains the gear handle's position. An electrically operated solenoid pin prevents the handle from being raised from the GEAR DOWN detent. Before the handle can be moved into the UP position, the solenoid must be energized, pulling the pin out of the way. The solenoid is powered when the NLG and either MLG's squat switch indicates weight off wheels. If the gear handle is UP, the solenoid cannot prevent the gear handle from being moved to DOWN.

Main Landing Gear

Each MLG is a trailing link type gear with a dual wheel and brake system attached to the link assembly. The trailing link assembly attaches to the landing gear trunnion. Support fittings in the wings attach the entire assembly to the aircraft structure. With the gear retracted, a two-piece door connected directly to the MLG assembly covers the gear shock strut and trailing link, leaving the wheels and tires exposed. Multiple carbon disc brakes operated by an anti-skid/power brake valve provide braking action. Anti-skid protection provides maximum braking efficiency while preventing wheel lock.

Figure 18-2: Main Landing Gear (MLG)

Nose Landing Gear

The NLG is a hydraulically actuated assembly consisting of a shock strut, torque links, and dual wheel and tire assemblies. Three doors fully enclose the retracted assembly. On the ground, a hydraulically powered nose-wheel steering unit positions the NLG in response to rudder pedal or nosewheel tiller movement.

On retraction, the nose gear automatically centers for clearance into the wheel well. The nose gear is retracted forward and extended aft.

> ***NOTE:*** The nose gear torque link must be disconnected during towing operations or the system may be damaged. The torque link disconnect pin is removed by removing a safety pin from the shaft, and then pushing a release button and pulling out the pin. The torque link is spring loaded to extend horizontally from the nose gear strut when the pin is removed. The disconnect pin attaches via a cable and can be left hanging.

Figure 18-3: Nose Landing Gear (NLG)

Struts

The NLG shock strut unit consists of a trunnion, upper and lower barrel assembly, isolation piston, oil filler plug/metering pin, and a nitrogen filler valve. The tapered metering pin extends through an orifice in the top of the piston. The upper barrel, lower barrel and isolation piston act as the shock absorbing unit for the NLG. Taxi lights are on the lower barrel. The MLG trunnion connects the oleo strut to the trailing link/axle assembly. It consists of an isolation piston, orifice plate, metering pin, bearing, hydraulic filler plug, and an air filler valve. The air chamber acts as a shock cushion to vary the resistance to shock loads.

Squat Switches

A Weight-On-Wheels (WOW) system incorporates three squat switches, one on each MLG strut and one on the NLG. The switches provide on-ground or in-air signals to WOW modules located in two of the Modular Avionics Units (MAUs). The status of the switches, either on-ground or airborne, affect multiple aircraft systems. A miscompare condition between the squat switches or the WOW modules will trigger an amber CAS message to alert the crew of a system malfunction. With respect to CAS message inhibit and most system functions, the aircraft is considered on the ground when both left and right WOW modules indicate that the aircraft is not in the air.

Tires and Wheels

Each wheel and tire assembly consists of a balanced wheel and a high speed tire. The wheel consists of two halves bolted together with an O-ring between the halves that provides sealing. The two piece wheel design assists in tire removal and replacement. On one side of each wheel assembly an inflation valve provides for tire inflation and deflation.

Tire Limitation

Maximum tire speed is 165 knots.

The MLG wheels employ three thermal fuse plugs in their inboard halves. The plugs protect the tire from excessive pressure. If the wheel over-heats due to excessive braking or a locked brake, the plugs melt and the tire deflates. Also, an over-inflation plug is installed 180° from the inflation valve. The chines on the nose tires deflect standing water and slush away from the aircraft engine inlets during taxi, takeoff roll, and landing rollout.

Linkages and Doors

The NLG has three doors: one rear and two side. The rear door is mechanically connected to the NLG actuator, extending aft or retracting forward as the NLG assembly is manipulated. The two forward side doors are operated mechanically by rollers mounted on the landing gear trunnion when the NLG is extended or retracted.

The MLG doors are mechanically connected to the main gear trunnion, opening and closing as the gear is extended or retracted.

Figure 18-4: MLG Door

Figure 18-5: NLG Doors

Control and Indication

Control

The landing gear control panel contains the landing gear handle, three green gear safe indicators and a red unlocked indicator. The landing gear handle has two positions: full down and full up; it must be pulled out to clear a detent before it can be repositioned. Operation of the gear and doors will not begin until the handle has been positioned in one of the two detents. A gear handle locking solenoid activated by the nose gear squat switch and either MLG squat switch physically prevents inadvertent movement of the gear handle while on the ground.

The solenoid releases and allows an upward movement of the handle when the nose gear and one of the main gear indicates air mode.

Electrical Power

Power for landing gear operation is received from the left and right Emergency Bus. Circuit breakers for landing gear operation are on the left and right cockpit CB panels (LDG GEAR CONT 1, LDG GEAR CONT 2). If the hydraulic gear control valve is not powered (with either circuit breaker out), the landing gear does not function hydraulically.

Position and Warnings

The landing gear position and warning system provides visual and audible indication of landing gear position. Three green safe lights and a red gear UNLOCK light are located in a group adjacent to the gear control handle. Each green light corresponds to one gear, NO (nose), LH or RH and indicates that it is in the down-and-locked position. The red light indicates an unsafe gear position (in transit or not locked).

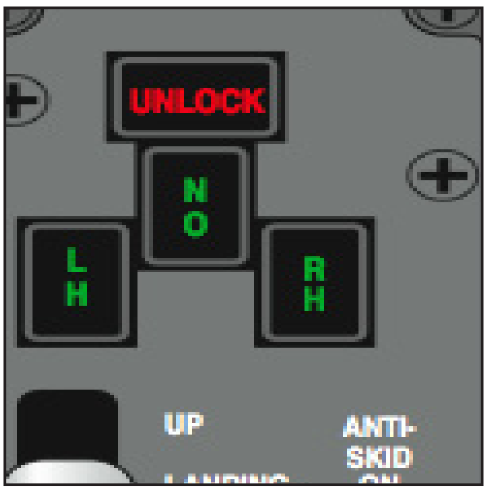

Figure 18-6: Landing Gear Position Indication

In addition to the visual indications, a warning horn sounds if any of the landing gear are in an unsafe condition. The horn is activated by any of the following conditions:

- Any gear not down and locked. Flaps are greater than 24°.
- Any gear not down and locked. Valid radar altitude indicates less than 500 feet AGL. Both Throttle Lever Angles (TLAs) are less than 30°.
- Any gear not down and locked. Radio altitude is invalid. TLAs are less than 30°. Both angles-of-attack (AOAs) are greater than 0.4.

System Operation

Normal Operation

Hydraulic pressure at 3,000 PSI is supplied to the landing gear control manifold and routed to either the extend ports or the retract ports by a solenoid operated directional control valve. When the directional control valve is commanded to the extend position, hydraulic fluid flows through the gear extend lines to the uplock actuators.

As the uplock actuators retract, they pull the gear uplock hooks clear of their respective rollers. Once the actuators retract, extend flow proceeds to the gear actuators to extend the landing gear. Regenerative shuttle valves in the circuit allow fluid from the retract side of the MLG actuators to port back to the extend side, thus improving gear free-fall capability and reducing pump demand during extension. The landing gear directional control valve returns to the center position, and extend pressure is removed, when the downlock switches are triggered.

When the directional control valve within the landing gear control manifold is commanded to the retract position, hydraulic fluid is routed into the retract lines and directly to the MLG actuators. Retract pressure not only retracts the landing gear, but also centers the nosewheels prior to retracting, actuates the brake metering valve to provide anti-spin brake pressure, and pressurizes the extend side of the uplock actuators to ensure the uplock hooks are in the proper position to receive the uplock rollers. The nosewheel steering unit will not allow hydraulic fluid to retract the NLG until the nosewheel has been centered.

The NLG and MLG actuators each incorporate an internal lock to hold the gear in the extended position. Once the gear is locked in the down position, no hydraulic pressure is required to maintain the lock. During retraction, hydraulic pressure is required to release the mechanical down locks. The gear is held retracted by mechanical uplocks that are normally released hydraulically, but in the case of hydraulic or other malfunction can be unlocked pneumatically through the emergency gear blow down bottle or mechanically by pull cables. The gear is locked up mechanically, after which the pressure is removed by the landing gear control manifold. Landing gear extension or retraction cycles take approximately 6 seconds to complete during normal system operation. The gear can be operated at airspeeds up to 210 KIAS (V_{LO}/V_{LE}).

Extension and Retraction

In a landing gear retraction cycle, the following takes place:

1. With the weight off the landing gear, the MLG and NLG squat switches close. Power is applied to the lockout soleniod allowing the landing gear handle to be placed in the UP position.
2. Actuation of the UP micro switch by the gear handle simultaneously:
   a. Lights the gear UNLOCK warning light.
   b. Positions the landing gear control valve to route hydraulic fluid to the retract side of the NLG and MLG actuators. Landing gear retract pressure is routed through the power steering unit and is prevented from reaching the NLG actuator until the nosewheel is in the centered position.
3. Deactivation of three GEAR DOWN micro switches:
   a. Extinguishes the green LH, RH, and NO gear lights.
   b. Allows momentarily application of the main wheel brakes.
4. Upon retraction, the landing gears are latched and mechanically held in place by the uplock hooks.
5. Activation of the three GEAR UP micro-switches:
   a. Removes power from the landing gear control valve, which removes hydraulic pressure from the actuators and gear uplock hooks.
   b. Extinguishes the gear UNLOCK indicator light.

The reversed sequence during gear extension is identical with the following exceptions:

1. The solenoid lock on landing gear handle is not in use.
2. Fluid is routed by the control valve through the uplocks to release them, and then to the extend side of the actuating cylinders.
3. Activation of the three GEAR DOWN micro-switches:
    a. Removes power from the landing gear control valve, which removes hydraulic pressure from the actuators and gear uplock hooks.
    b. Extinguishes the gear UNLOCK light and illuminates the green LH, RH, and NO gear lights.

Emergency Extension

Using the LANDING GEAR BLOWDOWN handle located on the bottom left hand side of the copilot's instrument panel activates the emergency gear blowdown. The handle is connected to a valve on the blowdown bottle (located in the right nose compartment) by a push/pull cable. This emergency extension method will operate only if the hydraulic lines for gear extension are intact. The system substitutes nitrogen gas pressure for hydraulic pressure to move the actuators of the landing gear components.

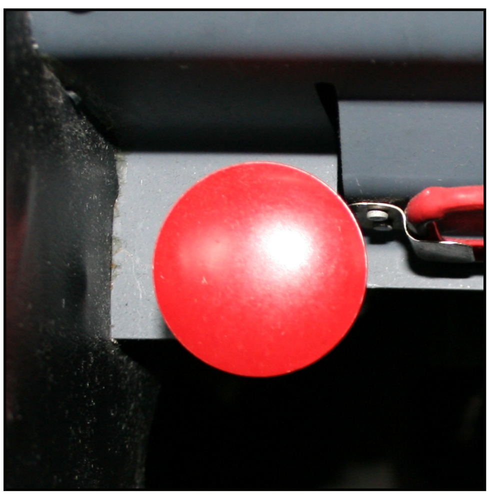

Figure 18-7: Emergency Blowdown Handle

Figure 18-8: NLG Uplock Release Handle

The valve input lever is locked in the discharge position once activated. This allows the LANDING GEAR BLOWDOWN handle to be returned to the stowed position without the loss of pneumatic pressure to the gear extension lines. The landing gear control manifold is equipped with a pneumatic line to engage a pneumatic override valve to allow the use of the emergency blowdown system. The pneumatic override valve becomes latched in the blowdown position in order to prevent hydraulic fluid from entering the gear extend and retract lines.

> ***NOTE:*** If the gear handle is jammed in the UP position, the blowdown will bypass the hydraulic system. After the gear blowdown has actuated, the gear cannot be retracted.

Whenever the emergency blowdown system is used, the system must be purged of trapped nitrogen and reset using maintenance procedures prior to resuming normal landing gear operation.

If the emergency pneumatic method is unsuccessful, a red "D" ring handle next to the gear blowdown knob is used to manually pull the nose gear uplock away from the gear roller and allow the gear to free fall. A lever below the lavatory closet pulls two cables, one for each main gear, manually disengaging the main gear uplocks from the gear rollers and allowing the gear to free fall. The lever must be checked in its stowed position during cabin preflight.

Rotary TEST Knob

With the rotary TEST knob in the LDG GR position on the ground, all four gear indicator lights illuminate and the gear warning horn sounds.

Nosewheel Steering System

Nosewheel steering is provided hydraulically through the use of the pilot or copilot pedals or a pilot's console mounted tiller operated gearbox. Steering is available on the ground with Main DC electrical power and the nose gear squat switch indicating ground mode.

Steering inputs from the rudder pedals will allow a nosewheel travel of approximately 7° either side of center. Use of the tiller operated gearbox will allow a nosewheel deflection of approximately 78° either side of center. The rudder pedals and the tiller can be used together to achieve a maximum angle of approximately 85°.

It is recommended that the tiller be used during taxi operations only; rudder pedal steering inputs alone should be used during the takeoff roll to prevent over-controlling the aircraft.

Tiller centering is accomplished by a spring-loaded cam mechanism attached directly to the gearbox. After takeoff, with the gear handle selected UP, the NWS unit hydraulically centers the nosewheel, and an isolation valve closes to remove hydraulic pressure from the NWS actuator. During ground operations, pressing and holding the red AP/TRIM/NWS DISC button on either control yoke shuts off hydraulic pressure to the NWS unit through an electrically-controlled valve. The AP/TRIM/NWS DISC button is used to deactivate NWS for checking rudder pedal movement during the flight control check, or to overcome an uncommanded nose wheel steering deflection. There are no CAS messages associated with the NWS system.

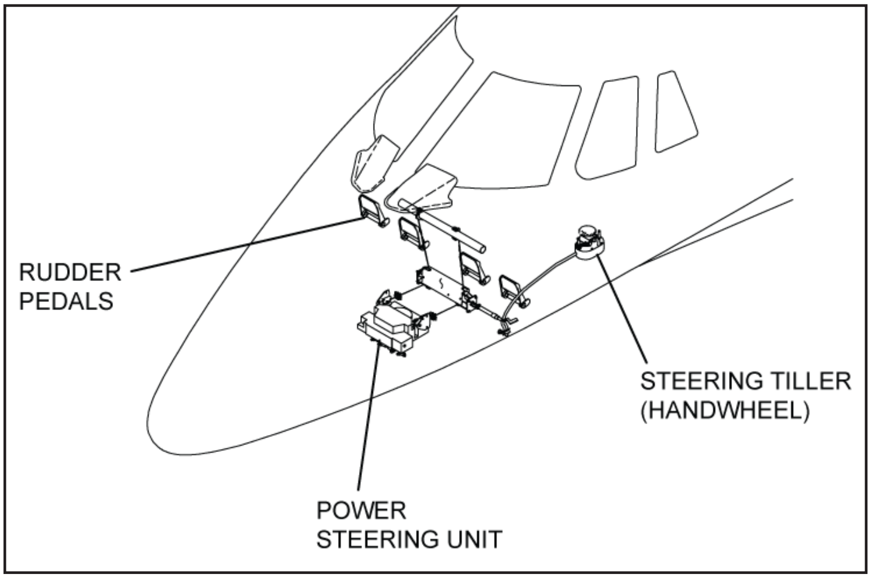

Figure 18-9: Nosewheel Steering System

Nose Wheel Steering Accumulator

During normal operations, a NWS accumulator stores hydraulic fluid at 3,000 PSI, which provides hydraulic pressure to the steering unit automatically if the hydraulic system fails. The nosewheel steering accumulator is in the right nose compartment below the baggage fire bottle.

The stored pressure in the accumulator is available for approximately 2 sweeps of the nosewheel. A sweep is defined as traveling from the center position to the full left or right position and back to center.

An accumulator pressure gauge located in the right nose compartment is checked during the preflight inspection for proper nitrogen charge in the cylinder. A NWS accumulator bleed button next to the gauge electrically opens the bleed valve using Left Battery Bus power, releasing pressure to the reservoir.

Figure 18-10: Nosewheel Steering Tiller (Handwheel)

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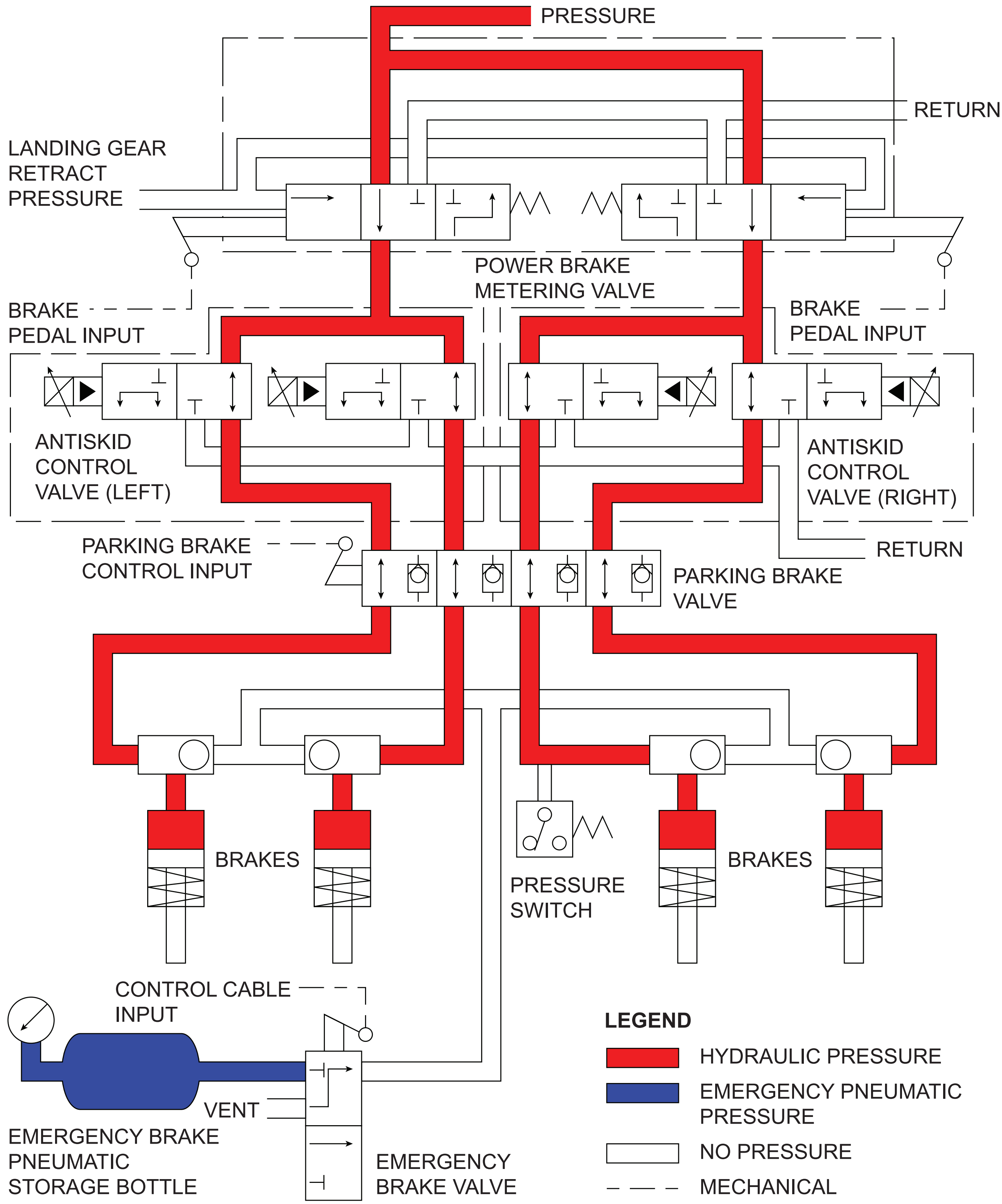
Brake System

General

The Citation Sovereign brake system consists of four carbon wheel brake assemblies, an anti-skid system, pneumatic emergency brake system, brake metering valve, and parking brake.

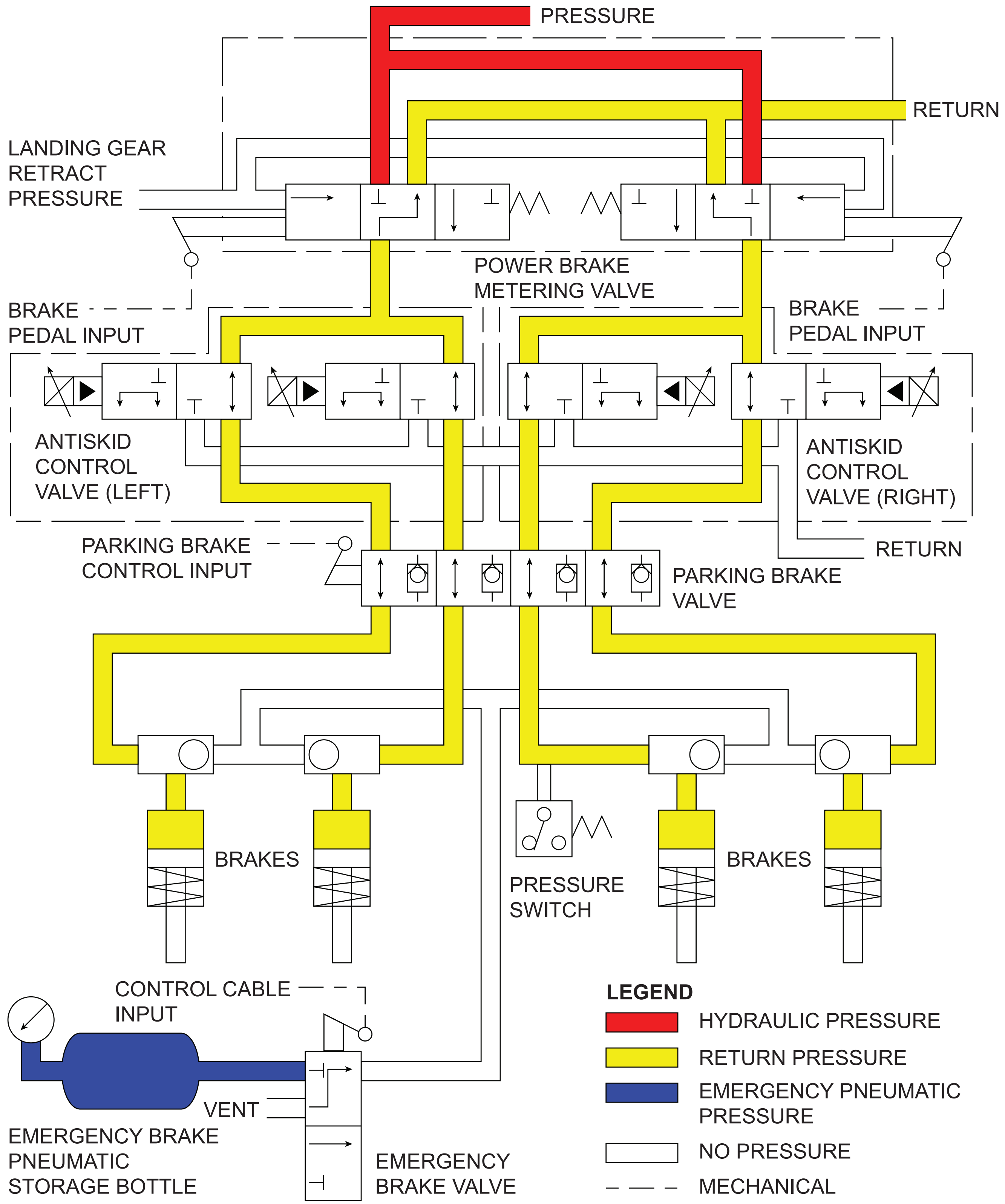
Each main landing gear wheel has multiple disc brakes that can be operated hydraulically or pneumatically. The pneumatic system provides braking if the normal hydraulic system fails. During normal braking, an anti-skid system provides maximum braking efficiency while eliminating tire skid and wheel locking. A parking brake system uses trapped hydraulic pressure between the parking brake valve and brake assemblies to lock the brakes.

Brake System - Brakes Applied



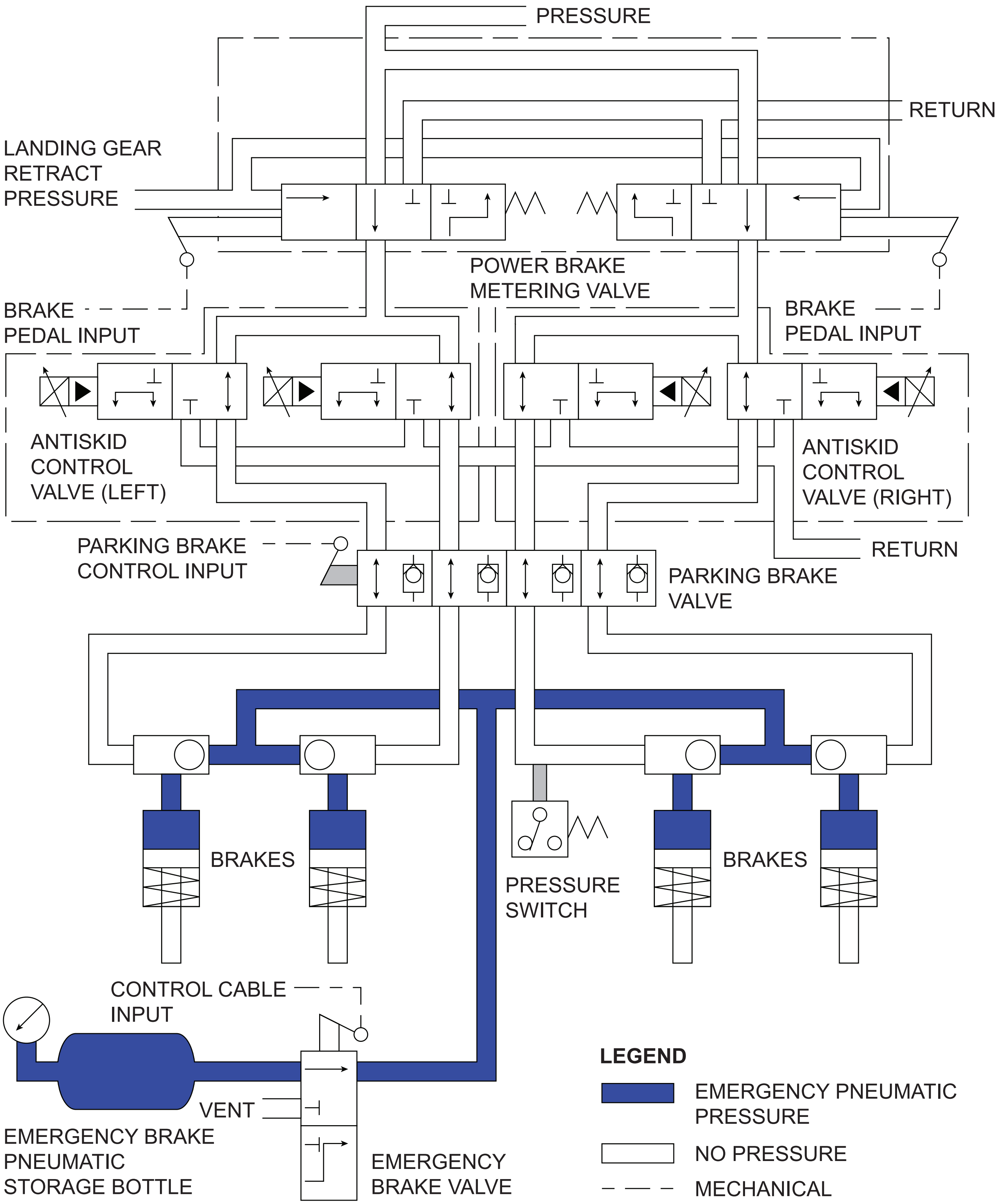
(BRAKES BEING APPLIED)

Brake System - Brakes Released



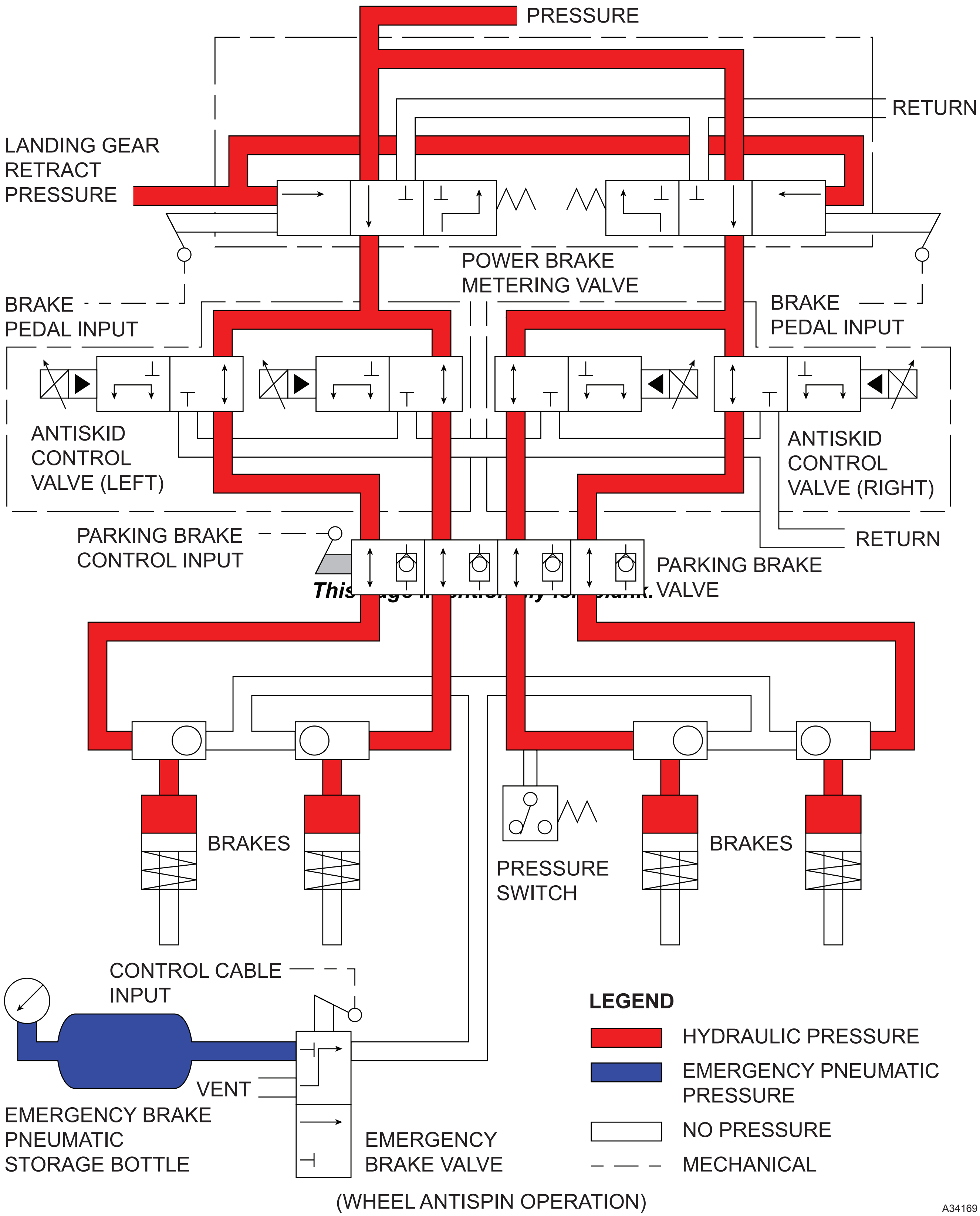
(BRAKES BEING RELEASED)

Emergency Brake System



(EMERGENCY BRAKES BEING APPLIED)

Anti-Skid System



(WHEEL ANTISPIN OPERATION)

Normal Braking System

The components of the braking, anti-skid, and parking brake systems are interrelated. This discussion includes selected components related to the brake system. The Citation Sovereign uses hydraulically powered main landing gear brakes. This system operates off the main aircraft hydraulic system. Crew inputs to the brake metering valves are transmitted mechanically via a series of cables from the toe brakes on the rudder pedals. Springs installed in the rudder pedal assemblies, along with brake pressure feedback, provide braking "feel" to the flight crew. The metering valves regulate main system hydraulic pressure based upon pilot or copilot inputs from the toe brake pedals.

An electronic anti-skid system monitors the main gear wheel speed and reduces braking forces as necessary to optimize stopping distances and prevent wheel lock-up. A parking brake valve is used to trap pressurized fluid in the brake lines and is activated by a T-handle in the cockpit. Brake fuses are used to prevent the loss of fluid due to a brake line failure on the landing gear.

A backup pneumatic braking system is provided in the event of a power brake failure. Pressurized nitrogen is supplied from a nitrogen bottle, located in the right nose compartment, directly to shuttle valves on the brakes and is controlled by an emergency brake handle located below the left side electrical switch panel beside the center pedestal.

Brake Controls

Depressing the top of the rudder pedals operates the main landing gear brakes. The pedals operate the brake metering valve through a system of push rods, cables, arms, and bell cranks. Springs in the system provide pedal feel. Pedal deflection is transmitted to the brakes by a series wire rope cables leading into a mixer assembly located beneath the copilot's seat. The pilot and copilot toe brakes can be applied independent of one another through this mixer assembly.

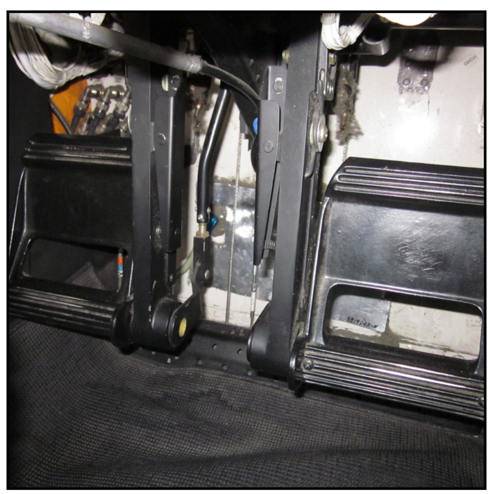


Figure 18-11: Brake Control Pedals

Brake Metering Valves

Aft of the mixer assembly are a pair of sheathed ball bearing ribbon cables that transmit pilot or copilot brake inputs to the brake metering valve in the RH forward wing fairing. This valve regulates main hydraulic system pressure to the brake system up to a maximum of 3,000 (±50) PSI in proportion to the amount of deflection by the pilot or copilot braking inputs. The metering valve also provides anti-spin braking during gear retraction in response from the gear retract hydraulic circuit.

Anti-Skid System

Anti-Skid Limitation
Anti-skid must be operational for takeoff.

The anti-skid system provides optimal wheel braking by controlling each wheel of the MLG independently. System operation includes locked wheel crossover protection, touchdown protection, and incorporates a comprehensive Built-In-Test (BIT) system. It will also activate during gear retraction to allow the use of the anti-spin braking provided by the brake-metering valve. Brake system fault indications and operational status are provided by the EICAS as an amber **ANTISKID FAIL** CAS message.

Figure 18-12: Anti-Skid Control Switch

Anti-Skid Limitation
With Anti-Skid Inoperative, multiply Flaps 35° landing distance by 1.29.

The anti-skid system works in conjunction with the hydraulic brake system to provide optimal braking on any runway surface. Four transducers monitor the main gear wheel speed, one for each wheel. These transducers transmit wheel speed information to the anti-skid controller located in the tailcone aft of the baggage compartment. The anti-skid controller continuously monitors and updates wheel speed information to detect a wheel skid condition. In the event of a wheel skid, the anti-skid controller senses the skid and sends an appropriate level current signal to the corresponding wheel anti-skid control valve that decreases commanded brake pressure and alleviates the wheel skid. The anti-skid controller receives power from the Emergency Bus when the anti-skid switch is in the ON position.

Anti-skid touchdown protection control remains active until the MLG squat switches signal that a landing has occurred. For this reason, wheel braking could remain unavailable for several seconds after the squat switches realize weight on wheels. In the case of landing on wet or ice covered runways, the touchdown protection will be overridden when the wheel rotation meets a specified speed requirement (59 knots). The anti-skid system can be manually activated and deactivated by the ANTISKID switch located on the landing gear control panel on the lower left hand side of the copilot's instrument panel. In the ON position, the anti-skid system will perform all normal automatic functions.

The anti-skid system also has crossover protection between outboard wheels and inboard wheels on both axles. If a counter-part wheel (i.e., outboard left or outboard right) on the other axle begins to slow, the anti-skid controller removes braking pressure from the slower wheel until the speed increases to match, and normal braking is then restored.

Parking Brake

The parking brake valve is engaged by pulling the parking brake T-handle located aft of the center pedestal. Pulling of the T-handle activates check valves within the parking brake valve that trap existing or subsequent pressure from application of the toe brake pedals. The parking brake valve also incorporates thermal relief valves to accommodate a pressure rise caused by fluid heating and expansion following engagement of the parking brake.

Figure 18-13: Parking Brake T-Handle

Parking Brake Limitation

The auxiliary hydraulic pump may not be used in flight.

The electrically powered auxiliary hydraulic pump may be used to set the parking brake if the engines are not operating. If a heavy braking condition was observed during landing, or in the event of an aborted takeoff, the brakes should be allowed sufficient cool-down time before applying the parking brake. Due to the decreased cooling airflow in a stopped condition, the thermal relief plugs in the wheel can melt, causing the MLG tire to lose pressure.

Use the following procedure to set the parking brake when the aircraft is on the ground:

1. If an engine is not operating, select the AUX button to ON until the EICAS hydraulic pressure indicates 2,400 PSI minimum.
2. Press both brake pedals.
3. Raise the PARK BRAKE handle to the full-up position and ensure that the cyan CAS message **PARK BRAKE ON** appears.

To release the parking brake, push the PARK BRAKE handle down to the stowed position and ensure that the **PARK BRAKE ON** CAS message clears.

Emergency Braking

In the event of a main hydraulic brake system failure, braking is accomplished by the use of a backup pneumatic system. The backup system uses a charged nitrogen bottle to provide pressure through dedicated pneumatic lines and an emergency brake valve located on the forward pressure bulkhead. The emergency brake valve sends this line pressure to the brake shuttle valves located on the wheel brake piston housings.

Figure 18-14: Emergency Brake Lever

Emergency braking is activated by the use of a lever, located to the left of the main pedestal underneath the pilot's side of the cockpit instrument panel. Pulling this lever enables the nitrogen charge to be distributed equally between all four brake assemblies proportional to the amount of deflection induced by the pilot. The emergency brake lever is spring loaded, which enables it to close the emergency brake valve, reduce the amount of pressure and vent residual nitrogen overboard.

NOTE:	Pneumatic brake pressure is proportional to the lever position. Use caution in initial application of the emergency brake lever until a "feel" for the deceleration rate is obtained. Too sudden of an application can result in blown main tires. Additionally, any brake pedal inputs during emergency braking will interfere with the emergency braking function; therefore, the crew must completely remove feet from pedals during emergency braking.

A fully serviced emergency brake bottle will initially provide approximately 95 cubic inches (1.5 liters) of nitrogen at a maximum of 1,800 to 2,050 PSI. The amount of brake application by the emergency brake handle is mechanically restricted in order to limit the amount of pressure metered to the brakes. Under normal braking conditions, full handle travel will result in braking that is just short of that which would cause tire skidding; however, caution should still be used so as not to over brake. The anti-skid system will not function with emergency braking. Emergency brake pressure is regulated for optimum braking at heavier weights on most dry surfaces. When surface conditions are other than dry and normal, braking application should be adjusted accordingly.

Each pull of the emergency brake lever releases more nitrogen from the brake pneumatic bottle into the brake lines. Repeated application and release will deplete available pneumatic pressure. If the emergency braking system is used, maintenance procedures are required prior to further flight.

Servicing and Procedures

Preflight Inspection

During the preliminary cockpit inspection, verify that the landing gear control handle is DOWN and confirm that the three green lights are illuminated. Set the parking brake. During the exterior preflight inspection accomplish the following checks of the landing gear and brake system:

- Conduct a visual inspection of the steering mechanism and nose gear for fluid leaks and proper strut extension.
- Visually inspect the tire for chine condition, signs of wear, and evidence of cuts or damage. Check the tires for proper inflation.
- Visually inspect the wheel well areas for condition, and the nose gear doors for condition and security.
- The nose gear door linkages should be checked in the over-center position, as evidenced when the upper portion of the door pushrod is pointing slightly outboard and the flat lower end of the linkage assembly is against the stop bolt on each side of the nose wheel well.
- Check that the emergency gear and brake pressure gauges are indicating pressure appropriate to the ambient temperature as depicted on the placard.
- Check the NWS accumulator pressure precharge by pressing and holding the NWS ACCUMULATOR BLEED button. Check that the gauge is indicating pressure appropriate to the ambient temperature as depicted on the placard. Verify the NLG torque link is connected before flight.
- Conduct a visual inspection of the main gear for tire condition and inflation, doors for condition and security.
- Inspect the wheel well areas for damaged or broken hydraulic lines and electrical wiring for condition.
- Check proper extension of MLG and NLG struts. The NLG strut extension should be between 2.9 inches to 6.5 inches and the MLG strut extension should be between 2.0 inches to 4.9 inches.
- Examine the brake wear. Brakes are normally replaced when a brake wear indicator pin is flush with the caliper housing. The parking brake must be set to provide proper brake wear indication.

Servicing

Tire Inflation

Tire pressure has a direct effect on tire wear and traction. Keeping a tire correctly inflated increases tire life and traction. An under-inflated tire wears excessively in the shoulder area. It also contributes to tire sidewall and shoulder damage from contact with the rim flanges. Excessive heat build-up due to over-inflation significantly decreases tire life.

A severely under-inflated tire requires replacement. An over-inflated tire wears excessively in the center of the tread. Under-inflation increases tire susceptibility to cuts and gouges.

Tire inflation should be accomplished by qualified maintenance personnel. Refer to the Aircraft Maintenance Manual, Chapter 12 for tire servicing procedures and pressure values.

Strut Servicing

Strut servicing requires qualified maintenance personnel and specific equipment. Strut servicing requires jacking the aircraft. Dry nitrogen inflates the struts and MIL-H-5606 hydraulic fluid fills them (not the phosphate ester-based hydraulic fluid used in the aircraft's main hydraulic system).

Refer to the Aircraft Maintenance Manual, Chapter 12 for strut servicing procedures.

Abnormal Procedures

Landing Gear Will Not Extend

When the red GEAR UNLOCK light remains illuminated and one or more of the three green GEAR DOWN lights fail to illuminate, hydraulic or electrical problems are interfering with landing gear extension.

Pull the LDG GEAR CONT 1 circuit breaker on the left circuit breaker panel. Check if the LANDING GEAR handle is DOWN and the airspeed is below 210 KIAS. Pull the LANDING GEAR BLOWDOWN handle. Verify that the landing gear is DOWN and LOCKED (3 green lights illuminated).

> ***NOTE:*** If the LANDING GEAR handle is locked up, the blowdown will bypass the hydraulic system. After the gear blowdown has actuated, the gear cannot be retracted.
> If the LANDING GEAR BLOWDOWN handle interferes with aircrew duties, the handle may be pushed back in to stow.

If either main landing gear fails to extend using the hydraulic or pneumatic method, pull the MLG uplock handle, located in aft cabin. If the nose landing gear fails to extend using the hydraulic or pneumatic method, pull the NG UPLOCK "D" Ring (located under the copilot's tilt panel), then stow. Ensure that the landing gear is verified DOWN and LOCKED (3 green lights illuminated). Yaw aircraft left and right as required to engage MLG downlocks.

Anti-Skid Failure

The amber **ANTISKID FAIL** CAS message is displayed when an anti-skid fault lasting for more than 1 second has been detected or if the anti-skid system is turned off. Cycle the ANTI-SKID switch to OFF, then ON. If the message does not clear, turn OFF the ANTI-SKID switch. Multiply FLAPS 35° landing distance by 1.29.

CAUTION
With anti-skid off, anti-skid touchdown protection is not available. Make sure the brakes are not applied while touching down. Apply wheel brakes lightly. Differential power braking operates without anti-skid protection.   **With anti-skid inoperative, excessive pressure on the brake pedals will likely cause the wheel brakes to lock, resulting in tire blowout.**

Weight-On-Wheels System Malfunction

The amber **WOW MISCOMPARE** CAS message is displayed when the WOW module has detected a miscompare between the squat switches or the MAU has detected a miscompare between WOW modules.

The following systems or equipment may be affected (the required squat switches for operation are in parentheses):

- Anti-skid touchdown protection may not be available (one main gear on ground).
- Baggage heat valve may remain open after landing without posting amber **BAGGAGE HEAT FAIL** CAS message (one main gear on ground).
- Idle speed may set to ground idle (one main gear on ground).
- Landing gear retraction may not be available (nose gear in air and one main gear in air).
- Nosewheel steering may not be available (nose gear and at least one main gear on ground).
- Thrust Reversers are not available (all three gear on ground).
- Taxi lights are not available (all three gear on ground).

Emergency Procedures

Hydraulic Wheel Brake Failure

Remove feet from the brake pedals. Pull and hold the EMERGENCY BRAKE handle until the aircraft stops. Apply smooth, steady pressure to the emergency brake handle. Repeated application and release will deplete available pneumatic pressure. Anti-skid is inoperative. Emergency brake pressure is regulated for optimum braking at heavier weights on most dry surfaces. Increase the Flaps 35° landing distance by a factor of 1.37. Maintain the directional control with nosewheel steering.

Nosewheel Steering Malfunction

Push and hold the AP/TRIM/NWS DISC button to disable nosewheel steering. An amber **PRIMARY STAB TRIM FAIL** CAS message will be displayed on the EICAS while the button is pressed. Use rudder or differential braking for directional control.

NOTE: The NWS fails passive to a free castor mode. Shimmy damping will still be available.

Wheel Fusible Plug Considerations

Brake application reduces the speed of an airplane by means of friction between the brake stack components. This friction generates heat, which increases the temperature of the brake and wheel assembly, resulting in an increased tire pressure. Each main wheel incorporates fuse plugs, which melt at a predetermined temperature, to prevent a possible tire explosion due to excessively high tire pressure.

Flight crews must take precautions when conducting repetitive traffic circuits, including multiple landings and/or multiple rejected takeoffs, to prevent overheating the brakes, which could melt the fuse plugs and cause loss of all tire pressure and possible tire and wheel damage. During such operations, available runway permitting, minimize brake usage and consider cooling the brakes in flight with the landing gear extended. Maximizing use of reverse thrust and extending speed brakes will assist in bringing the airplane to a stop.

EICAS System Displays

Information regarding the landing gear, brakes, anti-skid and nosewheel steering is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit.

Messages are displayed in cyan or amber according to their urgency. The following are possible messages displayed that relate to the Landing Gear, Brakes, Nosewheel Steering, and WOW systems.

For specific corrective actions associated with each CAS message, refer to the appropriate Emergency/Abnormal checklist or the FAA-approved AFM.

Cyan Message	Description
MAIN WHEEL SPINDOWN FAIL	This message is displayed 12 seconds after initial gear retraction and indicates that the spindown feature of the anti-skid has failed. This message is removed with Epic Phase 4 software or higher.
AUX HYDRAULIC PUMP ON	This message indicates that the HYDRAULIC PUMP AUX button has been selected ON.
PARKING BRAKE ON	This message is displayed when the parking brake is on and brake pressure is adequate.
Amber Message	**Description**
ANTISKID FAIL	This message is displayed when an anti-skid fault lasting for more than 1 second has been detected or if the anti-skid system is turned off.
WOW MISCOMPARE	This message is displayed when the WOW module has detected a miscompare between the squat switches or the MAU has detected a miscompare between WOW modules.
PARKING BRAKE LOW PRESSURE	This message is displayed when the parking brake handle is not stowed and the pressure switch indicates less than 1,850 PSI. This message is only displayed on the ground.
PARKING BRAKE ON	This message is displayed when the PARK BRAKE handle is not stowed, and either throttle is advanced above the CRU detent. This message will also display in flight any time the PARK BRAKE handle is not stowed.

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Miscellaneous

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Warning and Test

General

The Monitor, Warning and Test systems are discussed here primarily to clarify their relationship with the Engine Indicating and Crew Alerting System (EICAS). These systems operate in concert with the EICAS system, which is a function of avionics, and is covered in more detail in Chapter 11, Avionics.

Monitor and Warning System

The Monitor and Warning System (MWS) for the Citation Sovereign is a software function residing in two processor modules:

- Modular Avionics Unit (MAU) 1.
- MAU 4.

Normally both processor modules are active and provide specialized functions; however in event of a malfunction, a single MAU can continue operation of the monitor warning features. The first MAU to receive power becomes the controlling MAU for displaying CAS messages, and the other MAU provides comparison monitoring and backup for the controlling MAU.

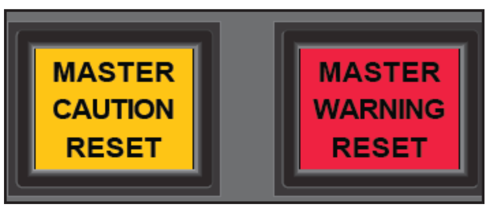

Figure 19-1: Master Warning and Master Caution Buttons

Figure 19-2: Fire Buttons

All monitored components, systems and subsystems are directly linked to the processor modules through the Avionics Standard Communication Bus (ASCB) or indirectly through Input/Output (I/O) modules communicating over ARINC-429 busses.

Thresholds for initiation of Warning, Caution and Advisory notifications over the crew alerting system (CAS) are software programmable and are set as part of the aircraft configuration model compiled by the ASCB. System and subsystem function CAS thresholds may be software determined or set by position information from hardware units (e.g. weight-on-wheels switches, speed brake position, etc.). If a CAS threshold is exceeded, the MWS prompts the display of the appropriate text message on the cockpit Display Unit (DU) configured for CAS messages.

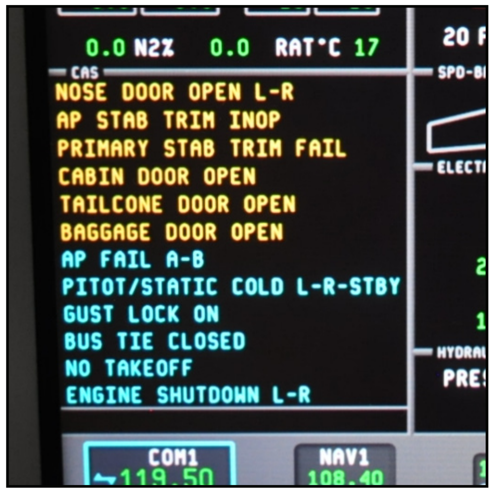

Figure 19-3: CAS Messages

The messages are displayed in red, amber or cyan (blue) text appropriate to the urgency of the malfunction and arranged chronologically with the most recent message at the top of the category. MAUs 2 and 3 illuminate the MASTER WARNING and MASTER CAUTION buttons, as well as the aural alerts, as commanded by MAUs 1 and 4.

- Red text for warnings indicates a condition that may result in injury or loss of life.
- Amber text for cautions indicates a condition that may result in damage to or loss of equipment.
- Cyan text for advisories includes indication of a condition degraded from normal operational specifications.

CAS Messages and Warning/Caution Buttons

CAS messages are displayed using upper case text. The CAS display accommodates twelve (12) lines for messages, with space reserved for status information and scroll buttons. There are approximately 100 possible digital CAS messages, depending upon optional equipment installed. These messages are discussed in Chapter 11, Avionics, under EICAS.

The text of warnings, cautions and advisories flashes on the CAS display when initially presented. Warnings and cautions also prompt the illumination of indicator lights located on the outboard sections of the cockpit glareshield: a red MASTER WARNING RESET button for warnings and an amber MASTER CAUTION RESET button for cautions (advisories do not warrant the additional indication). CAS messages are accompanied by aural tones broadcast over the cockpit speakers and cockpit headsets.

A double chime signals a warning condition and a single chime signals a caution condition. Advisory (cyan) messages are not accompanied by an aural chime. The glareshield indicator lights will illuminate, aural chimes will sound once, and CAS message text will continue to flash until either the pilot or copilot depresses the appropriate WARNING or CAUTION indicator light on the glareshield panel, cancelling the flashing “inverse video” indication and reverting the CAS text to steady display. Depressing the WARNING or CAUTION button also re-arms the indicator for any subsequent condition requiring illumination. The flashing text accompanying cyan advisories are active for only five seconds.

In some cases, system or equipment malfunctions that prompt CAS messages and illuminate glareshield indicator lights also cause the annunciator in the control switchlight for the associated system or equipment to illuminate. Annunciator lights are installed in panels throughout the cockpit, with most residing in the pilot and copilot tilt panels.

Aural Warnings

Aural signals associated with the display of CAS messages are computed by the MWS and output to the cockpit audio panels and speakers. Double chimes, female voice, or male voice are available and selected by maintenance personnel. Only specific red messages have associated voice messages. Additional aural warnings are provided for EGPWS, TCAS, autopilot disconnect, altitude alert, and other systems.

CAS Scroll

The CAS scroll may be used to scroll amber caution and/or cyan advisory messages up or down on the CAS display window in order to declutter the window or recall previously hidden messages. (Red Warning messages cannot be moved on the CAS display.) This is accomplished by using the knob located on either Cursor Control Device (CCD) with the cursor positioned over the CAS display. Caution messages must have been acknowledged with the glareshield switchlights and advisory messages must be displayed in steady mode in order for the CCD knob to move the messages on the display. When messages are scrolled from the CAS display, a status bar on the lowest line of the display will contain a numerical indication of the number of messages hidden from view with an arrow corresponding to direction that the messages have been scrolled. Caution message status is shown in amber on the left side of the display, and advisory status is indicated in cyan on the right of the display. If caution and/or advisory messages are removed from the display, the annunciation of a new message will recall the previously scrolled messages. A new caution message will recall both existing caution and advisory messages, but a new advisory message will recall only scrolled advisory messages.

Figure 19-4: Cursor Control Device with Scroll Knob

Message Debounce and Inhibit Functions

"Debounce" is defined as the required time for a condition to be true before activating a CAS message, voice or chime. Debounce also applies to the time a condition must be true before an existing message is promoted from a less severe color message to a more severe color. Specific CAS message debounce durations of interest to pilot operations can be found in the appropriate Emergency or Abnormal checklist procedure, where applicable.

Most CAS messages have inhibits that reduce crew workload and nuisance messages. The seven inhibits include:

- TOPI – Takeoff phase inhibit
- LOPI – Landing operations phase inhibit
- ESDI – Engine shutdown inhibit
- EFI – Engine fail inhibit
- BFI – Bus fail inhibit
- ON GROUND inhibit
- IN AIR inhibit

Inhibit function thresholds are software determined based upon engine or electrical configuration, or set by position information from hardware units (e.g. weight-on-wheels switches, speed brake position, etc.) If a threshold is exceeded, the MWS prompts the display of the appropriate CAS message. The majority of these functions and their associated logic are normally not apparent to the crew.

Monitor Warning System Failure

With a failure of a MWS function, comparison monitoring function or aural function in any MAU, an amber MONITOR WARNING FAIL L and/or R CAS message will display. A failure of both monitor warning channels or both MAUs 1 and 4 will result in the loss of CAS messages, indicated with a large red "X" positioned over the CAS display area.

Standby Annunciators

Four standby annunciators are located on the center cockpit panel above the standby instruments:

- L-R FUEL LOW (amber)
- STAB NO TAKEOFF (red)
- GEN OFF (red)
- L-R OIL PRESS (red)

These annunciators receive power from the left and right emergency buses and serve as a backup to the normal CAS message display.

Altitude and Speed Brake Monitor System

General

The altitude and speed brake monitor system provides a warning through the illumination of an amber **SPEED BRAKES** CAS message if the airplane is airborne but at less than 500 feet in altitude and the speed brakes are not stowed. It is designed to warn that the speed brakes are in use below 500 feet altitude, which could result in an undesirable rate of descent near the ground.

Description

A ground signal is provided from the radio altimeter when the airplane is at less than 500 feet in altitude; a ground-in-air signal is then obtained from the left and right squat switches and the monitor circuit outputs a SPEED BRAKE signal to the CAS system.

The following configuration will trigger an amber CAS message from the altitude and speed brake monitoring system:

- Speed brakes not in the STOWED position.
- Airplane is airborne at less than 500 feet in altitude.

An asymmetrical deployment of the speed brakes in which the asymmetry exceeds 5% will also result in an amber **SPEED BRAKE** CAS message, to warn of the abnormal condition.

No Takeoff Warning System

The no takeoff warning system is designed to prevent a takeoff when a hazardous condition exists which would render the takeoff unsafe due either to airplane configuration or to system malfunction(s). A cyan or red digital **NO TAKEOFF** annunciation advises of an unacceptable configuration or condition for takeoff. The cyan message will occur when either Throttle Lever Angle (TLA) is less than 60° and the weight-on-wheels (squat) switches show an on-ground condition. The digital **NO TAKEOFF** message will change to red when the TLA of either throttle is increased past 60°. At this time the “NO TAKEOFF” aural warning will sound. The no takeoff annunciation can be cleared only when the situation causing it is corrected.

Conditions that contribute to a **NO TAKEOFF** message are listed in the following table:

NO TAKEOFF ITEMS	NO TAKEOFF WINDOW DISPLAY	CAS MESSAGE
Cabin door is open	Cabin Door Open	CABIN DOOR OPEN
Parking brake is on	Park Brake on	PARKING BRAKE ON
Pitch Roll Disconnect is engaged	Pitch Roll Disc	PITCH/ROLL DISCONNECT
Flaps are not in takeoff configuration (flaps ≠ 7° (±1°) or ≠ 15° (±1°))	Flap Config	None
SPEEDBRAKE handle is not stowed	Speedbrakes	None
Gust lock is on	Gust Lock On	GUST LOCK ON
Stabilizer, aileron, or rudder trim not in the takeoff band	Stabilizer Trim Aileron Trim Rudder Trim	None
Parking brake pressure is low	Park Brake Press	PARKING BRAKE LOW PRESSURE
Aileron ratio changer is not in takeoff position	Roll System	ROLL SYSTEM CONTROL FAULT
Rudder bias actuator is not in the takeoff position	Rudder Bias	None
Thrust reverser emergency stow is engaged	T/R Emer Stow L T/R Emer Stow R	None

Door Unlocked Warning System

An amber **CABIN DOOR OPEN** CAS message will illuminate at any time the cabin door switches indicate the cabin door is in the open position, the inner handle is not secured, the locks are not engaged, or the monitor system operation has not been verified correct.

The cabin door is secured with an over-center main bellcrank, which in turn drives rotating cam locks positioned on the door frame. Inspection windows near each cam lock allow for visual inspection of the locking mechanisms.

Figure 19-5: Cabin Door

The door is electrically monitored by microswitches, and must be closed with main DC power selected on. If the door is not properly closed, the inner handle is not secured, the locks are not engaged, or the monitor system has not been verified correct, an amber **CABIN DOOR OPEN** message illuminates on the CAS portion of the EICAS display.

If the cabin door is closed prior to turning the batteries on or if power to the left main electrical bus is interrupted after closing the door, the amber **CABIN DOOR OPEN** CAS message will be displayed and the door must be cycled to clear the CAS message.

Above 80 knots ground speed, a locking solenoid engages the inner door handle to prevent it from inadvertently being moved during flight.

The baggage compartment door has four pins and latches which secure the door closed. The door is monitored electrically and will display an amber **BAGGAGE DOOR OPEN** CAS message when any baggage door sensor indicates the door is not fully closed, any of the four clasps are unlatched, or any one or more of the sensors are faulted.

In addition to the main cabin door and baggage door warning systems, the following amber annunciations will appear if the respective door is not properly closed at the mechanical latches:

- EMERGENCY EXIT OPEN
- LAVATORY DOOR
- NOSE DOOR OPEN L and/or R
- TAILCONE DOOR OPEN

A proximity switch on the upper doorframe monitors the emergency exit door on the right side of the airplane. If the locking pin in that position is unsafe, the switch will send a signal to the CAS system, which will illuminate an amber message ESCAPE HATCH OPEN. The MASTER CAUTION will also illuminate.

Figure 19-6: Cabin Door Seal

Overspeed Warning System

The on-side Micro Air Data Computer (MADC), backed up by the opposite MADC, feeds Mach and airspeed information to the aural warning system, which sounds a pulsing horn when speed exceeds V_{MO} or M_{MO} (maximum operating speed limit).

Test System

The rotary test selector switch is located on the right side of the center pedestal and offers a means of testing visual and aural warning systems. The system will function only when at least BATT switch is selected ON. A light above the test selector switch illuminates when the test selector switch is in any position other than off.

Figure 19-7: Rotary Test Knob

Test Selector Switch Positions

SWITCH POSITION	TEST FUNCTION	CAS MESSAGE	AURAL	LIGHTS	INHIBITS
SMOKE/DET	Performs a self-test of the smoke detector and checks the integrity of its aural/visual warning interface	BAGGAGE FIRE	CHIME	Master Warning	-
LDG GR	Performs a self-test of the landing gear warning systems and a lamp test of landing gear indicator lights 2.	-	LANDING GEAR WARNING HORN (flaps <24°)	Landing Gear Module Lights	-
FIRE WARN	Performs self-test of the engine fire detection systems and checks the integrity of its aural/ visual warning interface.	ENGINE FIRE L-R	-	Master Warning, APU FIRE, Engine Fire Warning Lights	Aurals Muted
STAB TRIM	Performs a self-test of the horizontal stabilizer trim system.	AP STAB TRIM INOP, PRIMARY STAB TRIM FAIL, STAB TRIM MONITOR WARNING	-	Master Caution	-
FLAP	Performs a self-test of the flap controller.	FLAPS FAIL	-	Master Caution and 2 Flap Annunciator Lights	-
W/S TEMP	Checks automatic control and operation of the electric windshield system.	WINDSHIELD HEAT INOP L-R, WINDSHIELD OVERTEMP L-R RAT HEAT FAIL L-R	CHIME	Master Caution	-
OVERSPD	Tests overspeed warning horn	-	OVERSPEED HORN	-	-
AOA	Self-tests the AOA computers and checks the stick shakers; checks the optional AOA indexer.	AOA/STALL WARN FAIL L-R	-	Optional Indexer	Aurals Muted
ANNUN	Performs lamp test of discrete annunciators.	OIL PRESS LOW L-R, FUEL PRESS LOW L-R, HYD PUMP FAIL A-B	-	Optional Annunciator Lights, GPWS and wind Shear Annunciators.	Aurals Muted
BLD LK DET	Performs a self-test of the bleed leak detection system.	ACM BLEED LEAK, STAB BLEED LEAK, SUPPLY BLEED LEAK L-R, WING BLEED LEAK L-R	-	Master Caution	-
SPARE	-	-	-	-	-
OFF	Disables all test functions. Red light will be off.	-	-	-	-

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Oxygen System

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Oxygen System

General

The Citation Sovereign is equipped with an oxygen system that provides supplementary oxygen for the cockpit quick-donning masks and the passenger continuous flow masks during emergencies (depressurization or in case of fire or smoke in the cabin). The system can be manually activated at any time to comply with regulations mandating oxygen use above certain cabin altitudes, or in case of emergency need by an indisposed passenger. Cabin altitude can normally be maintained at or below 8,000 feet by the aircraft's pressurization system.

Description

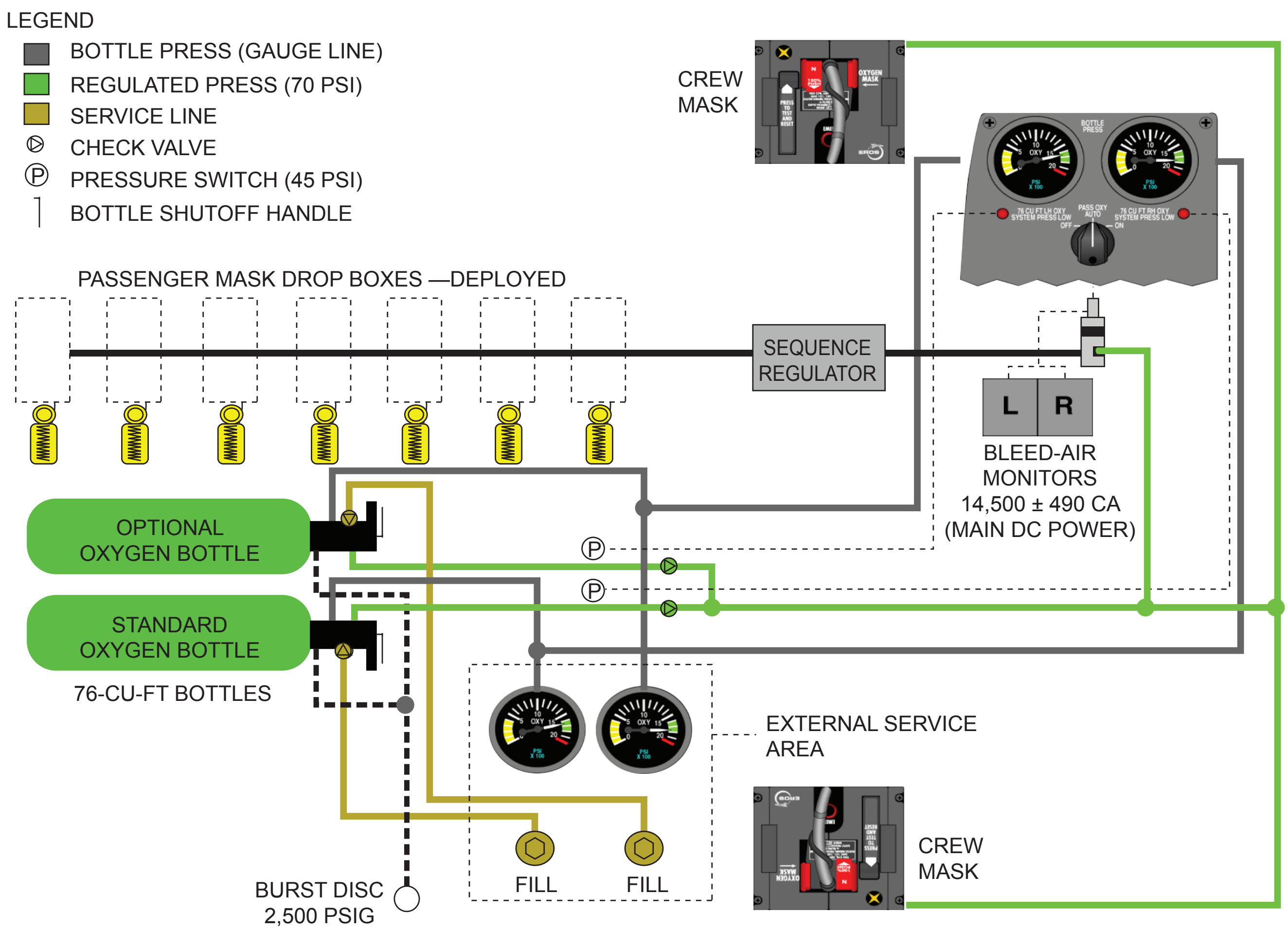
The aircraft supplemental oxygen system is designed for use to a maximum cabin altitude of 40,000 feet. The system consists of a standard one-cylinder storage bottle installation or an optional two-cylinder installation. The system is designed to ensure that the crew has an oxygen supply available at all times, independent of the passenger oxygen supply.

The crew controls the supply of oxygen to the passengers with a control valve selector located in the cockpit. The passenger oxygen system is normally set to allow the passenger masks to drop automatically from overhead storage boxes if cabin altitude climbs above 14,500 feet. The masks can also be deployed manually.

The standard aircraft oxygen system consists of the following components:

- Oxygen storage cylinder(s) and regulator(s)
- Oxygen service panel
- Pressure transducers
- Sequence regulator
- Passenger overhead oxygen drop boxes
- Crew oxygen masks and smoke goggles
- Passenger oxygen masks
- Portable oxygen bottle

Oxygen System Schematic



Components

Storage Cylinders and Regulators

Oxygen is stored in single or dual (optional) 76-cubic-foot cylinder(s) located in the belly fairing just aft of the Oxygen Service Panel. Pressure for the oxygen system is regulated at the cylinder. Two pressure gauges are installed, one located on the LH side of the instrument panel and the other at the Oxygen Service Panel. Oxygen cylinder pressure is read from these two gauges. Prior to flight, the pilot is required to check the oxygen quantity of the cylinder and select the flow schedule desired. A green arc on the oxygen pressure gauge indicates acceptable preflight pressure range.

A pressure relief valve prevents over-pressurization of the bottle. A green disc located at the end of the pressure relief tube (below the oxygen service panel) blows out if the bottle pressure is too high. During the preflight inspection, the crew must check to ensure that the disk is secure in the tube.

Service Panel

The oxygen service panel is on the right side of the fuselage in front of the wing fairing. A fill port and a pressure gauge provides servicing and oxygen pressure monitoring.

Figure 20-1: Oxygen Service Panel

Pressure Transducers

Control of the oxygen supply for the passengers is by means of the Oxygen Control Valve, which can be selected to ON, OFF, or AUTO. In AUTO, two pressure transducers sense cabin altitude. If cabin altitude rises above 14,500 (±490) feet, a solenoid on the Passenger Oxygen Control Valve is energized, allowing passenger oxygen to flow through the valve to the sequence regulator.

Sequence Regulator

The sequence regulator adjusts oxygen pressure relative to altitude before flowing to the passenger oxygen masks.

Crew Oxygen System

Stowage Box

Two EROS crew oxygen masks are stowed in OXYGEN MASK service boxes on the outboard cockpit consoles. The storage boxes fully enclose the masks and associated hose connections. When a mask is in the service box and the doors are closed, oxygen pressure is available to the service box but not to the mask. A bayonet inside the box provides a quick disconnect for the oxygen supply hose. The masks must be properly stowed to qualify as quick-donning masks.

Figure 20-2: Stowage Box

An oxygen flow indicator (blinker) and TEST/RESET switch are located on the storage box cover. Opening the left storage box door starts oxygen flow to the mask and causes a white "OXYGEN ON" flag to appear on the door. During preflight, pressing and holding the TEST/RESET switch will cause the blinker to show yellow for a few seconds, and then return to black. During in-flight mask use, proper oxygen flow can be confirmed by monitoring the blinker for a yellow indication when the user inhales. When stowing the mask, TEST/RESET must be depressed to retract the "OXYGEN ON" flag and remove pressure to the mask. As the mask is placed back in the storage box, a retaining pin on the left door must engage a receptacle built into the NORMAL 100% lever.

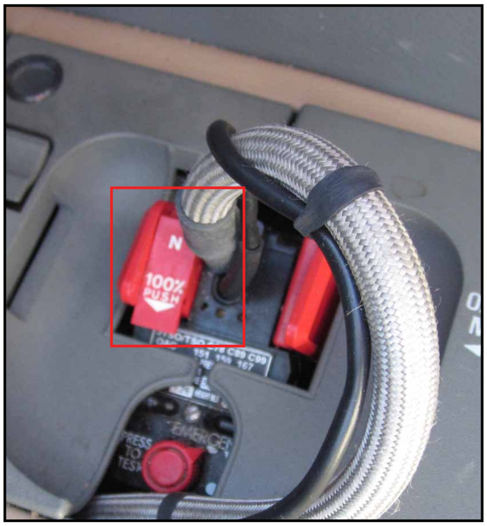


Figure 20-3: N 100% PUSH Actuator

Mask Operation

The standard EROS crew mask is a quick donning diluter-demand/pressure breathing mask with an integral microphone and oxygen regulator. It is certified to a maximum cabin altitude of 40,000 feet.

A red rocker lever on the bottom of the mask labeled "N" and "100%" selects either NORMAL or 100% oxygen scheduling to the mask. In the NORMAL mode the regulator increases the proportion of oxygen mixed with cabin air as cabin altitude increases. Above approximately 27,000 feet cabin altitude, the NORMAL mode provides 100% oxygen. The 100% mode provides 100% oxygen at all cabin altitudes. To provide the quickest recovery from hypoxia symptoms, the mask should be stowed with 100% selected. To conserve oxygen, in the case of the absence of smoke and/or fumes, the mask should be switched to the NORMAL mode when worn at any cabin altitude for an extended period of time.

The mask is removed from the service box by grasping the two mask ears and pulling. As the mask is removed, the storage box doors open outward and oxygen pressure is applied to the mask.

Depressing the red tab on the front of the mask (left side as viewed while wearing the mask) inflates the harness for donning. Releasing the tab causes the harness to conform to the user's head. To prevent damage to the harness it should not be inflated until the mask is completely out of the storage box.

The mask automatically supplies oxygen under pressure (pressure breathing) beginning at approximately 35,000 feet cabin altitude. Automatic pressure breathing is available in either NORMAL or 100% mode. Once pressure breathing begins, pressure supplied to the mask gradually increases as cabin altitude increases. Ability to speak via the mask microphone is not significantly impaired during pressure breathing.

A red knob on the bottom of the mask labeled "EMERGENCY" provides selection of 100% oxygen flow and creates a positive oxygen pressure in the mask. Turning the knob approximately one-quarter turn in the direction of the arrow selects emergency mode. Pressing the knob in momentarily may be used for mask preflight to ensure flow to the mask. Continuous emergency mode must be used in a smoke and/or fumes environment to provide positive pressure to the mask and goggles. Once the need for emergency pressure has been alleviated, emergency mode should be deselected, as the oxygen consumption is high.

Crew Microphone Buttons

The microphone buttons for each pilot position are located on the left and right tilt panels and are labeled MIC/SEL. The button is pushed to activate the crew mask microphone and illuminates "MASK" in the switch. Pushing the button again activates the headset microphone and illuminates "HEADSET" in the button. Depressing the microphone button on the appropriate control wheel allows a crew member to transmit through whichever microphone is selected.

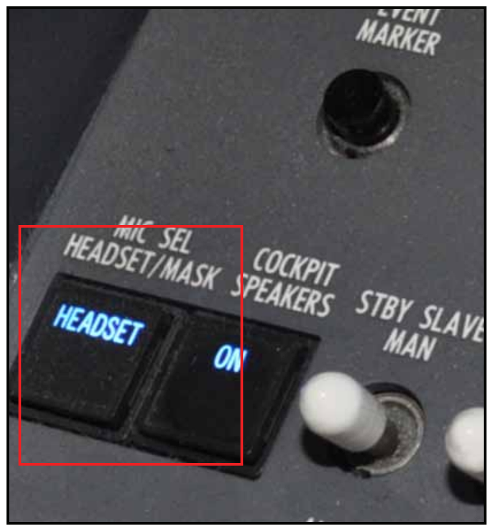


Figure 20-4: MIC SEL HEADSET/MASK Button

Smoke Goggles

Smoke goggles are designed to fit over the mask and interface with the vent on the side of the mask nose-bridge area. In a smoke and/or fumes environment, the mask should be donned first and then the goggles. As provided on the standard mask installation, a gray plastic slide on the mask nose-bridge may then be pulled downward, opening the goggle vent. The vent is fully open when a red band is visible above the slide. On the optional full-face mask installation, the vent is opened automatically by donning the goggles. Finally, the upper harness tubes should be placed over the lower sides of the goggle's frame to provide maximum sealing. When smoke and/or fumes have been eliminated, smoke goggles should be removed, the mask should be switched out of emergency mode, and the nose-bridge valve closed.

Passenger Oxygen System

Pressure Transducers

Cabin pressure is sensed by two solid state pressure transducers. The oxygen control valve opens when the PASS OXY selector is in AUTO and cabin altitude is greater than 14,500 (±490) feet. This allows oxygen flow through the valve to the sequence regulators on the passenger masks.

Passenger Oxygen Drop Boxes

Passenger oxygen is made available to cabin occupants from oxygen drop boxes in the cabin center overhead. The location and number of drop boxes varies depending upon the aircraft seating configuration. Each box is equipped with two oxygen masks. Each passenger mask has a head strap, a three-foot length of plastic tubing, a lanyard with a pintle pin, and an oxygen dispensing valve.

> ***NOTE:*** To allow proper operation of the passenger oxygen system, the cabin must be warmed up to at least 60°F (15°C) as indicated on the cabin temperature gauge if the aircraft has been exposed to prolonged temperatures below -9°C. This is required for flight above FL250.

Sequence Regulator

The sequence regulator is in the low-pressure oxygen lines. When the passenger oxygen control valve is open (cabin altitudes above 30,000 feet), the sequence regulator allows a full 70 (±10) PSI oxygen pressure to be delivered to the passenger masks.

At cabin altitudes from 14,500 to 26,000 feet, the sequence regulator decreases flow of oxygen pressure to approximately 36–41 PSI, with a momentary surge of 70 (±10) PSI, to unlock the passenger oxygen drop boxes.

Passenger Oxygen Control Panel

The PASS OXY selector is on the left side tilt panel below the oxygen pressure gauge.

The selector has three positions:

- OFF position: The manual valve closes and shuts off oxygen supply to the passengers. Oxygen is still available to the crew.
- AUTO position: At cabin altitudes greater than approximately 14,500 feet, the passenger oxygen valve opens automatically, providing oxygen to the passengers. AUTO Operation requires main DC electrical power. If the cabin altitude subsequently decreases below approximately 11,000 feet, the passenger oxygen control valve closes, shutting off flow to the masks.
- ON position: The manual valve opens and oxygen is available immediately to the passengers. The ON position does not require electrical power.

Figure 20-5: PASS OXY Selector

Passenger Oxygen Masks

Passenger oxygen masks are of the constant pressure/continuous flow oral-nasal type that form around the mouth and nose area. An orifice located in the mask tubing provides a constant flow of approximately 4.5 liters/min to each passenger regardless of altitude. Once the masks are dropped, the passengers begin the oxygen flow by pulling the mask down. Once pulled, the lanyard attached to the pintle pin will disengage the pin, beginning the flow of oxygen.

Portable Oxygen Bottle

A portable 11-cubic-foot oxygen bottle is stowed in the forward cabin area. The bottle contains a regulator and multiple connections to accommodate both crew and passenger system oxygen masks.

Servicing and Procedures

Preflight Inspection

During the cockpit inspection accomplish the following checks of the oxygen system:

- Ensure that the smoke goggles are stowed in the service boxes below the crew oxygen masks.
- Test each crew oxygen mask as follows:
  - On the left door of the regulator/mask compartment, press the test button.
  - Verify oxygen flow to the mask regulator assembly can be heard.
  - Verify the flow indicator shows yellow momentarily, then black, indicating the regulator is not leaking. If the blinker remains yellow, check for leakage in the system.
  - While holding the RESET TEST button in the aft position, push the regulator red PRESS TO TEST button in.
  - Check that the blinker turns yellow and remains yellow for as long as button is depressed.
  - Release the RESET TEST button.
  - Check that the blinker returns to black, showing that the regulator demand mechanism is operating properly.
- Check available oxygen pressure on the cockpit gauges as per the oxygen bottle preflight table.
- Ensure that the PASS OXY selector is positioned to AUTO. Use caution to prevent inadvertent selection to the ON position of the selector knob.

TEMP (°F)	-40	0	70	100	120
PRESS (PSI)	1290	1475	1800	1940	2075

Table 20-1: Oxygen Bottle Preflight Table

> ***NOTE:*** The two red O2 SYSTEM PRESS LOW lights on the optional extended range oxygen panel will illuminate during the warning systems ANNUNCIATOR test.

Oxygen Supply Duration

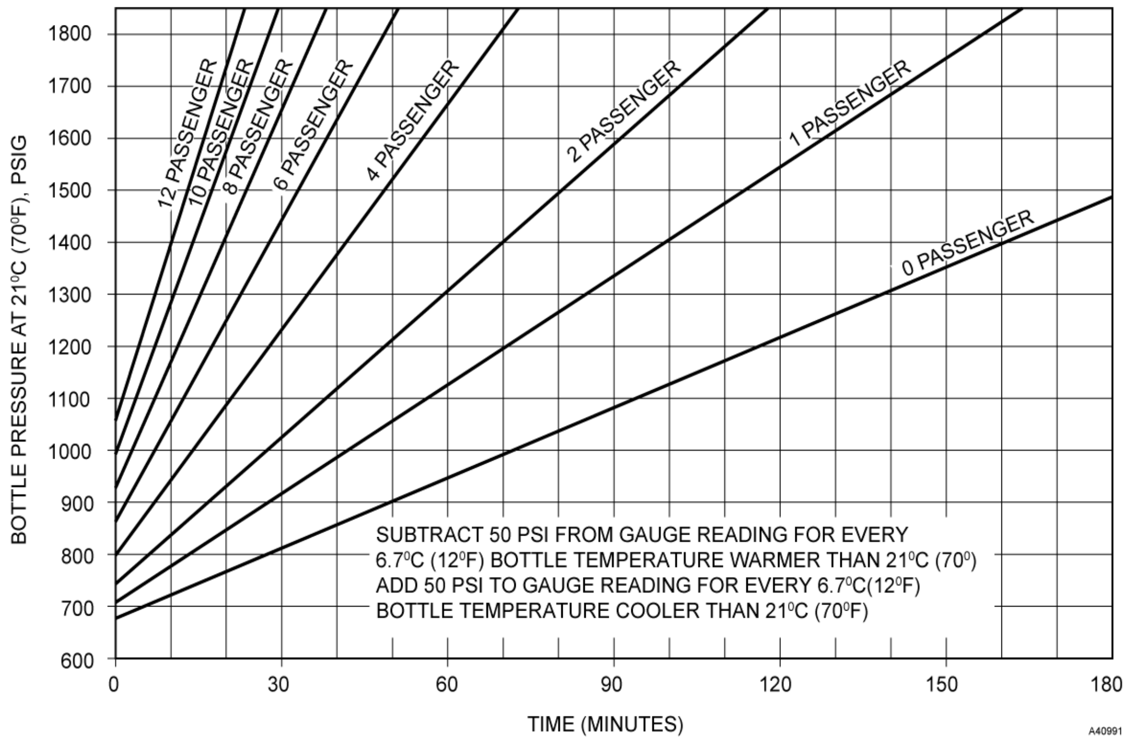


Figure 20-6: Oxygen Duration with Single 76-Cubic-Foot Bottle

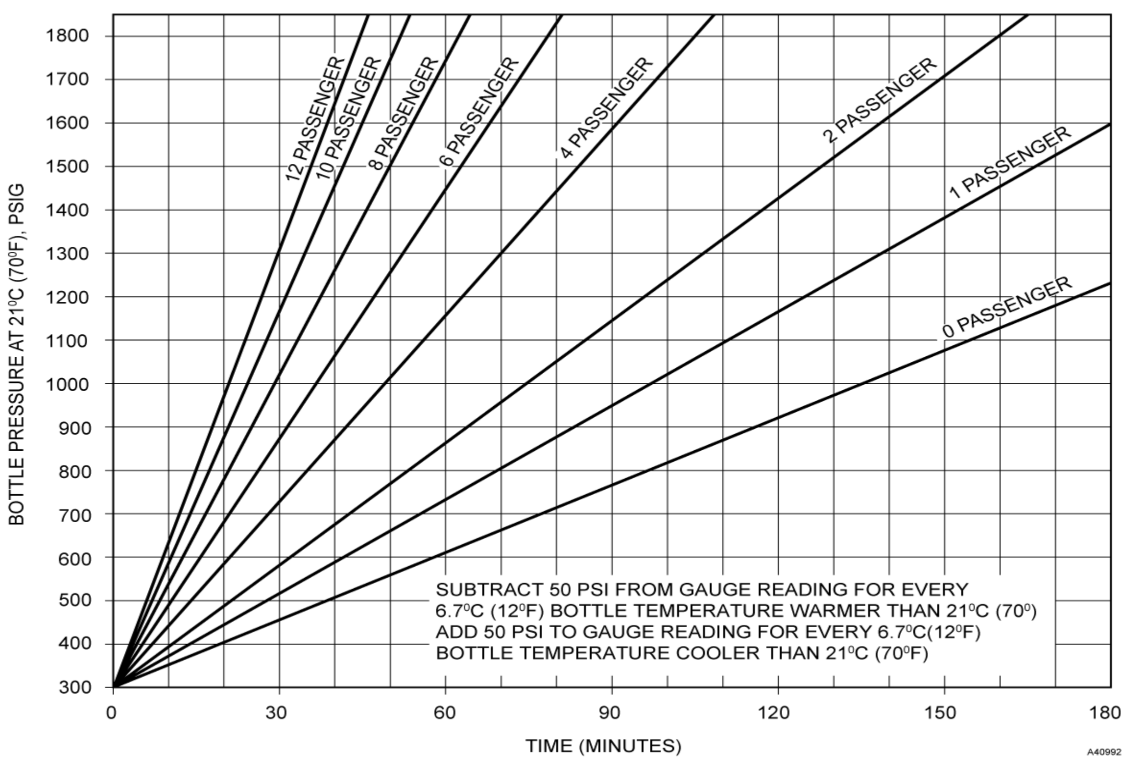


Figure 20-7: Oxygen Duration With Second 76-Cubic-Foot Bottle (If Installed)

Servicing

The oxygen system must be serviced with aviator's breathing oxygen. Servicing pressure varies with ambient temperature. Refer to the AFM for minimum oxygen supply required for the crew.

Always refer to the Cessna Citation Sovereign Maintenance Manual, Chapter 12 for correct oxygen servicing procedures and precautions. Failure to follow safety precautions can result in a serious fire, injury, and damage to the aircraft.

Abnormal Procedures

Use of Supplemental Oxygen (Unpressurized)

When operating the aircraft in unpressurized flight, ensure that the crew oxygen masks are set to NORMAL below FL250 cabin altitude and 100% at or above FL250. Make sure crew and passengers are receiving oxygen.

With passengers on board, do not exceed FL250. With crew only, do not exceed FL400. Check oxygen endurance per AFM tables and compute aircraft range (based upon oxygen endurance and revised fuel flow and ground speed).

Oxygen Low Pressure Light Illuminated (Extended Range Oxygen System Only)

With the optional two-bottle oxygen system installation, an illuminated red LED indicates low pressure in the supply line from an individual bottle.

If the oxygen bottle gauge reads near zero, the oxygen supply has been exhausted in the affected bottle. If the oxygen bottle gauge shows adequate pressure available, the oxygen supply in the affected bottle is not available for use (probable cause: the bottle valve has been turned off). Plan to use the remaining bottle only.

Emergency Procedures

Loss of Cabin Pressurization

In the event of cabin pressurization loss during flight, don oxygen masks immediately and select 100% mode. Select left and right MIC SEL buttons to MASK. Commence an emergency descent if required.

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EICAS System Displays

Information regarding the oxygen system is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit.

Messages are displayed in cyan, amber or red, according to their urgency. The following are possible messages displayed that relate to the Oxygen system.

Cyan Messages	Description
CABIN ALTITUDE	This message indicates the cabin altitude is above 8,000 feet and the pressurization controller is set for the high elevation airfield mode (landing field elevation above 8,000 feet). If the cabin altitude exceeds 12,000 feet while operating in high elevation airfield mode, it is recommended that at least one pilot don an oxygen mask.
Amber Messages	**Description**
CABIN ALTITUDE	This message is displayed when the cabin altitude exceeds 8,500 feet due to failure of the pressurization system. This message is also displayed when the pressurization system is operating in high elevation airfield mode and (1) the cabin altitude exceeds 9,650 feet for more than 30 minutes or (2) the cabin altitude exceeds 8,500 feet and the aircraft is above 24,500 feet MSL.
Red Messages	**Description**
CABIN ALTITUDE	This message is displayed when the cabin altitude exceeds 10,000 feet (14,500 feet in high elevation airfield mode).

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Powerplant and Thrust Reverser

Contents

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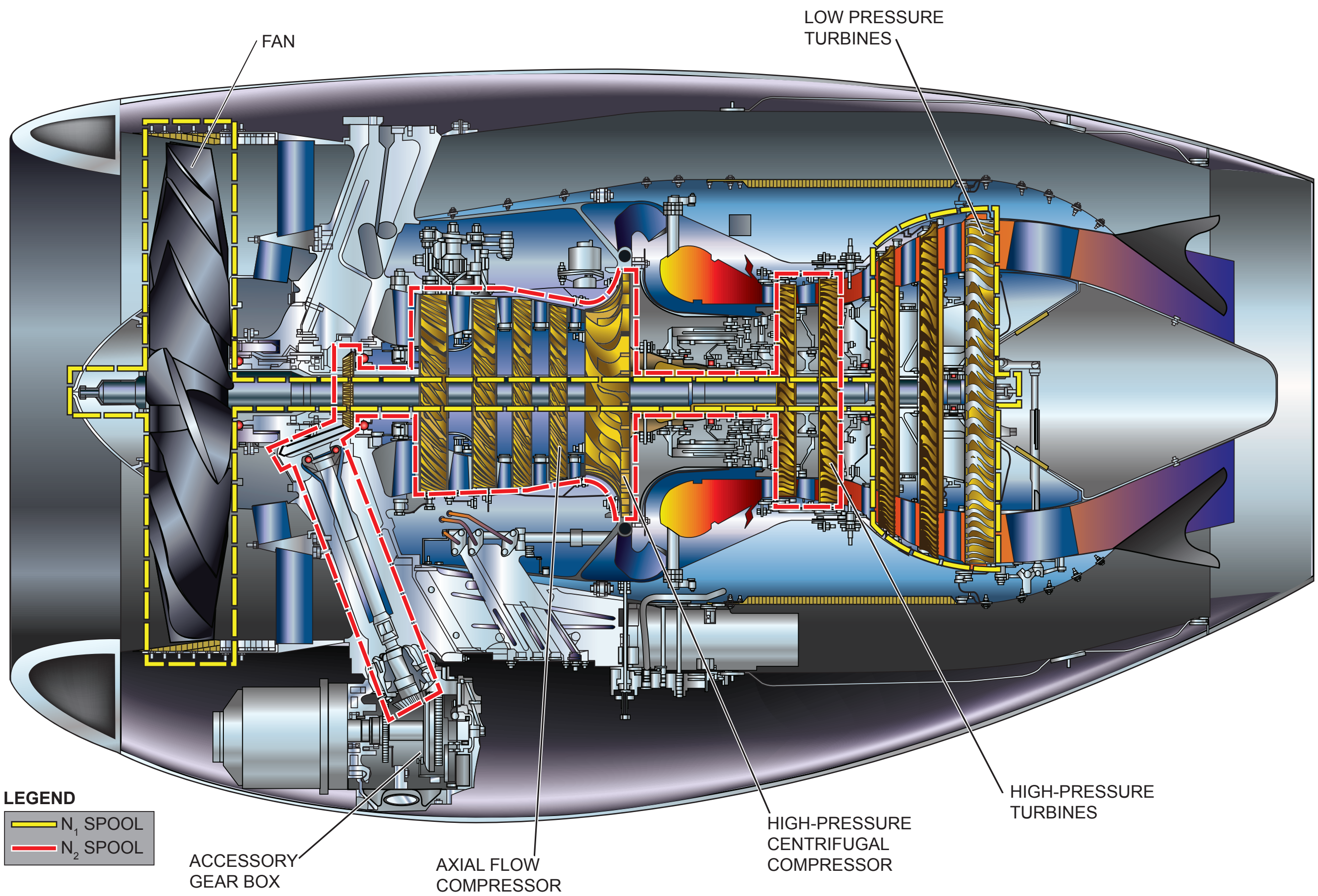
Engine Airflow and Cross Section



Powerplant

General

The Citation Sovereign has two rear-mounted Pratt & Whitney PW306C engines. The PW306C engines are high bypass ratio turbofan engines that develop 5,770 pounds of thrust at sea level up to 30°C.

Each engine is controlled by a dual-channel full-authority digital electronic control (FADEC) unit on each engine. A forced mixer exhaust nozzle reduces noise levels and increases performance.

Description

The PW306C engine is a high bypass ratio turbo fan with two concentric spools each containing compressor and turbine stages. The inner spool contains a large fan assembly at the forward end that is driven by three turbine stages at the aft end of the engine. Since these three turbine stages are located within the larger diameter and cooler section of the engine exhaust where gases expand, the inner spool is referred to as the low pressure (LP) or N_1 turbine. The outer spool rotates freely around the inner spool and is termed the high pressure (HP) or N_2 turbine since it contains four axial compressors and one centrifugal stage compressor at the forward end which are driven by two turbine stages positioned in the narrower high pressure section of the engine immediately aft of the combustion chambers. Each spool is supported by roller / thrust bearings that both enable rotation and maintain the position of each spool. The bearings are lubricated by a recirculating oil system that is cooled by a fuel-oil heat exchanger. As the engine rotates, the fan draws in a large volume of air and compresses it, forcing the air aft through the engine. Most of the air is ducted into the nacelle around the engine core, providing thrust and cooling the turbine section before mixing with and cooling the combustion section exhaust. The air flowing around the engine core is termed bypass air and the engine has an approximate bypass ratio of four to one (4:1), so only one fifth (1/5) of all of the air drawn into the engine is ducted into the engine core for combustion. The fan air used for combustion is fed into the five compressor stages of the outer spool. Each compressor stage increases the pressure of the air by interaction with stators between each compressor stage. As the name implies, the stators are fixed and do not rotate, however the angle of incidence of the inlet guide vanes directing LP air into the compressor and the angle of the stators is variable in order to control the level of pressure generated by the compressor stages.

After the compressor stages, high pressure air is forced into an annular shaped combustion chamber. The circular chamber surrounds the core of the engine and is shaped to impart a swirling motion to the airflow to ensure smooth distribution. Fuel is injected into the combustion chamber by spray nozzles arranged around the circumference of the chamber. Two igniter plugs provide a high energy spark to ignite the fuel/ air mixture. The high temperature/high velocity air produced within the combustion chamber is first directed against the two high pressure (N_2) turbine blades and subsequently the three low pressure (N_1) turbine blades. The high energy of the rapidly expanding air produces rapid rotation of both the N_2 and N_1 turbine stages. Rotation of the turbine stages powers the rotation of the associated fan compressor stage and the five N_2 compressor stages through the common shafts connecting the turbine and compressor stages. After dissipating substantial energy in producing the rotation of the turbine stages, combustion air enters the engine exhaust area where it is mixed with cool fan stage air flowing around the engine core within the nacelle. The engine exhaust section is fitted with a flange surrounding the inside of the nacelle to thoroughly mix the flow of fan and exhaust air. The resultant exhaust mix is lower in temperature and distinctly quieter, enabling compliance with noise reduction regulations.

All engine operation is controlled by a Full Authority Digital Engine Control (FADEC) mounted on the side of each engine core. The FADEC is powered by a self-contained generator, but can use aircraft direct current (DC) if the generator fails. The FADEC is electrically linked to the cockpit power levers and switches and communicates with all four Modular Avionics Units (MAUs) over ARINC-429 data buses.

Figure 21-1: Turbofan Engine

Figure 21-2: Fan Section

Components

Accessory Gearbox

The rotational force of the engines is used to provide the mechanical drive for aircraft system components mounted on the accessory gearbox. The gearbox is attached to the engine exterior and connected to the N_2 compressor through a drive shaft. The gearbox reduces engine RPM to a lower speed in order to power the following components:

- DC Starter/Generator
- AC Generator
- Fuel Pump and Metering Unit
- Oil Pump
- Hydraulic Pump
- Full Authority Digital Engine Control (FADEC) Generator

Oil System

Pressurized oil is supplied to the engine bearings and gears to provide lubrication and cooling. Each engine has an individual oil tank integral to the accessory gear box. The engine oil pump, mounted on and driven by the accessory gear box, pressurizes oil drawn from the tank and supplies the engine bearing compartments and the accessory gearbox through distribution lines. Scavenge pumps downstream of the bearings and gear box return oil back to the tank through a common return line. Integrated into the circulation of the engine oil system are a filter with a differential switch, pressure and temperature sensors and magnetic chip detectors. Sensors within the oil system report data to the Full Authority Digital Engine Control (FADEC) that in turn communicates with the Modular Avionics Units (MAUs) to provide information for cockpit displays.

Oil System Limitation

Maximum oil consumption is 1 quart per 8 flight hours.

Oil Tank

The oil tank is located on the intermediate case as an integral component. An oil level sight glass installed on the tank permits direct observation of tank quantity. If the oil quantity requires servicing, oil can be added directly to the tank through a filler tube. When oil quantity is low, the crew is alerted by a message posted on the EICAS.

Oil Pump

The oil pump is located on and driven by the accessory gearbox. The pump is a positive displacement unit that operates whenever the engine begins to rotate, drawing oil from the engine tank and pressurizing the supply lines for distribution to engine components.

Oil Filter

A filter installed on the oil pump removes any debris in the oil prior to delivery to engine components. The filter incorporates a differential pressure switch that monitors oil pressure at the filter inlet and pressure at the filter outlet. If debris collects within the filter restricting oil flow through the filter, a pressure differential will be detected by the switch.

Oil Filter Bypass Valve

If the oil filter becomes contaminated, restricting the flow of oil through the filter, a bypass valve opens, allowing unfiltered oil to flow to the engine. A cyan CAS message **OIL FILTER BYPASS** appears on the EICAS, indicating an impending bypass situation.

For extremely low oil temperatures during engine starts, the CAS message is inhibited.

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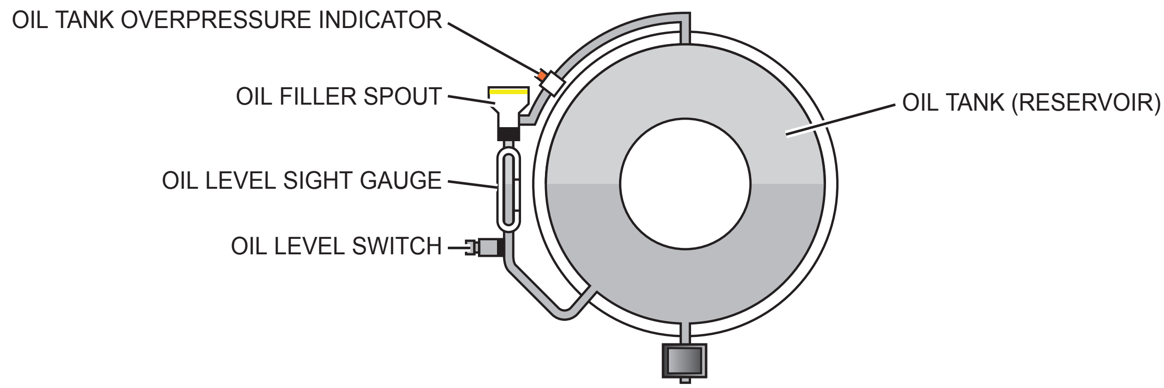
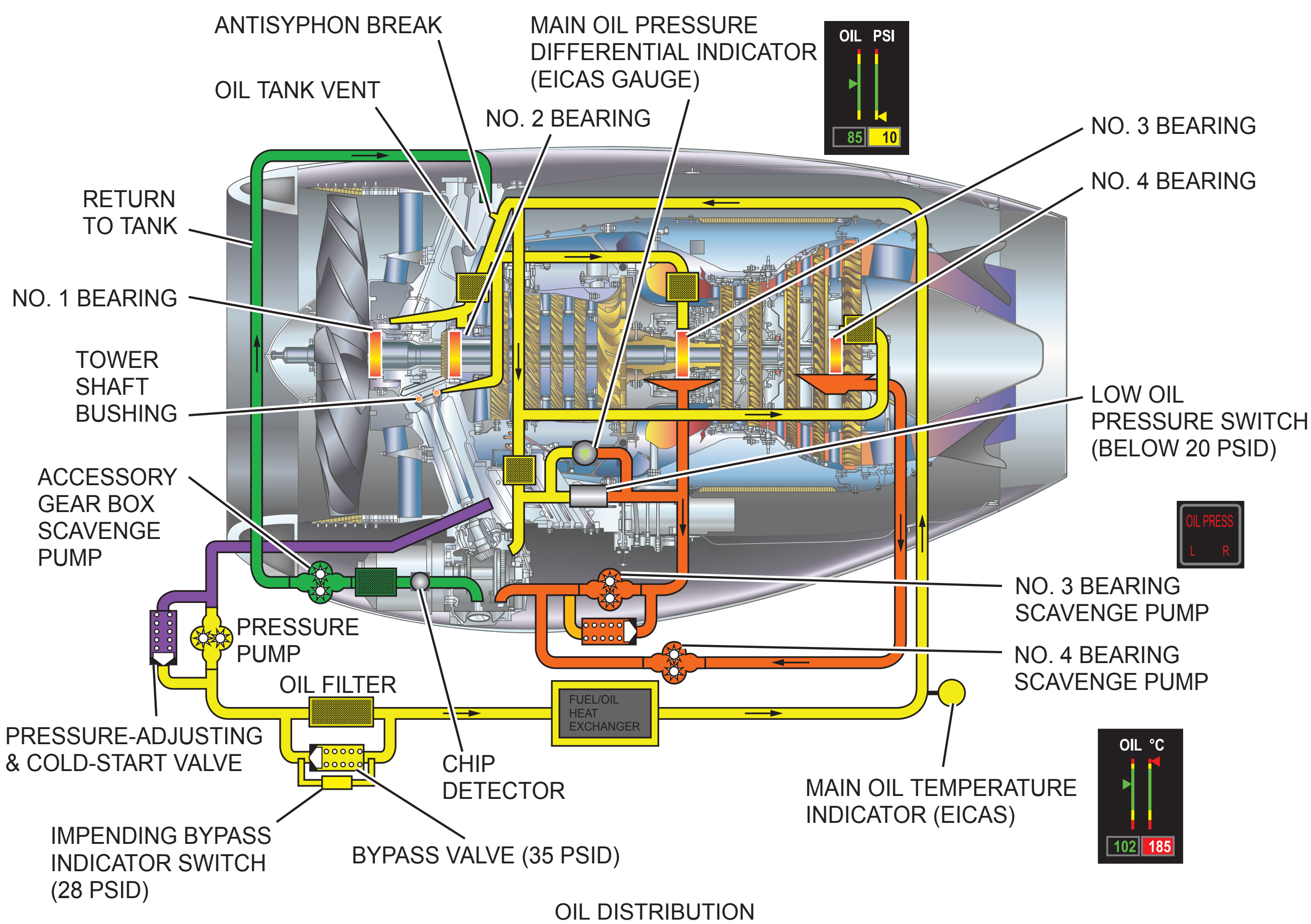
Oil System



OIL TANK



OIL DISTRIBUTION

Oil Pressure Transducer

Engine oil pressure is measured by a transducer that senses the difference in oil pressure supplied to the engine bearings and oil pressure removed from the bearings by the oil scavenge pump. The transducer provides input to the EICAS for indication.

The differential pressure switch activates a red CAS message **OIL PRESSURE LOW L** and/or **R** and illuminates the **L–R OIL PRESS** standby annunciator if oil pressure drops below 20 PSI.

Oil System Limitation

To preclude low oil pressure, intentional uncoordinated flight for longer than 20 seconds is prohibited.

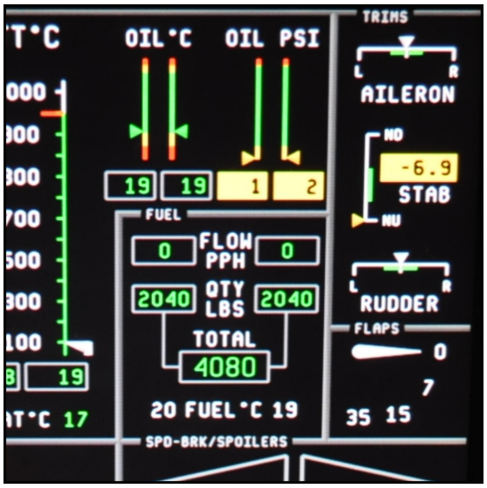


Figure 21-3: Engine Oil Indications

Figure 21-4: Standby Annunciators

Fuel/Oil Heat Exchanger

The fuel/oil heat exchanger (FOHE) is located between the oil filter outlet and the supply inlets to the engine bearings and accessory gearbox. The oil cooler is a heat exchanger that uses hot engine oil to warm fuel drawn from the wing tanks prior to entering the engine fuel metering unit. The lower fuel temperature is increased and the warm oil temperature reduced in the heat exchange process.

Oil System Limitation

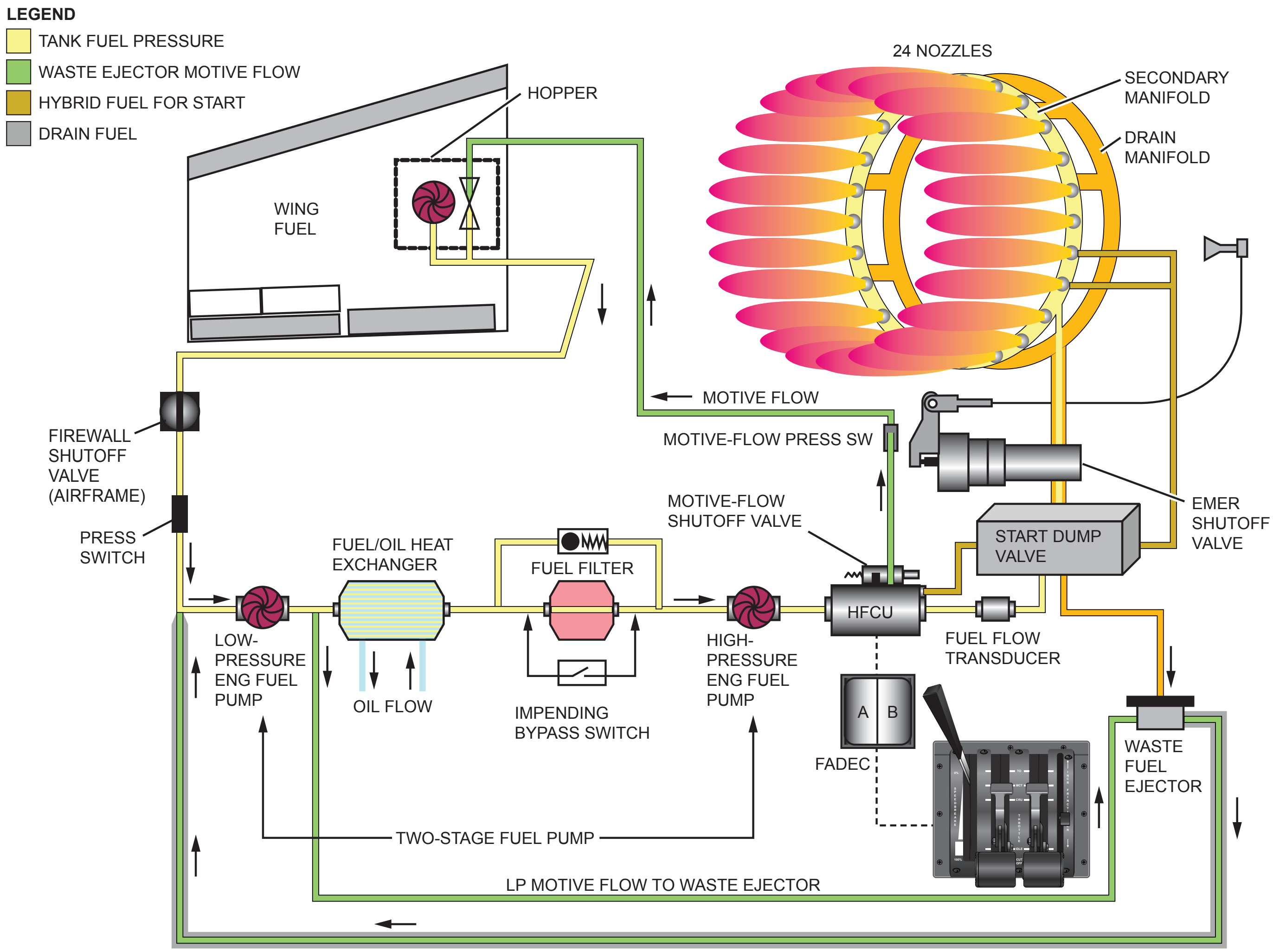
Oil temperature must be above 16°C before increasing thrust beyond the CRU detent.

Ignition System

Each engine has two igniter plugs installed in the combustion chamber to ignite the fuel / air mixture injected into the chamber by the fuel nozzles. Each igniter plug provides a high voltage pulse of energy supplied by a dedicated ignition exciter. The exciters transform twenty-eight volt (28v) direct current from the aircraft electrical system to a three thousand volt (3,000v) energy pulse routed to the igniters through shielded electrical leads. When the igniters are selected on, the exciters send the high voltage pulse to the plugs. When the engine reaches a stabilized normal RPM, ignition is no longer required since the combustion of the fuel / air mixture is self-sustaining.

Cockpit control consists of two-position L and R ignition switches. In the NORM position, the igniters activate automatically during engine start or when anti-ice is selected ON. Moving the throttle out of CUTOFF to IDLE after pressing the start button activates ignition, which terminates automatically at approximately 38% turbine RPM (N_2). Continuous ignition occurs any time the respective engine anti-ice or ignition switch is ON.

Engine Fuel System



Fuel System

Fuel is delivered from the fuel tanks to a Hydromechanical Fuel Control Unit (HFCU) on the accessory gear box. The HFCU modulates fuel flow to the engine in response to commands from the FADEC. A fuel pump receives the fuel and boosts the pressure before sending it through the fuel-oil heat exchanger into the fuel filter, then on to the HFCU.

If the fuel filter becomes blocked due to contamination, a bypass valve opens, allowing fuel to bypass the filter. A differential pressure switch triggers the amber CAS message **FUEL FILTER BYPASS L** and/or **R**, alerting the pilots of an impending or actual bypass situation. Upon landing, the filter must be inspected prior to any subsequent flights.

From the fuel filter, the fuel enters an HP boost pump, boosting the pressure for atomization in the fuel nozzles. The HP fuel is delivered to the FADEC-controlled HFCU, which delivers metered fuel to the fuel nozzles and variable guide vanes. The HFCU also provides HP fuel for motive flow, engine starting and shutdown, and controls thrust, idle speed, acceleration/deceleration, and variable guide vane positioning. The HFCU also contains an overspeed solenoid valve which will shut off fuel flow to the engine if an overspeed condition occurs.

Waste Fuel Ejector

Whenever the engine is shut down, excess pressurized fuel must be drained from the engine fuel system to avoid waste and leakage. At shutdown a drain valve downstream of the HFCU opens to deliver the excess fuel to a drain tank on the engine. Fuel in the tank is returned to the low pressure fuel pump at the next start.

Fuel Nozzles

Twenty four (24) fuel spray nozzles are arranged symmetrically around the engine combustion chamber. The nozzles are positioned within the air flow generated by the high pressure compressor stages and mix a fine spray of fuel with the airflow to provide an optimal combustion medium.

Fuel Flow Transmitter

After the FADEC has regulated the fuel supplied to the engine, fuel flow is measured by a transmitter downstream of the HFCU. The fuel mass flow meter reports fuel usage to the FADEC that in turn transmits the data to the MAUs The MAUs subsequently supply fuel flow information for display on the EICAS and FMS MCDU.

Emergency Fuel Shutoff Valve

The overspeed and splitter unit divides the incoming fuel flow equally to both manifolds to ensure uniform distribution. A safety feature providing overspeed protection is incorporated into the fuel splitter function. The function will interrupt the distribution of fuel to the engine combustion chambers if a failure is detected in the engine low pressure (N_1) shaft connecting the fan and turbine stages. If a difference in fan and turbine stage rotational speed is detected, a spring actuator on the splitter unit will close to prevent fuel flow to the engine.

Operation

Air enters the engine through the fan case, is accelerated rearward by the fan and is split into bypass and core flow streams through concentric dividing ducts. The bypass air passes through a single stage of stators and a faired bypass duct before exiting with the core flow through a common mixing nozzle.

The core airflow passes through variable inlet guide vanes and first-stage variable stator vanes, which allow optimum airflow into the HP compressor. Both sets of vanes are hydraulically actuated by fuel pressure from the hydro-mechanical unit, as commanded by the electronic engine control. From the HP compressor, core airflow is passed through 24 diffuser tubes, which convert velocity to static pressure. The diffused air then passes to the annulus surrounding the combustion chamber liner.

The air enters the combustion chamber liner and mixes with fuel. Fuel is injected into the combustion chamber by 24 air blast nozzles supplied by a single tube manifold. Two of the nozzles are a hybrid type, having an additional fuel supply line of lower pressure, to provide a separate primary fuel flow for ease of starting. During starting, the mixture is ignited by two spark igniters that protrude into the combustion chamber liner.

The resultant gases expand from the combustion chamber liner and pass through the first stage HP turbine stator to the first-stage HP turbine. The still expanding gases pass rearward to the cooled second-stage HP vanes and turbine, then to the three-stage LP turbine and associated stator vanes, to the atmosphere through the exhaust duct, subsequently mixing with the bypass flow.

Full Authority Digital Electronic Control System

Engine Control

FADEC engine control functions are hosted within the Electronic Engine Control (EEC). The EEC, mounted on the engine exterior, is a dual channel fully redundant unit. The channels are denoted as A and B. Both channels of the EEC have independent connections to engine pressure and temperature sensors as well as independent electronic circuits for control of engine operation. Although both A and B channels are powered whenever the engine is operating, only one channel controls the engine. (The FADEC switches control authority between the channels at each engine shutdown.) The redundant channel acts as a standby unit, available to assume engine control in the event of failure of the active channel. The active channel is continually monitored for performance by an internal circuit termed a “watchdog timer”. The timer actively interrogates the controlling channel and requires a response within a specified time frame. If the timer does not receive the expected response, engine control is temporarily shifted to the alternate channel while the previously controlling channel is reset. If multiple resets occur, engine control is permanently shifted to the alternate channel.

The EEC channels are powered by a dedicated generator attached to the engine accessory gearbox. The generator consists of rotating permanent magnets that produces three phase Alternating Current (AC). The output is rectified into twenty-eight volt Direct Current (28v DC) that is the normal power source for the EEC. Since power from the dedicated EEC generator is not available until the engine is running, airplane electrical system DC power from the respective start bus is provided to the active EEC channel during engine starts. Start bus power is provided to both engine FADEC EECs until the engine being started reaches approximately twenty five percent (25%) N_2 RPM. As the engine accelerates, sufficient power is produced by the EEC generator to support control of engine functions for the remainder of the starting process. The power source is switched with no interruption of voltage to the EEC channel. At engine shutdown, the process is reversed, with the airplane system power being acquired to complete shutdown monitoring.

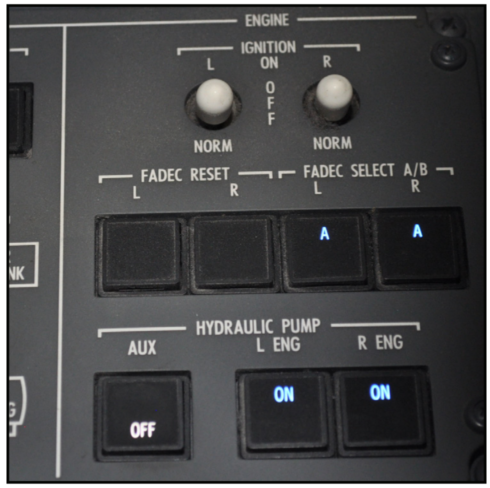


Figure 21-5: Engine System Control Panel

The FADEC also monitors engine parameters during start on the ground and in flight. On the ground, FADEC will deselect ignition and terminate fuel flow if ITT fails to rise sufficiently within 15 seconds after fuel is introduced or a 100°C deviation from the start trend line is observed (hot start protection). In flight, the FADEC functions include start monitoring for a starter-assisted or windmill start (with the exception of automatic start abort logic), and automatic relight if actual N_2 drops below the commanded N_2 value.

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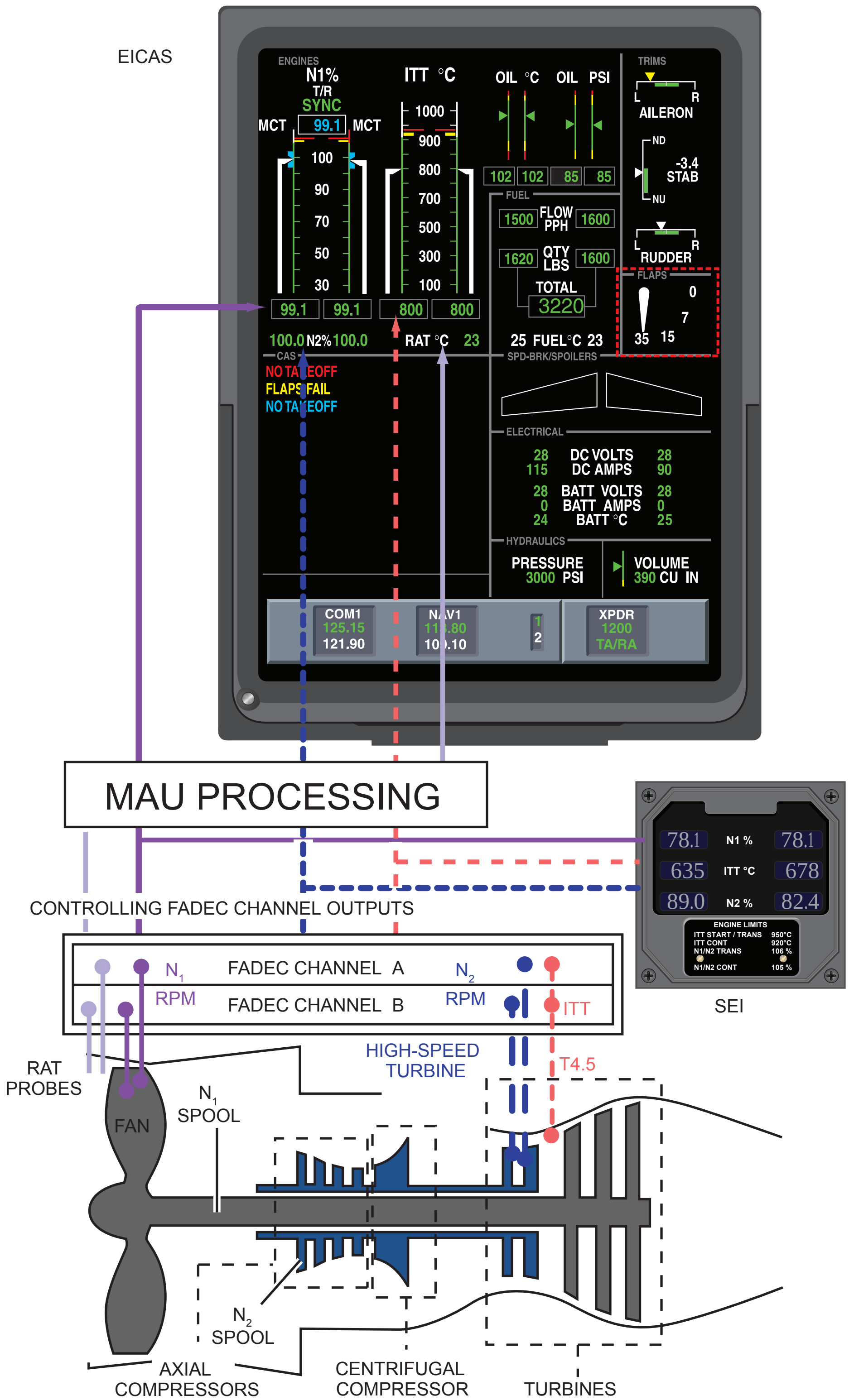
FADEC System



FADEC Channels

The FADECs must be functioning normally for dispatch. The FADEC calculates proper N_1 to obtain the required thrust. The FADEC has two independent channels, either of which can control the engine. The required N_1 is a function of throttle position and ambient conditions. The controlling channel adjusts the fuel metering valve position to achieve the appropriate fan speed and produce the desired thrust. Selection of the FADEC operating channel is by the FADEC SELECT A/B RESET NORM/SELECT button. These buttons are spring loaded to NORM. Momentarily pressing the button will select the opposite FADEC, unless the opposite FADEC has failed. Momentarily pressing the button resets the fault memory only; it does not clear the fault. The FADEC channel is automatically alternated at each engine start to ensure equal use and reliability.

FADEC Channel Select

The controlling FADEC channel is displayed on the FADEC select A/B buttons on the ENGINES panel, left side tilt panel. The non-controlling FADEC channel can be selected on each engine by pressing the respective FADEC button with the engines running.

The FADEC reset buttons next to the FADEC Select buttons allow the crew to attempt to reset the respective FADEC should a fault occur within the FADEC. The corresponding N_1 target indicator (bug) will turn amber when the monitoring FADEC channel is unable to calculate the N_1 value and it is subsequently set by the controlling channel.

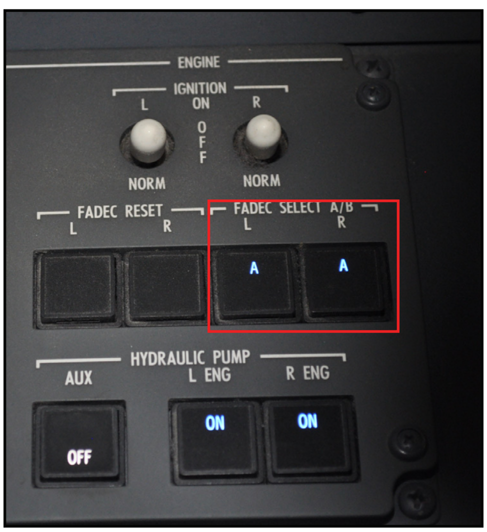


Figure 21-6: FADEC Select Buttons

Engine Synchronization System

Engine sync is an electronic thrust trim system that commands limited authority thrust changes to the FADECs. During flight with the landing gear up, throttles above idle and below the TO detent, and the ENGINE SYNC button in NORM, the left and right FADECs continuously monitor fan synchronization adjust the engines to match. N_1 sync is performed as the throttles are moved between the MCT detent and the flight idle rating setting. The button is generally left in the NORM position. A green SYNC indication is displayed on the EICAS when the synchronization system is active.

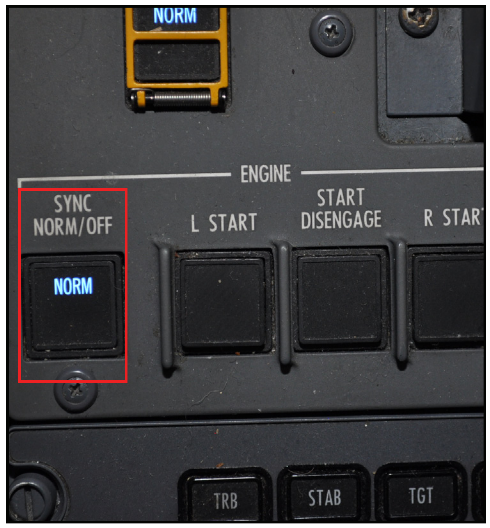


Figure 21-7: Engine Sync Button

Engine Vibration System

The engine vibration monitoring (EVM) system provides oversight of the mechanical health of the engines. Since turbofan engines operate at a very high RPM, all rotating components must be very accurately balanced in order that centrifugal effects within the engine do not result in destructive forces. Even small amounts of vibration within the engine could be the precursor of catastrophic damage. The EVM system detects anomalies in engine rotational balance through accelerometers mounted on the engine exterior. The accelerometers detect vibration as a centripetal force (perpendicular to engine centrifugal force) is induced by any out of balance component on the N_1 or N_2 rotors.

Engine vibration is monitored anytime the engine is running. If a vibration is detected, a red message **ENGINE VIBRATION L** and/or **R** is displayed on the EICAS.

Controls and Indications

Throttles

Four throttle positions are selectable for various phases of flight. The T/O and climb (MCT) are detented positions allowing FADEC to determine the thrust setting. The CRU position is infinitely variable from the cruise stop (high RPM) to the idle position (low RPM). When the engines are shut down, the throttles are placed in the CUTOFF position. A trigger under each throttle handle releases a latch to allow the movement of the throttle in or out of the CUTOFF position. This is to prevent inadvertent shutdowns or accidental engine starts.

Ignition Switches

Two three-position IGNITION toggle switches are on the pilot FUEL–ENGINE control panel. The toggle switch functions are as follows:

- ON: Selects continuous ignition
- OFF: Removes all power from the exciter boxes
- NORM: Gives the FADEC control of ignition operation

If the ignition switch is not in the NORM position, an amber CAS message **ENGINE CONTROL FAULT** appears on the EICAS. The FADEC applies ignition during engine start when a throttle is taken out of the cutoff position and terminates ignition when N_2 reaches 40%. The FADEC applies ignition as required during flight operations.

> ***NOTE:*** If the engine ignition switch is in the OFF position, the engine will not start.

Ignition Indication

The green IGN text (for the left or right engine) is displayed above the N_1 indication on the EICAS. The IGN illuminates when power is received to one or both of the two engine exciter boxes.

L and R ENGINE Start Buttons

Engine start is initiated by pressing the ENGINE START button. When the respective start relay is closed, the button illuminates. At 44% N_2, the relay opens and the button extinguishes.

> **Engine Limitation**
> *Maximum tailwind component for engine starting is 10 knots.*

START DISENGAGE Button

This button illuminates when the START button is pressed and extinguishes at 44% N_2. It is used to terminate a start or to open the start relay if it fails to open automatically during start.

Engine Instruments

The following information applies to the engine instruments:

1. Dual tapes (one for each engine) provide N_1, ITT, OIL °C, and OIL PSI indications.
2. Data is displayed from the controlling FADEC channel.

Engine System Indicators

For an explanation of the EICAS engine indications, refer to Chapter 11, Avionics.

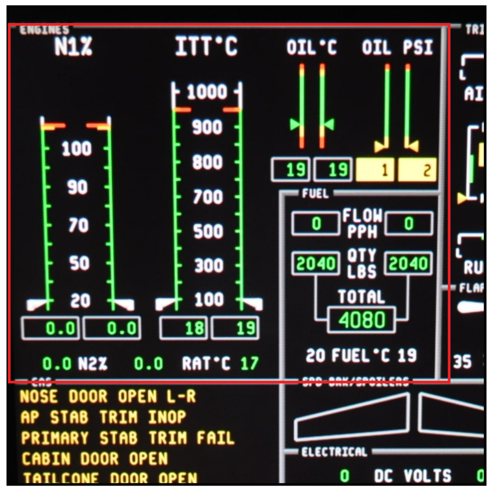


Figure 21-8: EICAS Engine Indications

An independent oil pressure switch illuminates the red standby OIL PRESS L–R annunciator and the red CAS message **OIL PRESS LOW L–R** on the EICAS when pressure is below 20 PSIG. The standby annunciator continues to operate off the emergency bus in the event of an electrical emergency with loss of main DC power.

Standby Engine Instruments

A standby engine indicator is installed between the MFDs in the center instrument panel. The indicator combines six liquid crystal displays to relay engine N_1%, N_2%, and ITT°C information to the flight crew in the event of a loss of power to the EICAS system. Power is normally provided to the standby engine instruments by the emergency bus system. In the event that this power source becomes unavailable, a standby battery located in the nose compartment will supply electrical power. A placard showing engine operating limits is located directly below the information display.

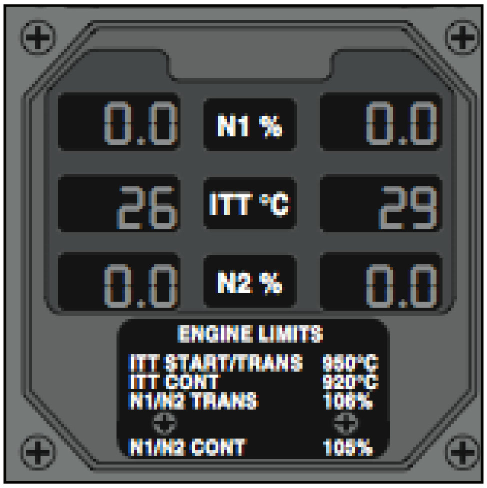


Figure 21-9: Standby Engine Indications

In the event of a FADEC channel becoming unreliable, the standby engine indicator has the redundancy of using a second FADEC channel to provide the flight crew with engine power and temperature information. During initial power up, the standby indicator will display all eights (8s) and flash these digits for approximately three seconds. If the display shows all dashed lines, the information on the ARINC-429 serial bus data line is invalid or a signal has been lost.

Engine Synchronization

The Engine SYNC button located on the center pedestal enables engine synchronization, if the following conditions exist:

- TLA is at or above idle and at or below the MCT detent.
- N_1 differential is less than 5%.
- The landing gear is up.

The SYNC button is generally left in the NORM position. For the synchronization system to operate, thrust must be initially set to within 5% N_1. Synchronization can be disabled by selecting the button to OFF.

Engine Diagnostic Unit

The Engine Diagnostic Unit (EDU) is an on-board maintenance computer that permits data transfer to a ground based computer for engine trend monitoring, fault isolation and cycle counts. It is an integral part of the FADEC system along with the 2 EECs. Data stored in the EECs during flight is transmitted to the EDU after shutdown; for that reason, battery power should not be turned off for 30 seconds after engine shutdown to allow the proper transfer of data.

An EVENT MARKER button is located on the pilot tilt panel adjacent to the PASS OXY knob. When the button is momentarily depressed, the EDU saves a data block of engine information that spans from 4 minutes prior to switch activation and continues for one minute following release of the switch.

Idle Thrust Management

The engine EEC controls N_2 RPM when the power lever is positioned to idle. The idle power lever setting has two ranges: flight idle (high) and ground idle (low). The EEC will control the engine at the flight idle setting if data from the MAUs indicate that the airplane is airborne. The EEC will continue the high idle control mode for eight (8) seconds after landing to allow rapid engine acceleration for reverse thrust if needed. The exact N_2 RPM setting for both ground and flight idle is dependent upon pressure altitude, with a minimum RPM setting predicated upon the following engine functions:

- Supplying sufficient bleed air to meet pneumatic system and anti-icing requirements
- Prevent ice accumulation on the engine fan stage
- Maintain the engine-driven generator at operational speed
- Operation of the engine handling bleed valves during rain ingestion or other inclement conditions

If the engine idle remains in the ground mode after takeoff, an amber **GROUND IDLE L** and/or **R** message will display on the EICAS.

Thrust Reversers

Description

The Citation Sovereign thrust reversers are of the external target type employing two vertically oriented doors or buckets. The thrust reverser doors are attached to the thrust reverser body, which bolts to the aft end of the engine case. The faired reverser doors seal sufficiently to control and direct the escape of the high-pressure exhaust gasses. The reverser system is designed for two-position operation: stowed during takeoff and flight and deployed during landing ground roll.

Each reverser uses two hydraulic actuators connected by pushrods to the reverser door. The hydraulic actuators are located on the left and right sides of the thrust reverser. The aft end of the thrust reverser door is attached to a fixed hinge. As the hydraulic rams move aft, pushrods open the doors to the full-deployed position. As the hydraulic rams move forward, the pushrods pull the doors into the stowed position and UNLOCK digits display as inverse video amber, along with an associated CAS message **T/R ARMED L-R** or **T/R UNLOCK L-R**.

Thrust Reversers Limitation

Reverse thrust must be reduced to idle at 65 KIAS on landing roll.

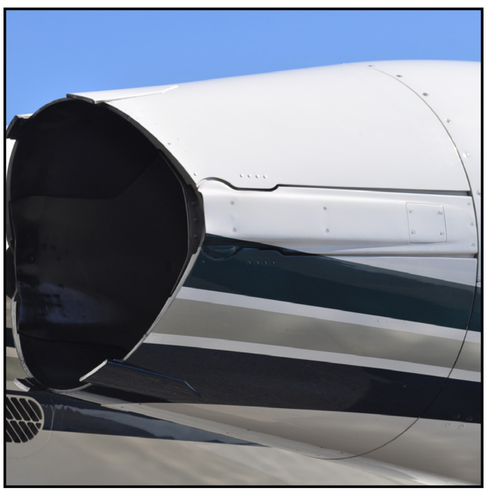


Figure 21-10: Thrust Reversers

Because an inadvertent opening of a thrust reverser door during flight would cause severe aircraft control difficulties, the thrust reverser system has a multi-layered architecture to prevent in-flight door actuation. If, nevertheless, such an in-flight deployment occurs, a separate independent command circuit is available to power the door closed, supplemented by a FADEC feature that reduces engine power to idle whenever a door is not closed during flight.

Components

Isolation Valve

Prior to deploying the thrust reversers, an isolation valve must open, allowing hydraulic pressure to reach the control valve. The valve is a solenoid-type valve and requires main DC power through the control of the thrust reverser levers to open. An ARM annunciation indicates that the isolation valve has opened and hydraulic pressure has reached the control valve. With the electric buttons in EMER or during a total loss of main DC power, the isolation valve remains closed and thrust reverser operation is not possible.

Control Valve

The thrust reverser levers operate the position of the double solenoid control valve. The valve directs hydraulic fluid to the deploy or stow side of the actuators. Main DC power is also required for valve operation.

Controls and Indications

Thrust Reverser Levers

Thrust Reversers Limitation

The use of thrust reversers to back the airplane is prohibited.

Thrust reverser levers attached to the throttle levers allow the crew to deploy, stow, and add reverse thrust during ground operations. Inputs from all three squat switches is required for thrust reverser operation.

Emergency Stow Buttons

An emergency stow button for each thrust reverser, located on the cockpit pedestal immediately behind the throttle levers labeled EMER STOW, will apply power to open the T/R isolation valve and cause the T/R HCV to apply hydraulic pressure to the stow side of the actuator. This will hold the T/R in the overstow position in the event of a T/R system malfunction. The emergency stow function can be checked on the ground by deploying the reversers normally and then actuating each emergency stow button. The ARM messages remain illuminated. Return the thrust reverser lever to the stow position, then turn each emergency stow button off. The ARM messages will extinguish.

Indications

Thrust reverser status is displayed above the respective N_1 tape in the upper left corner of the EICAS. Each thrust reverser has three mode indications: ARM, UNLOCK, and DPLY. The mode indications vary based on squat switch inputs. On the ground, ARM and UNLOCK display in white digits and DPLY displays in green digits. In flight, the ARM and UNLOCK digits display as inverse video amber, along with an associated CAS message **T/R ARMED L-R** or **T/R UNLOCK L-R**. The DPLY digits display as inverse video red. Any invalid data is displayed as amber dashes.

Operation

Moving the reverse thrust lever from the STOWED to the DEPLOY position actuates the deploy cycle. This supplies power through the TRCU logic modules to open the thrust reverser isolation valve, which allows hydraulic pressure to reach the T/R hydraulic control valve (HCV). A pressure switch is located immediately downstream of the isolation valve. When this pressure switch senses hydraulic pressure, it causes the amber **T/R ARM** message on the EICAS to display. Signals from the thrust reverser logic modules will cause the T/R HCV to direct hydraulic pressure to the latch actuator causing the latches to begin to retract. Once the latches have retracted, the thrust reverser logic module will cause the T/R control valve to pressurize the deploy side of the actuator and the T/R doors will move to the fully deployed position.

To stow the thrust reversers, move the reverse thrust lever through the idle reverse detent to the stow position. This will remove the deploy signal to the TRCU and cause the TRCU to start the stow sequence. The TRCU will signal the T/R HCV to remove hydraulic pressure from the latch actuators and internal springs in the latches will cause the latch to rotate against the T/R door leaf springs. The T/R doors reach the overstow position and the green **DPLY** message will be replaced by the amber **UNLK** message. After the T/R doors reach the overstow position, the latches will rotate to the fully latched position, deactivating the latch and lock switches. The amber **UNLK** message will be replaced by the amber **ARM** message. The TRCU will then close the T/R HCV and isolation valve allowing the doors to move to the fully closed position and the amber **ARM** message to extinguish.

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Servicing and Procedures

Preflight

During the preflight, check the nacelle drains for leaks; check the thrust reverser clamshell doors are retracted and flush with the rear cone profile.

Replenish engine oil as necessary. The engine oil filler cap and access doors should be checked for security. Check engine cowlings and access doors for security.

Thrust Reverser Check

The following table outlines the procedure and calls to perform a thrust reverser check. This check is accomplished during the Taxi checklist.

CONDITION	LEFT PILOT	RIGHT PILOT
Thrust reverser check		"Thrust Reversers – Check"
	Deploy TRs	
EICAS displays two DPLY annunications and EMER STOW buttons flash red		"Two Deployed"
		Press EMER STOW buttons
EICAS displays two ARM annunications and EMER STOW buttons illuminate steady red		"Two Armed"
	Stows TR Lever	
EICAS two ARM annunications remain illuminated		"No Change"
		Press EMER STOW buttons
EICAS displays no TR annunications and EMER STOW buttons not illuminated		"Lights out – Checked and Stowed"

Servicing

Before servicing the aircraft, always refer to the Aircraft Maintenance Manual and Aircraft Flight Manual for approved fluids, servicing procedures and safety precautions.

Approved Oils

The following oils are approved for use:

MOBIL JET OIL II	BP TURBO OIL 2380	AEROSHELL TURBINE OIL 500
MOBIL JET OIL 254	ROYCO TURBINE OIL 500	AEROSHELL TURBINE OIL 560
CASTROL 5000		

Table 21-11: Approved Oils

In addition, oils listed for the engine in the latest revision to PW306C Maintenance Manuals (P/N 30B4422) are approved.

CAUTION

When changing from an existing lubricant formulation to a "third generation" lubricant formulation (Aeroshell Turbine Oil 560 or Mobil Jet Oil 254), the engine manufacturer strongly recommends that such a change should only be made when an engine is new of freshly overhauled. For additional information on use of third generation oils, refer to engine manufacturer's pertinent oil service bulletins.

Maximum oil consumption is 1 U.S. quart per 8 flight hours. When oil consumption is greater than 1 U.S. quart per 8 hours, refer to the Aircraft Maintenance Manual.

Oil types or brands may not be mixed unless specifically approved in the PW306C Maintenance Manuals.

Checking and Replenishing Engine Oil

To check engine oil levels, proceed as follows:

- Check oil level through sight gauge. Absence of the amber CAS message **OIL LEVEL LOW L** and/or **R** indicates a suitable engine oil level for flight.
- Open cowling of the engine to be serviced.
- Press, then turn the oil filler cap 90° counterclockwise.
  - Add oil slowly to allow the flapper valve to open.
  - Add until the oil reaches the upper portion of the transparent window.
  - Install the oil filler cap. Verify the yellow marks on the cap and tank are aligned.
  - Record the quantity of added oil.
  - Close the engine cowling.

NOTE: A malfunction of the engine oil level sensor is indicated by a cyan CAS message **OIL LEVEL LOW L** and/or **R**. The message is amber if the oil level is actually low.

Dry Motoring

For dry motoring of an engine, ensure that the throttle on the affected engine is in CUTOFF and that the IGNITION switch is OFF. Push the ENGINE START button and motor engine for the desired duration. Observe engine starter limits as follows:

- With EPU: 7 seconds maximum
- With APU: 15 seconds maximum
- With battery power: 20 seconds maximum

To terminate motoring, push the START DISENGAGE button and return the IGNITION switch on the affected engine to NORM.

Abnormal Procedures

The following is a discussion of abnormal procedures pertaining to engine operation. Refer to the CAE SimuFlite Operating Handbook for checklist details.

Precautionary Engine Shutdown

For a precautionary shutdown, the affected engine should remain at idle for a minimum of 2 minutes prior to shutdown to allow the engine inter-turbine temperatures to stabilize. If an inoperative engine windmills for more than 15 minutes without a positive indication of oil pressure or 3 hours with a positive indication of oil pressure, ground maintenance procedures are required (reference Pratt and Whitney Engine Maintenance Manual).

For detailed information, refer to the ENGINE FAILURE OR PRECAUTIONARY SHUTDOWN checklist in the CAE SimuFlite Operating Handbook.

In-Flight Airstart

If attempting to restart an engine in flight, either a windmilling start or starter assist can be accomplished. If attempting a windmilling start, unloading the hydraulic system will help accelerate N_2 to the 9% necessary to start the engine.

If a starter-assisted restart is attempted, ensure that the autopilot is disconnected. During the start, equipment (including selected flight guidance modes) on the side of the starting engine may lose power momentarily and then recover.

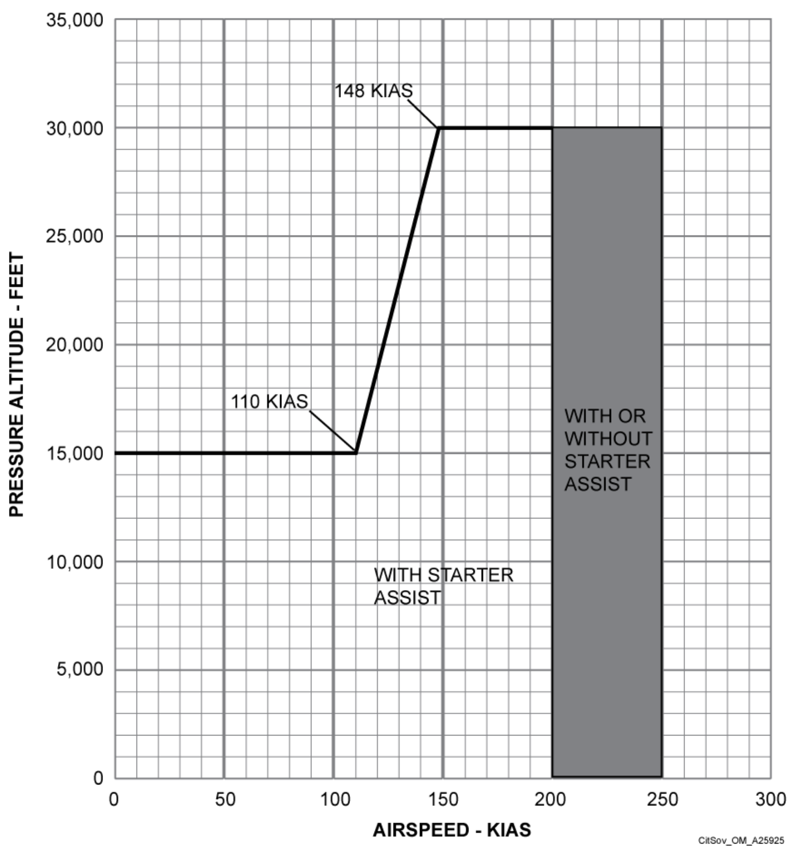

Figure 21-12: Engine Airstart Envelope

FADEC EICAS Messages

Various EICAS indications are associated with the FADECs such as faults or modes. Examples include the amber CAS message **ENGINE CONTROL FAULT L** and/or **R**, or N_1 target bugs indicating amber on the ENGINES portion of the EICAS display. See the appropriate checklist for details but consider that the engines may be operating in a compromised position. Therefore, avoid abrupt movements on the throttles. Also, adjustments may have to be made if using the Anti-Ice systems. Attempting to reset the FADEC using the FADEC RESET button may solve the problem.

Single-Engine Approach and Landing

A one-engine inoperative approach and landing is performed similar to a normal two-engine approach and landing, except that flaps are set at the 15° position for landing. The minimum airspeed on approach is V_{REF} for the flaps 15° configuration. For landing distance, multiply flaps 35 by 1.20.

An amber **HYDRAULIC PRESSURE LOW** message may be displayed on the EICAS when one engine is shutdown and the other engine is at or below 75% N_2. Gear extension time may be longer than normal. Hydraulic system pressure will recover to normal pressure once landing gear are down and locked or the throttle on the operating engine is increased. Refer to the CAE SimuFlite Operating Handbook and the Maneuvers chapter of this manual for detailed information.

Thrust Reverser Unlocked In Flight

If two or more of the four locks on either reverser are sensed to be unlocked on the respective thrust reverser, an amber message **T/R UNLOCK L** and/or **R** will illuminate on the CAS. If three or four locks are sensed to be unlocked on the respective thrust reverser, the rudder bias actuator arm will move to the minimum position and rudder pedal force required for single-engine operations will increase significantly. Press the T/R EMER STOW button on the affected side. Ensure that both thrust reverse levers are stowed. Maintain a maximum airspeed of 150 KIAS and a maximum altitude of FL410. Land as soon as practical.

Emergency Procedures

The following is a discussion of emergency procedures pertaining to engine operation. Refer to the CAE SimuFlite Operating Handbook for checklist details.

Engine Vibration

Two vibration sensors are located on the engine: one in front, the other in the rear. The red EICAS message **ENGINE VIBRATION L** and/or **R** is activated by the sensors. If vibration exists, retard the affected engine to reduce vibration. If vibration continues or other evidence of engine malfunction exists, consider shutting down the engine to prevent greater damage and subsequent engine failure. Land as soon as possible.

Engine Failure Below V_1

If an engine failure occurs prior to V_1, the primary consideration is to maintain directional control of the aircraft and stop on the remaining runway. Simultaneously move both throttles to IDLE and apply maximum braking. Extend speed brakes and use thrust reversers as required. When stopped, notify the tower and accomplish the appropriate abnormal or emergency checklist.

Engine Failure After V_1

If an engine failure occurs after V_1, maintain directional control and rotate at the normal V_R speed. Attain V_2 after liftoff, retract the landing gear once a positive rate of climb is established, and continue to climb to at least 1,500 feet above airport level at V_2. Refer to the appropriate emergency checklist procedure.

Takeoff power may be maintained for 10 minutes during single-engine operations as needed. Power should then be reduced to Maximum Continuous Thrust (MCT).

> ***NOTE:*** For an obstacle above 1,500 feet AGL or a SID that requires a climb to more than 1,500 feet AGL, continue climbing at V_2 speed with flaps in the takeoff position until the obstacle is cleared or the SID requirement has been satisfied.

Engine Fire

The important action for controlling an engine fire is to shut the affected engine down and shut off the combustible fluids as quickly as possible.

For an engine fire warning (red ENG FIRE light accompanied by warning tone and CAS message), move the throttle on the affected engine to IDLE.

If the ENG FIRE light is still illuminated after 15 seconds, push the illuminated ENG FIRE button and then push either illuminated BOTTLE ARMED button. Refer to the emergency checklist, **ENGINE FIRE L** and/or **R**.

WARNING
THE ENGINE MUST NOT BE RESTARTED AFTER A FIRE WARNING.

Dual Engine Flame-Out – Low Altitude

It is unlikely than an engine start using the battery or APU can be accomplished from below 1,000 feet AGL, or using a windmill start from below 3,000 feet AGL. Check fuel quantities and select both FUEL BOOST buttons to ON. Move both throttles to cutoff. Attempt a restart of one or both engines using the emergency checklist for DUAL ENGINE FLAMEOUT - LOW ALTITUDE. Refer to the CAE SimuFlite Operating Handbook for detailed information.

Dual Engine Flame-Out – Cruise

If a dual engine flame-out occurs during cruise, don crew oxygen masks if necessary and establish communication. If required, select passenger oxygen ON as well. Attempt an engine start at or below FL300 using the emergency checklist for DUAL ENGINE FLAMEOUT - CRUISE. An engine restart may be attempted using either a windmill start (both engines simultaneously) or starter assist (one engine at a time). Note that there are no ITT limitations associated with this procedure.

EICAS System Displays

Information regarding the powerplant, thrust reverser and associated systems is displayed in the message area of the Engine Indicating and Crew Alerting System (EICAS) display unit.

Messages are displayed in cyan, amber or red, according to their urgency. The following are possible messages displayed that relate to the powerplant, thrust reverser and related systems.

Cyan Messages	Description
ENGINE SHUTDOWN L and/or R	This message is displayed when the engine throttle has shut down the respective engine or when a below idle recovery is in progress.
OIL FILTER BYPASS L and/or R	This message is displayed when the pressure across the oil filter becomes large enough due to debris contamination.
OIL LEVEL LOW L and/or R	This message is displayed when a fault has occurred in the oil level low sensor. If engine oil level is low, this message will be amber. This message is displayed only on the ground. The message may also display if the oil level is over-filled.
Amber Messages	**Description**
ENGINE CHIP DETECT L and/or R	This message is displayed when metal chips have been detected in the engine oil by the electronic magnetic chip detector switch.
ENGINE CONTROL FAULT L and/or R	This message is displayed when the redundancy of the engine control systems is reduced due to the FADEC detecting an internal fault or sensor miscompare. This message may also display due to a failure of the FADEC permanent magnetic alternator (PMA).
OIL LEVEL LOW L and/or R	This message is displayed when the oil quantity is too low for an engine start with the aircraft on level ground.
T/R ARMED L and/or R	This message is displayed when the respective thrust reverser is armed in flight.
T/R UNLOCK L and/or R	This message is displayed when two or more of four locks are sensed to be unlocked on the respective thrust reverser in flight.
Red Messages	**Description**
ENGINE FAILED L or R	This message is displayed when the monitor determines the engine has failed, based upon N_2 being less than approximately 6%, start not in progress, and throttle not in cutoff.
ENGINE VIBRATION L and/or R	This message is displayed when excessive engine vibration is detected.
OIL PRESSURE LOW L and/or R	This message is displayed when low oil pressure is detected.

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22

Pressurization/Environmental

Contents

Pneumatics

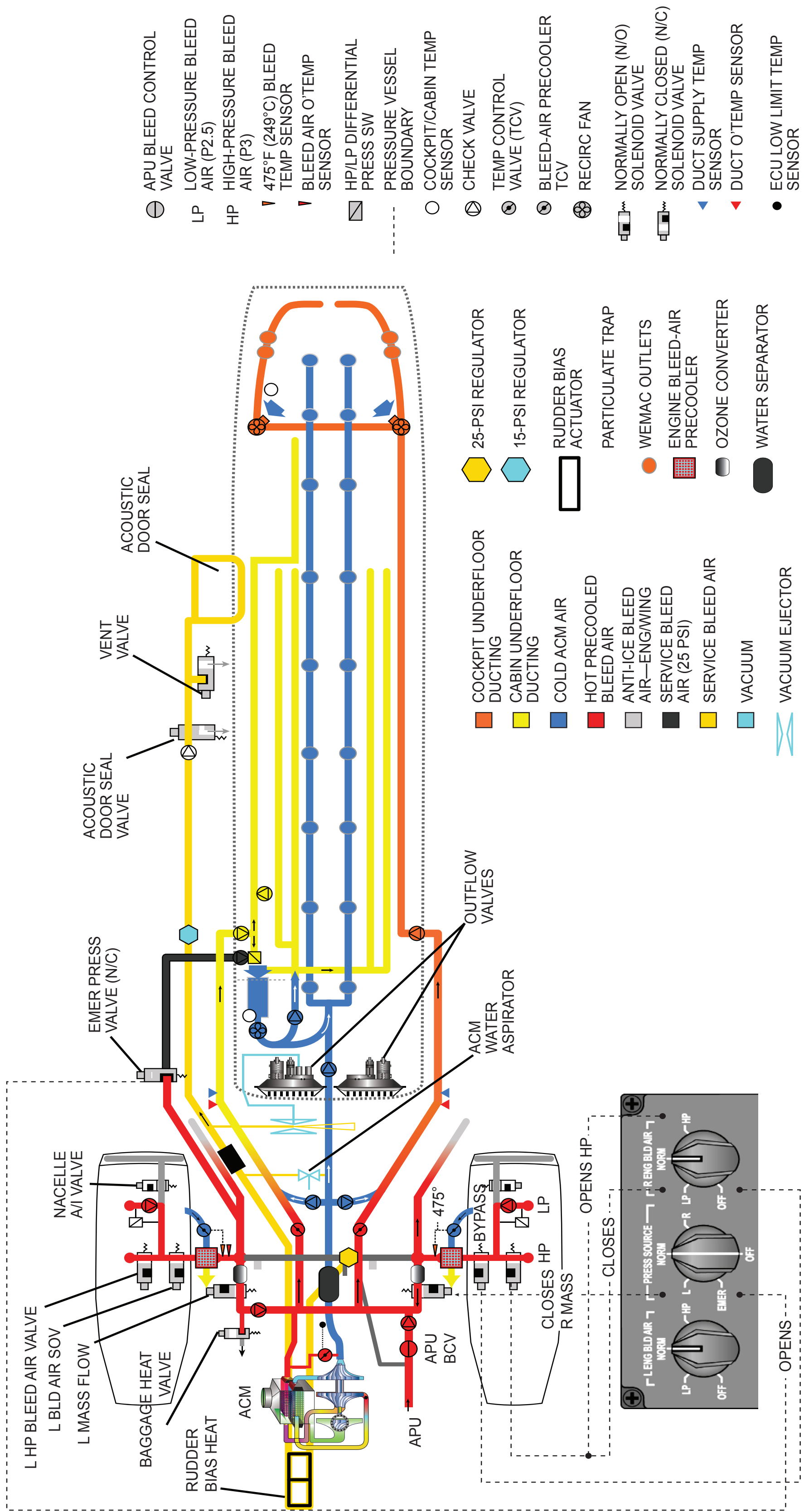
General

The Citation Sovereign pneumatic system uses high temperature pressurized air from the compressor section of the left and right engines or Auxiliary Power Unit (APU) bleed air to supply the following aircraft systems that require a modulated pneumatic source:

- Air conditioning and normal pressurization
- Emergency pressurization
- Wing and engine anti-ice
- Service air
- Pressurized cabin door acoustic seal
- Rudder bias heat and baggage compartment heat

Airflow is supplied to aircraft systems through a bleed air manifold connected to both engines and the APU. Air supplied by the engines is temperature and pressure regulated by printed circuit board Bleed Air Controllers (BACs) that monitor the air supply with sensors within the ductwork. The engine BACs draw air from either the low pressure (LP) mid-stage or a higher pressure (HP) stage of the compressor sections of the engines, depending upon the engine power settings and bleed air demand. The air is regulated by selective switching between compressor stages for a source of supply air using a control valve on the HP output, and by passing the supply air through a pre-cooler heat exchanger that uses N1 air drawn into the engine from the bypass duct. Pressure is controlled through regulator and shutoff valves that vary the size of the valve orifice in the manifold. Air supplied by the APU is regulated separately by an APU bleed control valve (BCV). The temperature and pressure of air from the APU is a function of APU speed and ambient conditions. APU bleed air is used primarily only on the ground for air conditioning, but can be used during flight.

Pneumatic System



Pneumatic Distribution

Bleed air is extracted from a Low Pressure (LP) and High Pressure (HP) port on the compressor section of each engine. LP air is directed into the same tube as the HP air, and a check valve is installed to prevent HP air from back-feeding into the LP tube. Based upon bleed air requirements for the flight conditions, bleed air controller logic enables either high pressure or low pressure air into the regulated bleed air manifold. The HP or LP air can be controlled manually or automatically with the L or R ENG BLD AIR knobs. When the L or R ENG BLD AIR knob is in the NORM position, the source of the bleed air is selected with the use of data from the throttle settings, aircraft altitude, cabin altitude, anti-ice system and squat switch settings. A HP bleed air valve on each engine opens and closes as determined by the controller, which determines the type of bleed air directed into the manifold.

A bleed air shutoff valve (BLD AIR SOV) located immediately downstream from the HP bleed air valve is used to completely stop the flow of bleed air from the engine into the manifold. This valve is actuated manually from the cockpit, or it can be actuated automatically through the logic of the bleed air controller.

An air-to-air heat exchanger downstream of the shutoff valve is used to cool the bleed air to a usable temperature. As hot bleed air is sent through the heat exchanger, cooler N_1 bypass air is pushed over the outside of the heat exchanger. A temperature sensor measures the air exiting the heat exchanger and is used to manipulate an actuator controlling the amount of fan air that is pushed over the heat exchanger. A CAS message will illuminate if the air exiting the heat exchanger is excessively hot.

The source of air being directed to the Air Cycle Machine (ACM) for conditioning of the air is controlled by left and right mass flow valves located in the regulated manifold. These valves are both normally de-energized open and are controlled automatically, or manually by the crew.

Bleed Air Controllers (BACs)

BACs are microprocessors that provide the control signals for the engine bleed valves, pressure regulator/shutoff valves and pre-coolers. The BACs open and close the HP engine bleed and regulator/shutoff valves in response to commands from the selector knobs on the Environmental Control Panel located in the cockpit and in response to feedback from sensors in the supply manifold. The BACs modulate the position of the HP bleed valves, regulator/shutoff valves and pre-cooler operation to meet the supply demands of the pneumatic system.

Under normal operating conditions, the major demand on the pneumatic system is to supply the ACM for cabin pressurization and temperature control. Bleed air is supplied at approximately 65 PSI. Temperature modulation is accomplished by routing the engine bleed air through a pre-cooler. The pre-cooler is a heat exchanger that contains cold ambient air extracted from the LP bypass air of the engine to circulate within the pre-cooler and is then exhausted overboard through louvers in the engine pylon. The BACs vary bleed air valve openings and the amount of fan stage air to the pre-cooler to obtain the required temperatures measured by sensors at the pre-cooler outlet.

If the engines are operating at low power settings such as during descents or when the aircraft is at low speeds when in a holding pattern, the pressure of the LP bleed air may not be sufficient to satisfy demand. Under these conditions the BACs will supplement LP bleed air with HP air extracted from the engine compressor that is hotter and at a higher pressure. Higher pressure air is automatically supplied as the HP valve opens. The two bleed sources are connected to a common supply duct that includes a check valve to prevent the more highly pressurized HP air from entering into the LP stage of the engine. The BACs control the aperture of the HP bleed valves and the regulator/shutoff valves to satisfy bleed air requirements.

Once the air enters the regulated bleed air manifold, the source of air being directed to the ACM for conditioning of the air is controlled by left and right mass flow valves located in the manifold. These valves are both normally de-energized open, and are controlled either automatically or manually by the crew.

Although both engines and are normally used to provide bleed air to the ACM for cabin pressurization and temperature control, a single engine can provide sufficient airflow to operate the air cycle machine for pressurization and environmental needs. Air conditioning system components and operation are discussed later in this chapter.

Figure 22-1: Bleed Air Control Knobs

Bleed Air Distribution Ducts

After engine bleed air has been modulated by the BACs and introduced into the common supply manifold, the air is distributed to meet the requirements of aircraft systems though a system of ducts. The air cycle machine has an independent duct plumbed into the supply manifold. Supply ducts for the left and right wing anti-ice are also connected to the regulated manifold. For more information pertaining to wing anti-ice bleed air ducting, reference the Ice and Rain Protection chapter of this manual.

Pressurized air is also supplied to a service air regulator which provides air to the rudder bias heat, ACM water separator vacuum ejector, outflow valve vacuum ejector and cabin door acoustic seal. All of these items are drawn from a shared duct that is configured to permit any bleed air source to supply these systems. The acoustic door seal supply line incorporates a pressure regulator to reduce the bleed air supply to avoid damaging the inflatable seal.

Auxiliary Power Unit (APU) Bleed Air

The APU is capable of supplying bleed air for operation of the air conditioning pack and service air systems. The APU air supply is introduced into the common supply manifold on the right side of the duct. The duct contains a check valve to prevent engine bleed air from entering into the APU supply duct to preclude the interruption of air flow within the APU while it is running.

Control of the APU air is through the push button labeled BLEED AIR on the APU Control Panel on the cockpit side wall. Depressing the switch while the APU is operating will open the Bleed Control Valve (BCV) of the APU, allowing bleed air drawn from the compressor stage of the APU to enter the supply manifold. The ON legend within the switch will illuminate when the BCV is selected open. Since there is no BAC for APU air and APU operation is governed by an Electronic Control Unit (ECU) that controls APU RPM to approximately one hundred percent (100%) within temperature limits, the amount of bleed air produced by the compressor section will vary with density altitude. Although APU air is normally only used to supply air conditioning on the ground, it is also available in flight to provide environmental and service air requirements. The APU cannot supply air for anti-ice equipment.

Service Air System

The service air system receives bleed air from the regulated manifold. Any of the three sources of bleed air can supply the service air system. A check valve on each source will stop the flow of bleed air back through one of the supply lines if the source is not in operation. Air in the manifold is directed through a service air regulator. As the air is pushed through a service air regulator, the pressure is reduced to approximately 25 PSI. The service air regulator will also operate as a pressure relief valve if the air pressure in the system goes above 28 PSI.

Warm regulated service air is pushed through the rudder bias actuator to keep the actuator warm. After the service air flows through the rudder bias actuator, it is sent to two different vacuum ejectors. The first vacuum ejector is the air/water aspirator in the air conditioning system. As service air is pushed through the ejector, suction occurs in a tube that is attached to the ACM water separator. Water is pulled out of the bottom of the water separator and into the air stream as it is pushed through the ejector. The air and water mixture is then released on the ACM's heat exchangers. The second vacuum ejector is the pressurization vacuum ejector. The service air is pushed through a particulate trap/particle tube and through the pressurization vacuum ejector. The vacuum that is supplied by the ejector is used by the outflow valves in the pressurization system.

The last system that uses service air is the cabin door acoustic seal system. The service air is sent through a pressure regulator to the acoustic seal valve at 15 PSI. When the door latch is in the closed position, the acoustic seal valve allows service air into the acoustic seal. When the door latch is in the open position, the vent valve is opened and the service air in the acoustic door seal is released into the cabin of the airplane.

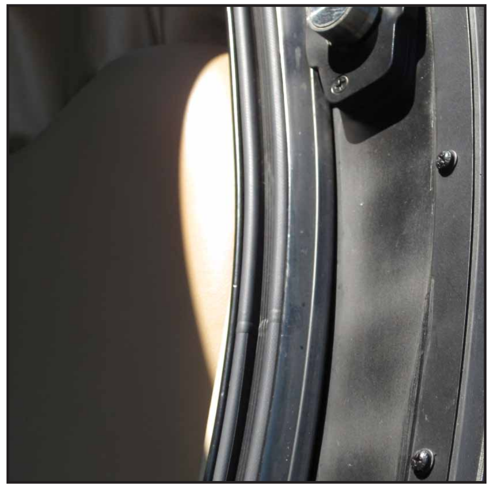


Figure 22-2: Cabin Door Seal

Rudder Bias Pneumatic Supply

The rudder bias pneumatic supply system removes air directly from the compressor section of the engine and directs it to the rudder bias actuator. The rudder bias system is completely separate from the regulated bleed air manifold. The bleed air is removed on the left and right sides of the engine compressor case between the low and high pressure bleed air ports. The bleed air from each engine is sent to opposite ends of the rudder bias actuator.

If one of the engines fails, decelerates or is stopped in flight, and the other engine continues to operate normally, the difference in compressor bleed air pressure will actuate the rudder bias system. The difference in bleed air pressure in the ends of the rudder bias actuator will cause the rudder bias actuator to deflect the rudder to compensate for the additional yaw produced by the loss of thrust from one of the engines.

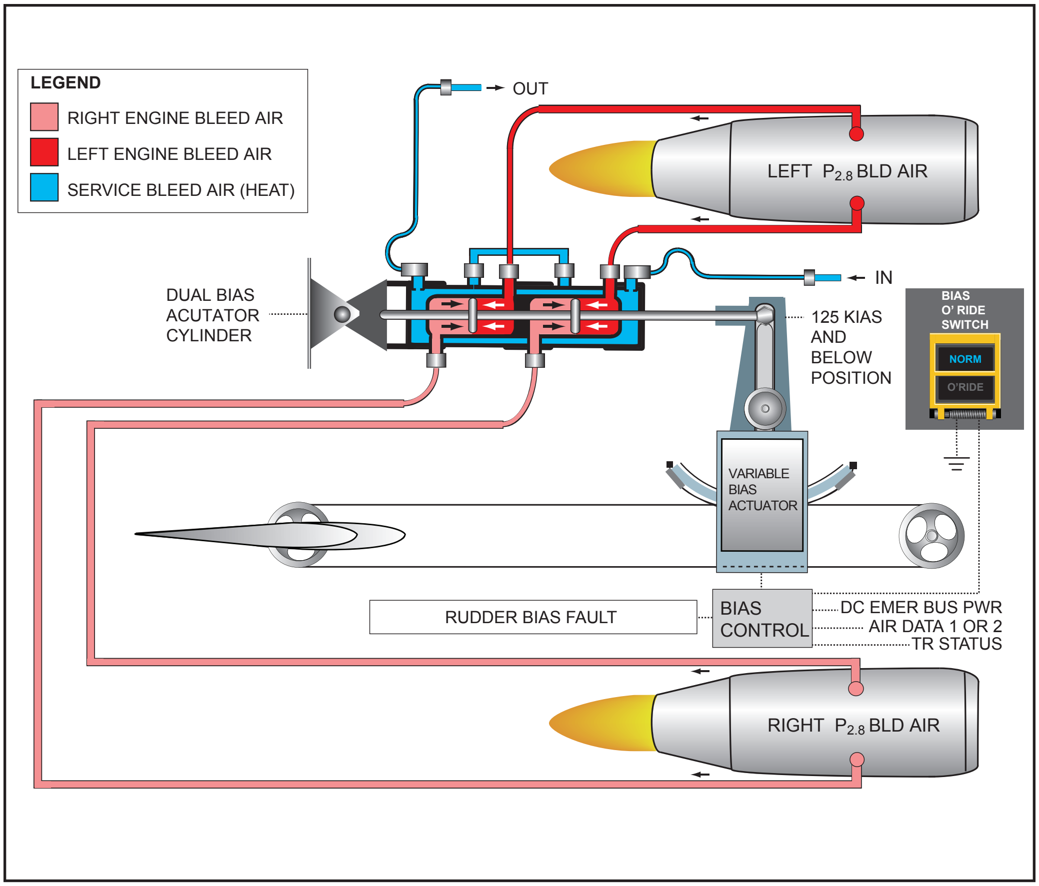


Figure 22-3: Rudder Bias System

Pneumatic System

The pneumatic indication system has three separate functions that are monitored. The pneumatic system is constantly monitored for bleed air leaks with the use of a loop system that is similar to the fire detection loops found in the engine compartment. An amber CAS message is displayed if a leak is detected in the associated zone. Other than the CAS messages, there is no direct display of bleed air pressures or temperatures available to the crew.

The temperature of the bleed air in the distribution system is monitored by a bleed air overheat sensor that is found in the bleed air supply tube downstream of the bleed air distribution heat exchanger. The **BLEED AIR O'TEMP** message is shown on the EICAS if the bleed air temperature is more than 293°C (560°F) for 20 seconds and will automatically stop the bleed air flow through the bleed air shut off valve on the side with the overheat condition. If the temperature is above 315°C (600°F) the **BLEED AIR O'TEMP** message is shown on the EICAS display and the BAC will immediately stop the bleed air flow through the bleed air shut off valve on the side with the overheat condition.

The differential pressure system monitors the air pressure on the low-pressure and high-pressure outputs of the compressor. The differential pressure switch is found immediately downstream of the high-pressure regulating/shutoff valve. The high-pressure regulating/shutoff valve keeps bleed air pressure at approximately 65 PSI. A check valve installed between the low-pressure and high-pressure bleed air tubes prevents the flow of high-pressure bleed air into the low-pressure system. A differential pressure switch actuates at a pressure difference of 5 PSI. A pressure difference of less than 5 PSI indicates that the high pressure valve has closed or is no longer operational. A signal is then sent to the EICAS system and the amber **HP VALVE FAIL L** and/or **R** message will be shown on the EICAS display.

If a high temperature or bleed leak is sensed in the tail cone, engine pylons, ACM, or wing and tail anti-ice systems, BAC system logic closes respective valves, preventing bleed air from entering the affected zone. Amber CAS messages associated with each zone will illuminate on the EICAS. Refer to the end of this chapter for detailed information pertaining to bleed leak and bleed overheat CAS messages.

System Test Functions

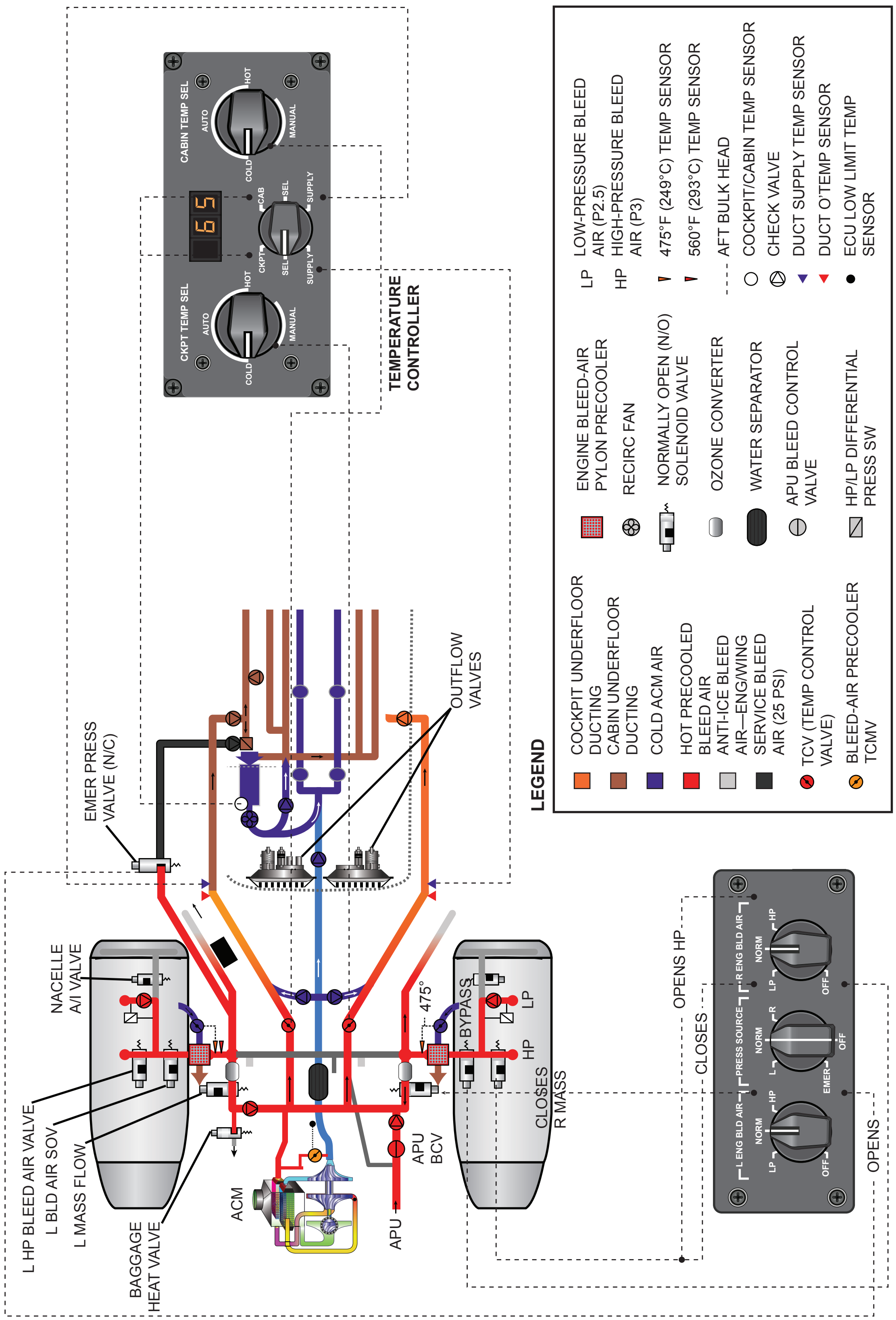
The rotary TEST knob checks the loop continuity of all six bleed air leak detection systems zones and the capability to display CAS messages in the event of a bleed air leak. The rotary test function is checked prior to flight during the Cockpit Preparation checklist. Additionally, the bleed air control knob positions are checked after engine start when bleed air is available, verifying the correct positions of the control valves. Refer to the Expanded Normal Procedures chapter for detailed information pertaining to bleed air functional checks.

Environmental and Temperature Control

General

The air conditioning system provides pressurized and temperature controlled airflow to maintain a comfortable environment for the occupants of the aircraft. Hot pressurized air from the compressor sections of the engines or the auxiliary power unit is cooled through a series of processes by the Environmental Control Unit (ECU) Air Cycle Machine (ACM), remixed with some of high temperature bleed air to achieve the desired temperature, and then delivered throughout the airplane. Distribution ducts provide air to the cockpit, passenger cabin, and baggage compartment. The higher pressure of this airflow allows regulation of the ambient pressure within the airplane to maintain an air density comfortable for breathing even though the airplane may be at the highest operating altitude limit of 47,000 feet.

Environment Control Unit (ECU)



Environmental Control Unit (ECU)

The tailcone-mounted ECU is designed to extract hot engine bleed air from both engines and produce cold air for use in the temperature and distribution system. This conditioned air also serves as the primary source of pressurization. The ECU consists of a primary heat exchanger, secondary heat exchanger, ACM, water separator, and an overtemperature switch.

Precooled (246°C (475°F)) engine bleed air enters the ECU through two interconnected mass flow control valves. The flow control valves drop the pressure of the bleed air and control the flow to the ECS. Bleed air is then cooled to 93 to 149°C (200 to 300°F) prior to entering the ACM. Once the air enters the ACM it is compressed raising the temperature to approximately 149 to 204°C (300 to 400°F). This compressed air then flows to secondary heat exchanger where it is cooled to 37.7 to 65.5°C (100 to 150°F). Air from the secondary heat exchanger returns to the ACM and is expanded. This expansion process provides energy to drive the compressor as well as the fan that draws ambient air into the primary and secondary heat exchangers. As the air is expanded, it will cool to approximately 0°C (32°F) on a hot day. On a normal or cold temperature day the turbine outlet temperatures can go well below freezing.

When the outlet temperature of the air from the turbine drops below the ambient air dewpoint, the water vapor is condensed out of the air in liquid form. With the outlet temperatures below freezing, the water vapor will freeze creating ice particles. In order to prevent these ice particles from freezing over the water separator and blocking airflow, cold turbine inlet air is mixed with hot engine bleed air. The low limit temperature control valve modulates bleed air to maintain a temperature near 0°C (32°F).

Air leaving the water separator is routed to the rest of the airplane via the temperature control ducting. Cabin heat is produced using air that has bypassed the ECU and mixed with cooled air to maintain the desired temperature.

Components

Primary and Secondary Heat Exchangers

The primary and secondary heat exchangers are joined as a unit and arranged in parallel with ram airflow. A ram air scoop located at the base of the vertical stabilizer supplies air for the heat exchangers. On the ground the ACM requires an additional cross-sectional area in order to pull enough air across the heat exchangers. For this purpose, an impeller is installed within the ACM driven by a turbine creating enough suction to open an auxiliary door at the ram air duct. Air is drawn from both the ram air scoop and a set of louvers in the fillet fairing through the door in the ram air duct, across the heat exchangers, and exits out of the right hand side of the airplane through the ACM exhaust grill. Fan inlet pressure is boosted by ram air in flight.

Figure 22-4: Heat Exchanger

Air Cycle Machine (ACM)

The ACM consists of a compressor, turbine, and fan that are mounted by a common shaft supported by air bearings. No oil is required for these bearings as they ride on a film of compressed air. The ACM requires approximately 5 PSIG to spool up the rotating equipment and bring the air bearings into effect.

Water Separator

A mechanical water separator is integrated into the ECU to provide a method of extracting water droplets out of the air. If the air temperature entering the water separator is above the dewpoint, all of the water is in vapor form and cannot be extracted. During the expansion process, the air temperature typically drops below the dewpoint and condenses into very small water droplets in the air stream. Since these droplets are too small to centrifuge out of the air, they pass through a coalescer sock inside the water separator. This sock combines the smaller droplets so the water can be forced to the outer shell by centrifugal force.

The water droplets from the water separator are collected in the outer shell where they are passed into a drain system to be sprayed on the secondary heat exchanger. This increases the cooling efficiency of the exchanger.

Overtemperature Switch

An over temperature switch is mounted in the compressor discharge outlet duct. Upon sensing an overtemperature condition, the switch closes the L and R mass flow regulating shutoff valves, opens the emergency pressurization valve and activates both the **EMERGENCY PRESSURIZATION** and **ACM O'TEMP** EICAS amber messages. On the ground, the switch closes the mass flow shutoff valves and triggers the **ACM O'TEMP** EICAS message.

Air Distribution System

The cabin and cockpit air distribution systems direct the flow of fresh temperature conditioned air for a comfortable and well-ventilated cabin and cockpit. Air distribution is made up of three distinct networks: lower cabin air distribution, cockpit air distribution, and overhead cold air distribution.

Lower Cabin Air Distribution

The lower cabin air distribution system supplies conditioned air through the L lower supply duct. When the air enters the cabin it is diverted forward along several paths; the L armrest and foot warmer ducts, dropped aisle ducts on the L side of the dropped aisle, and the R armrest and foot warmer ducts. The foot warmer and armrest ducting is a piccolo tube design that allows air to flow evenly over the length of the cabin. The L side ducting extends from the aft cabin forward to the main entrance door. Right side ducting is extended from the aft cabin forward to just aft of the cabin/cockpit divider. A duct at the forward side of the aft pressure bulkhead connects the L and R sidewall ducts.

Cockpit Air Distribution

The cockpit air distribution system is supplied with conditioned air through the R lower supply duct. The air enters the aft cabin and is ducted underneath the floorboard towards the cockpit. When reaching the cockpit, the air is split into sidewall diffusers, side window defog, torso WEMAC outlets and foot warmers. The sidewall diffusers, foot warmers, and dual torso WEMAC outlets are also supplied by recirculation fans located in the distribution ducting.

Figure 22-5: Cockpit Air Recycling Buttons

Condensation on the cockpit side windows is prevented by the use of frost panes that keep moist cockpit air from coming in contact with the cold outer window surface. Conditioned air from the cockpit supply is fed between the panes from the bottom of the window. A small vent hole, placed in the upper corner of the frost pane, allows the air to flow over the pane and into the cockpit.

Overhead Cold Air Distribution

The overhead cold air distribution originates at the ECU. Air is ducted through the PSU panel to the airplane occupants. The left and right cold air distribution is supplied to the cockpit and cabin by overhead WEMAC outlets. One outlet is provided for each passenger seat and flight crew position. Operation of the WEMAC outlets is independent of one another for the full open to full closed positions.

Cold air continuously pressurizes the overhead ducting when the engines are running and bleed air is being supplied. A series of piccolo holes in the overhead allows for air overflow if the WEMAC outlets have all been closed.

Recirculation Fans

A cabin recirculation fan increases air movement through the floor and sidewall outlets. Air is recirculated from the cabin back into the overhead and under-floor ducting for stabilization and additional temperature control. The fan speed is controlled using the CABIN NORM/HI button located on the pressurization control panel.

Two cockpit recirculation fans located behind the pilot and co-pilot seats increase airflow from the under-floor cockpit ducts. Fan speed is controlled by the CKPT NORM/OFF button located on the pressurization control panel.

Bulkhead Check Valves

There are three check valves in the cabin/cockpit environmental system. Two are located on the left side of the airplane within the over wing fairing. One is in the cockpit supply line on the right side of the airplane in the over wing fairing. The left side valves provide air to the cabin. The right side provides air to the floor and armrest ducting in the cabin. The primary function of the check valves is to permit conditioned air to flow into the cabin air distribution system and prevent pressurization loss in the event of a duct failure.

Temperature Control System (TCS)

The basic operation of the TCS is to mix a stream of cold air from the ECU outlet with hot bleed air from downstream of the mass flow valves. Environmental air supply is mixed proportionally, as selected by the temperature controller, to maintain a comfortable temperature in the cabin/cockpit.

A dual zone TCS is installed. A DC digital controller provides independent control and selection of cockpit and cabin temperature as well as providing low limit control for the ECU.

Three temperature control valves (cockpit, cabin, and ECU low limit), three duct sensors, two zone temperature sensors, two duct overheat switches, and a temperature controller that is integrated into the Temperature Control selector/indicator comprise the system. The temperature controller processes signals from the flight crew inputs and positions the temperature control valves accordingly.

The temperature control selector/indicator contains system controls along with a display showing the selected temperature, measured zone temperature, or the measured air supply temperature. Zone and supply temperatures are taken directly from the zone sensors or duct sensors respectively. A control knob at the center of the selector/indicator allows the flight crew to cycle between current cockpit/cabin zone temperatures when in the CKPT or CAB position. Two select (SEL) positions for the cockpit or cabin allow the flight crew to select the desired temperature by using the CKPT TEMP SEL or CAB TEMP SEL knobs to control cabin or cockpit temperature. Selectable temperatures range from 18.3 to 29.4°C (65°F to 85°F). A MANUAL position is provided to allow the supply temperature to be manually controlled by the flight crew.

A DC digital controller modulates the temperature control valves based on select knob and zone sensor inputs. These input signals are compared to their respective set points. If a correction to maintain the desired temperature is necessary, the controller sends a DC signal to the appropriate temperature control valve. Valve modulation then occurs in the open or closed direction sending more or less flow to the respective compartment. The ECU limit control operates similarly at a fixed range of 0 to 1.6°C (32 to 35°F).

The passenger using the remote temperature controller located in the cabin at the VIP seat position can select cabin temperature. The flight crew can disable the remote temperature control by pressing the CABIN TEMP CONTROL COCKPIT/CABIN button located on the Pressurization/Environment control panel on the copilot's instrument panel.

Figure 22-6: CABIN TEMP CONTROL COCKPIT/CABIN Button

Figure 22-7: Temperature Control Panel

Components

Temperature Control Valves

Three temperature control valves are utilized to regulate the amount of hot bleed air mixed with ECU cold air. Two of the temperature control valves are located just right of the ACM while the third is located aft of the ACM. The valves are butterfly type valves controlled by a DC motor. The DC motor receives a signal from the controller to position the butterfly to modulate the flow of bleed air to the conditioned air ducts.

Duct Temperature Sensors

The duct temperature sensors monitor the temperature of the air entering the cabin and cockpit air distribution system and signal the logic for the TCS in the controller portion of the environmental control panel. Three sensors are provided. One is located in the cabin conditioned air duct just upstream of the pressure penetration (left-hand side), the second in the cockpit conditioned air duct just upstream of the pressure penetration (right-hand side) and the third is located upstream of the water separator.

Zone Temperature Sensors

A cockpit zone temperature sensor is located in the return side of the recirculation air loop on the right hand side of the cockpit. The cabin zone temperature sensor is located in the return side of the recirculation air loop near the aft pressure bulkhead. Sensors are mounted in the recirculation loop so cabin/cockpit air flows across the sensor; this provides a more accurate sample of zone temperature. The sensors monitor the temperature of the air in the cockpit and cabin and provide a reference temperature to the temperature controller.

Temperature Controller

The temperature controller consists of cabin and cockpit temperature selectors, a digital temperature indicator and a display selector. The cabin temperature selector and the cockpit temperature selector are rotary knobs (CABIN TEMP SEL and CKPT TEMP SEL) incorporating both auto and manual mode controls. The temperature indicator provides a digital temperature readout of the selected switch position. Switch positions provide temperature readouts of the cabin zone temperature, cockpit zone temperature, cabin supply duct temperature, cockpit supply duct temperature, selected cabin temperature, and selected cockpit temperature. The temperature controller has system diagnostic capabilities that are performed each time power is applied to the controller. The diagnostics identify and report potential error conditions.

Duct Overheat Temperature Sensors

Two duct overheat temperature sensors are provided, one for the cabin and one for the cockpit system. The cockpit overheat sensor is located in the cockpit supply duct just upstream of the pressure vessel penetration in the lower, aft, RH cabin. The cabin overheat sensor is located in the cabin supply duct just upstream of the pressure vessel penetration in the lower, aft, LH cabin. The duct overheat sensors will illuminate the amber **DUCT O'TEMP COCKPIT** or **CABIN** EICAS message when the temperature at the duct exceeds approximately 300°F.

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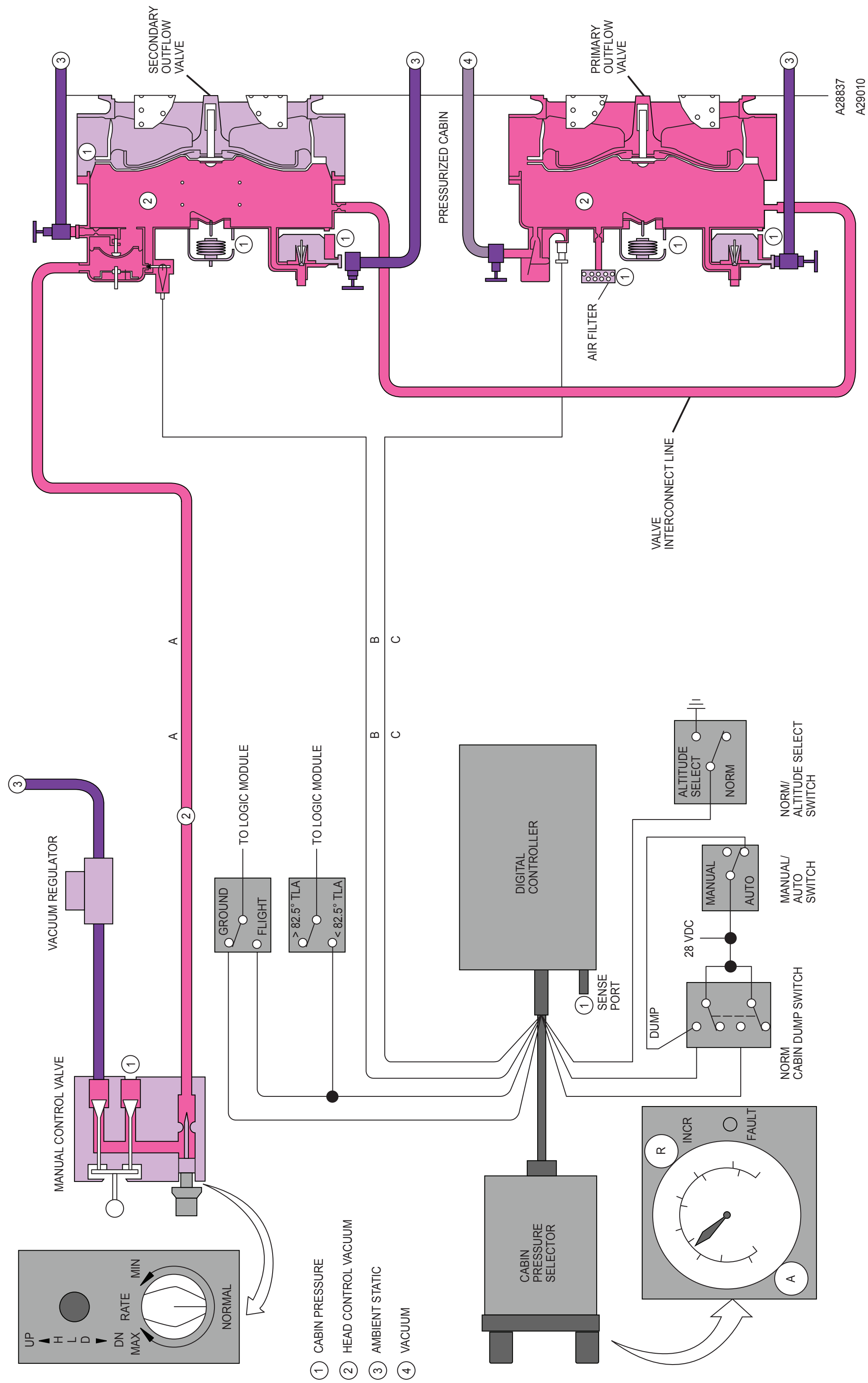
Pressurization

General

The atmosphere within the pressurized section of the aircraft fuselage is regulated to maintain a density range sufficient for breathing without supplemental oxygen, approximating conditions of the ground environment.

To compensate pressurization leakage from the fuselage, a constant source of airflow and a controlling method for that airflow are used to maintain the desired differential pressure. Constant air inflow is available through a wide range of power settings controlled by a single Environmental Control Unit (ECU). Two outflow valves control outflow air. Either the Cabin Pressure Controller or the Manual Rate toggle valve controls the positioning of the outflow valves.

Pressurization System



Components

Pressure Controller

The pressure controller is an electronic microprocessor that drives the primary outflow valve. The pressure controller is controlled with the CABIN PRESS MODE buttons.

Cabin Limiters

Cabin altitude is limited by cabin altitude limit valves, which prevent cabin altitude from climbing above 14,250 feet. In the event that an uncommanded cabin altitude approaches 14,250 feet, a limit valve on each outflow valve allows cabin air into the control chamber, closing the valves. This limiter works in either AUTO or MANUAL operation.

A maximum differential pressure (delta P) limiter mechanism on each outflow valve opens if the electronic controller malfunctions, causing an uncontrolled cabin pressure increase. If the cabin differential pressure reaches 9.6 PSID, the outflow valves will begin to open. Dedicated static ports in the lower fuselage/wing fairing area sense atmospheric pressure for the delta P valves.

Primary Outflow Valve

The primary outflow valve meters the air escaping from the cabin to maintain cabin altitude. A servo-type torque motor metering valve is directly driven by the controller via electrical signals. The valve regulates vacuum pressure from the service air vacuum ejector applied to the primary outflow valve. Controlling the vacuum flow adjusts the position of the outflow valve, and controls air venting into the tail cone.

Secondary Outflow Valve

The secondary outflow valve is connected to the primary outflow valve via a pneumatic interconnect line. As the primary valve moves, the secondary valve moves along with it. During manual operation, the secondary outflow valve is controlled via the CABIN ALT lever and the primary outflow valve moves along with the secondary outflow valve. The secondary outflow valve vents cabin air into the unpressurized tail cone.

Ground Operation

In order for the pressurization system to operate, bleed air must be directed to the cabin via the Bleed Air Control Panel.

The following bleed air control panel switch positions provide normal operation of the pressurization system:

- L ENG BLD AIR Knob - NORM
- R ENG BLD AIR Knob - NORM
- PRESS SOURCE Knob - NORM

The R BLEED AIR CONT, L BLEED AIR CONT, and R BLEED AIR MONITOR circuit breakers must also be engaged.

Figure 22-8: Pressurization Control Panel

Ground Mode (Unpressurized)

When the LH throttle setting is sensed at less than 82.5% N_2 (24.5° TLA), the pressurization controller goes into unpressurized operation, commanding the outflow valves to the full open position.

Ground Mode (Pre-pressurization)

The primary purpose of the pre-pressurization is to prevent cabin climb bumps during takeoff. Once the left throttle is advanced to beyond 82.5% N_2 (24.5° TLA), the TLA decoder logic module signals the pressurization controller to start pressurizing the cabin.

To start pressurizing the cabin, the controller begins to close the outflow valves to descend the cabin at a rate determined by the position of the rate knob, (located on the cabin pressure selector), to an altitude of 180 feet (55 meters) below field elevation. This pressure will be held until takeoff or until the system senses a rejected takeoff by the LH throttle being pulled back. A rejected takeoff will prompt the system to hold for another 30 seconds before returning the outflow valves to their full open/minimum pressure differential position.

> ***NOTE:*** Once the outflow valves are given a full closed signal, the valves require 10-20 seconds to close from fully open. This is due to the rate at which cabin pressure bleeds through the filtered orifice on the primary outflow valve.

Flight Operation

As the airplane reaches a takeoff attitude, the landing gear squat switches indicate to the pressurization controller that the airplane is airborne. The control logic will automatically switch to Flight Mode.

Automatic Control

Two types of automatic in-flight pressurization control are available to the flight crew:

SCHEDULED MODE - With the CABIN PRESS MODE buttons in NORM (auto scheduled mode) and AUTO, the pressurization controller follows a pre-programmed schedule of cabin altitude vs. aircraft altitude. Cabin altitude adjusts as aircraft altitude changes.

Because scheduled altitude is a function of airplane altitude, the cabin rate of change required to follow the scheduled altitude is a function of airplane rate of change. For most normal flight conditions, the cabin rate of change required to follow the scheduled altitude will be some value less than the selected limit rate.

ALTITUDE SELECT MODE - Altitude Select (ALT SEL) mode provides a lower cabin altitude for a given aircraft altitude. After selecting the desired cabin altitude with the "A" knob on the inner scale of the altitude/rate indicator (or aircraft cruise altitude on the outer scale), the controller automatically modulates the outflow valves to climb or descend the cabin altitude at the selected "R" knob rate.

Figure 22-9: Cabin Pressure Indicators

Manual/Backup Control

In addition to the two automatic modes of operation, a manual method of cabin pressure control is provided that is not dependent upon electrical power.

Manual control can be obtained by selecting MANUAL on the AUTO/MAN CABIN PRESS MODE button. The cabin pressurization system will automatically revert to manual mode in the event of an electrical failure.

Once the manual mode is initiated, the following actions occur:

- Power to the torque motor metering valve on the primary outflow valve is removed. This causes the valve to close and no longer regulate the outflow valves.
- The secondary outflow valve immediately takes over, locking the current cabin pressure (Isobaric Hold) closing the solenoid isolation valve from the removal of electrical power. This traps the current control pressure in the control-metering valve causing the secondary outflow valve to become the primary source of cabin pressure control.

> ***NOTE:*** The cabin pressure will momentarily decrease in altitude until the secondary outflow valve sufficiently opens in order to maintain a controlling position.

In order to adjust cabin altitude when in manual mode, select the red manual control toggle valve (cherry picker) to the up or down position. The manual control toggle valve is spring-loaded to the center position enabling the cabin pressure to be maintained at release.

> ***NOTE:*** If rapid rate of change in cabin altitude is desired, the MANUAL RATE knob should be selected to the MAX position.

The manual control may be used to dump cabin pressurization by positioning the MANUAL RATE knob to MAX and holding the manual control toggle in the UP position. If the airplane is above 14,250 feet, the cabin altitude will increase to 14,250 (±250) feet maximum, limited by the altitude limit control on the outflow valves.

CABIN DUMP - The switch guard covering the CABIN DUMP button must be raised to select DUMP. A full open signal is sent to the torque metering valve on the primary outflow valve commanding it to full open. Cabin altitude will increase rapidly and hold at 14,250 feet (±250 feet) .

Placing the button back to the NORM (auto-scheduled) position returns the pressurization control to normal.

Cabin altitude will not increase above 14,250 feet due to the altitude limit valves. For complete cabin depressurization, bleed air must be selected OFF using the bleed air control panel.

Cabin Altitude Warnings

Cabin altitude greater then 8,500 feet is indicated visually by the EICAS. If cabin altitude exceeds 8,500 feet, a single chime will be heard in the cockpit, followed by an amber **CABIN ALTITUDE** message on EICAS. When the cabin altitude descends below 8,100 feet, the EICAS message will extinguish. This message is generated from a pressure transducer mounted in the left or right logic module.

NOTE: If the airplane is above 14,250 feet, the cabin altitude will increase to 14,250 feet (±250 feet) and be controlled by the altitude limit control on the outflow valves.

Landing Operation

Normal Landing Mode

Upon touchdown, the landing gear logic module (via the weight-on-wheels input) indicates to the pressurization controller that airplane is on the ground. The cabin is depressurized at a rate determined by the position of the RATE knob. Depressurization of the cabin will then begin for 60 seconds or until the cabin becomes unpressurized. After 60 seconds, the pressurization controller enters the Ground Mode and dumps any remaining cabin pressure.

If the left throttle is advanced past 82.5% N_2 (24.5° TLA), the pre-pressurization mode will begin.

High Altitude Mode

The cabin pressure control system incorporates a discrete electrical signal from the pressurization controller any time an aircraft altitude above 8,000 feet is selected while in the automatic mode. This signal becomes active when airplane altitude is less than 24,500 feet and the cabin altitude is above 8,000 feet, shifting the red EICAS cabin altitude warning message from 8,500 to 14,500 feet cabin altitude.

To ensure the cabin altitude will not exceed 8,000 feet any time airplane altitude is greater than 25,000 feet, the cabin pressure controller incorporates rate of change multipliers that affect the selected rate once the discrete signal is active.

As the airplane descends to an airport above 8,000 feet, the cabin pressure controller will not allow the cabin altitude to rise above 8,000 feet until the airplane descends below 24,500 feet.

Takeoffs from airports higher than 8,000 feet with a selected altitude for landing less than 8,000 feet activates the discrete signal and rate multipliers. They remain active until the airplane exceeds 24,500 feet or the cabin altitude drops below 8,000 feet, whichever occurs first.

Emergency Pressurization

Emergency pressurization allows precooled bleed air from the left engine only to enter the under-floor ducting to maintain pressurization. Emergency pressurization is automatically turned on when there is an ACM over-temperature, an ACM bleed leak, or the cabin altitude is greater than 14,500 feet. Emergency pressurization can also be selected manually using the EMER position of the PRESS SOURCE selector knob on the right side tilt panel. Normal temperature control is not available when emergency pressurization is active. An amber message **EMERGENCY PRESSURIZATION** will illuminate on the EICAS.

Servicing and Procedures

Preflight

Bleed-air extracted from the engines passes through a precooler in the pylon to reduce the temperature prior to entering the fuselage. The bleed-air is separated and sent to its respective areas for anti-icing, pressurization and environmental temperature control, and service-air systems.

Prior to flight, a satisfactory bleed-air check must be performed. Positioning the bleed air selectors and pressure control selector in the various positions and monitoring the interturbine temperature verifies proper operation of the bleed valves. The check is conducted as follows:

Bleed Air System . . . . CHECK/SET

1. Throttles. . . . . IDLE
2. APU SYSTEM BLEED AIR Button. . . . . .OFF
3. L and R ENG BLD AIR and
4. PRESS SOURCE Selectors . . . . .NORMAL
5. L ENG BLD AIR Selector . . . . OFF THEN NORMAL
   VERIFY DECREASE THEN INCREASE
   IN LEFT ENGINE ITT
6. PRESS SOURCE Selector, position as follows:
   a. OFF. . . . . VERIFY DECREASE IN BOTH ENGINE ITTS
   b. EMER . . . . VERIFY INCREASE IN LEFT ENGINE
   ITT AND SMALL INCREASE IN NOISE
   c. L. . . . . VERIFY SMALL DECREASE IN NOISE
   d. R . . . . VERIFY DECREASE IN LEFT ENGINE
   ITT AND INCREASE IN RIG HT ENGINE ITT
   e. NORM. . . . . VERIFY INCREASE IN LEFT ENGINE ITT
7. R ENG BLD AIR Selector . . . . OFF THEN NORMAL
   VERIFY DECREASE THEN INCREASE
   IN RIG HT ENGINE ITT
8. APU SYSTEM BLEED AIR Button. . . . . AS DESIRED

Exterior Inspection

Ensure that the static ports in each lower fuselage/wing fairing area are clear. Operation with APU bleed air ON with the cabin door closed will result in a slight positive pressure in the aircraft. Ensure that the cabin door and seals are in good condition. To avoid potential injury to persons or damage to the cabin door, APU bleed air should be turned OFF or a cockpit side window opened prior to opening the cabin door.

Abnormal Procedures

The following is a discussion of abnormal procedures for the pneumatic, environmental and pressurization systems. Please refer to the CAE SimuFlite Operating Handbook for a detailed checklist.

Overpressurization

Overpressurization of the cabin/cockpit is most commonly the result of a malfunction in the cabin controller or of the outflow valves. Set the CABIN PRESS MODE buttons to NORM and MANUAL and set the CABIN ALT lever UP. Increase the pressurization rate knob as required. If still overpressurized, set the PRESS SOURCE SELECTOR to L or R. Set the ENG BLD AIR selector (on the side selected as pressure source) to LP. Set BAGGAGE HEAT BUTTON to OFF and set altitude to FL410 Maximum (11 or less passengers) or FL390 Maximum (12 passengers). Decrease engine power (on the side selected as the pressure source) as required.

Cracked or Shattered Windshield

If the cockpit forward or side windshields shatter or become cracked during flight, reduce pressure on the windshield by switching CABIN PRESS MODE button to ALT SEL and increasing cabin altitude to 9,500 feet, then descend to the lowest practical altitude consistent with fuel range requirements; FL410 or lower is recommended.

Cabin Altitude >8,500

The amber **CABIN ALTITUDE** message is displayed when the cabin altitude exceeds 8,500 feet due to failure of the pressurization system. This message is also displayed when the pressurization system is operating in high elevation airfield mode and (1) the cabin altitude exceeds 9,650 feet for more than 30 minutes or (2) the cabin altitude exceeds 8,500 feet and the airplane is above 24,500 feet MSL. Don the oxygen masks and set L and R MIC SEL buttons to MASK.

Cabin Altitude >10,000

The **CABIN ALTITUDE** message turns RED when the cabin altitude exceeds 10,000 feet. Initiate emergency descent and set PASS OXY selector to ON.

BAGGAGE DOOR OPEN

This message is displayed when any baggage door sensor indicates the door is not fully closed, any of the four clasps are unlatched, or any one or more of the sensors are faulted. Land as soon as practical.

CABIN DOOR OPEN

This message is displayed when the cabin door switches indicate the door is in the open position, the inner handle is not secured, the locks are not engaged, or the monitor system operation has not been verified correct.

Emergency Procedures

The following is a discussion of emergency procedures for the pneumatic, environmental and pressurization systems. Please refer to the CAE SimuFlite Operating Handbook for a detailed checklist.

Environmental System Smoke or Odor

In the event of smoke in the cabin or cockpit, immediately don masks and goggles test the mask microphone and ensure PASS OXY knob (if fire source is known and away from oxygen system) and set the PAX safety button to ON. Determine source of fire and/or smoke.

Emergency Descent

When initiating an emergency descent, place the throttles in the IDLE detent and set the speed brakes to 100%. Push the AP/TRIM/NWS DISC Button. The initial pitch attitude should be at 15° down. Descend at M_{mo}/V_{mo} to a safe altitude.

> ***NOTE:*** This procedure assumes structural integrity of the airplane. If airplane structural integrity is in doubt, limit speed as much as possible and avoid high maneuvering loads.

Automatic Emergency Descent

The autopilot has an automatic EDM mode that is armed any time airplane altitude is great than 31,000 feet with the autopilot selected ON. When the cabin altitude reaches 14,500 feet with the airplane above 31,000 feet and the autopilot ON, the following occurs:

1. A red **EMERGENCY DESCENT** message illuminates on the EICAS.
2. A red **EMER DESCENT** annunciation appears at the top of each PFD.
3. An "emergency descent" aural warning sounds.
4. The aircraft enters a 90 degree left turn from the current heading.
5. 15,000 feet is placed in the ALT select window.
6. Descent is maintained at V_{mo}/M_{mo} -10 KIAS.

To attain a maximum rate of descent, reduce the throttles to IDLE and deploy the speed brakes to 100%. EDM can be disengaged by pressing the AP/TRIM/NWS DISC button.

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EICAS System Displays

Cyan Messages	Description
BLEED SELECT NOT NORM L and/or R	This message is displayed when an engine bleed air source is selected to other than the normal position. This message is amber on the ground.
CABIN ALTITUDE	This message indicates the cabin altitude is above 8,000 feet and the pressurization controller is set for the high elevation airfield mode (landing field elevation above 8,000 feet).
Amber Messages	**Description**
BAGGAGE DOOR OPEN	This message is displayed when any baggage door sensor indicates the door is not fully closed, any of the four clasps are unlatched, or any one or more of the sensors are faulted.
BLEED AIR MONITOR FAIL	This message is displayed when one or both bleed air monitor cards have failed. There is no means of telling if one or both bleed air monitor cards have failed. If both cards have failed, the cabin altitude warning system will be inoperative.
BLEED AIR O'TEMP L and/or R	This message is displayed when the bleed air temperature from the respective precooler has exceeded 293°C for more than 20 seconds or 316°C instantly.
BLEED SELECT NOT NORM L and/or R	This message indicates the bleed air selector is not in the normal position with the airplane on the ground. This message is cyan in the air.
CABIN ALTITUDE	This message is displayed when the cabin altitude exceeds 8,500 feet due to failure of the pressurization system. This message is also displayed when the pressurization system is operating in the high elevation airfield mode and (1) the cabin altitude exceeds 9,650 feet for more than 30 minutes or (2) the cabin altitude exceeds 8,500 feet and the airplane is above 24,500 feet MSL.
CABIN DOOR OPEN	This message is displayed when the cabin door switches indicate the door is in the open position, the inner handle is not secured, the locks are not engaged, or the monitor system operation has not been verified correct.
DUCT O’TEMP CABIN	This message is displayed when the cabin duct temperature exceeds 149°C.
DUCT O’TEMP COCKPIT	This message is displayed when the cockpit duct temperature exceeds 149°C.
EMERGENCY PRESSURIZATION	This message is displayed when emergency pressurization is active.
HP VALVE FAIL L and/or R	This message is displayed when the high-pressure bleed valve is failed in the closed position when commanded open on the ground, or open position when commanded closed in flight or on the ground.

Amber Messages	Description
PRESS SOURCE NOT NORM	This message is displayed when the PRESS SOURCE selector is not in the normal position and emergency pressurization is not active.
Red Messages	**Description**
CABIN ALTITUDE	This message is displayed when the cabin altitude exceeds 10,000 feet (14,500 feet in high elevation airfield mode).
EMERGENCY DESCENT	This message is displayed when the autopilot enters the emergency descent mode (EDM). A red **EMER DESCENT** message will also be displayed on both PFDs.