Honda Aircraft Company

PILOT'S OPERATING MANUAL

HondaJet

Model HA-420

Original Issue: December 10, 2015

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This Pilot's Operating Manual is supplemental to the current FAA Approved Airplane Flight Manual, HJ1-29000-003-001. If any inconsistencies exist between this Pilot's Operating Manual and the FAA Approved Airplane Flight Manual, the FAA Approved Airplane Flight Manual shall be the governing authority.

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LIST OF EFFECTIVE PAGES

This list contains all current pages with effective revision date.

Use this list to maintain the most current version of the manual:
Insert the latest revised pages. Then destroy superseded or deleted pages.

Note: A vertical revision bar in the left margin of the page indicates pages that have been added, revised or deleted.

MODEL HA-420 PILOT'S OPERATING MANUAL

SECTION 1 – SYSTEMS DESCRIPTION

SECTION 2 – FLIGHT PLANNING

SECTION 3 – OPERATING PROCEDURES AND TECHNIQUES

SECTION 4 – SERVICE, HANDLING, AND MAINTENANCE

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SECTION 5 – GLOSSARY

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RECORD OF REVISIONS

REVISION	REV. DATE	DESCRIPTION OF REVISION
Original	12/10/2015	Original Issue
A	-	Not Used
B	10/30/2016	Added FIKI Information and General Update
B1	12/23/2016	Removed requirement and added approval for use of fuel icing inhibitors.
B2	3/3/2017	Updated frontmatter to align with updated documentation group

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RECORD OF TEMPORARY REVISIONS

Temporary changes to this manual must be entered in this table and revised pages added to the document for all flight operations.

TEMP. REVISION	TEMP. REV. DATE	DESCRIPTION OF TEMPORARY REVISION

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LIST OF SERVICE BULLETINS

The following is a list of active Service Bulletins applicable to the operation of this airplane and incorporated into this manual.

SB NO.	SB REV. NO.	REVISION INCORPORATED	SB TITLE	EFFECTIVITY

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DOCUMENTATION GROUP

The following is a list that defines the group of current documents that provides pilots with the information required for the safe and efficient operation of the airplane.

MANUAL PART NO.	REV. NO.	MANUAL	RELEASE DATE
HJ1-29000-003-001	B2	Airplane Flight Manual	3-3-2017
HJ1-29000-035-001	B2	Electronic Checklist	3-3-2017
HJ1-29000-005-001	B2	Pilot's Operating Manual	3-3-2017
HJ1-29000-007-001	B2	Quick Reference Handbook, Vol I and II	3-3-2017

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INTRODUCTION

This Pilot's Operating Manual (POM) provides data to supplement the information contained within the FAA approved Airplane Flight Manual (AFM).

This POM has been prepared to provide pilots with the information required for the safe and efficient operation of the airplane.

Honda Aircraft Company supports authorized facilities worldwide for ease of maintenance and service on our aircraft. For information on how to obtain revisions for this manual or other Honda Aircraft Company service publications, visit the Honda Aircraft Company website: www.HondaJet.com.

SECTION CONTENTS

Section 1 – Systems Descriptions A basic description of the airplane systems.

Section 2 – Flight Planning Performance and fuel consumption data derived from flight testing. This data may be used for flight planning.

Section 3 – Operating Procedures and Techniques Recommended procedures and techniques to operate the airplane and its systems.

Section 4 – Service, Handling and Maintenance Supplemental information to assist flight crew with general service, handling and maintenance of the airplane.

Section 5 – Glossary A list of acronyms, common terms, and definitions used in this Pilot's Operating Manual.

REVISION INSTRUCTIONS

Honda Aircraft Company Technical Publications will update and distribute revisions to this manual as required.

The List of Effective Pages shows the revision status of each page by notating the date of the revision. The Record of Revisions shows each revision and its date of release.

MANUAL CONVENTIONS

TABLE OF CONTENTS

A table of contents precedes each section of the manual, except Section 5 – Glossary.

OPTIONAL EQUIPMENT

This manual contains information and techniques for using standard and optional equipment. Omit technique steps referring to any optional equipment that is not installed.

USE OF L(R) AND L-R

L(R) or L-R may precede a CAS message text. L(R) applies if the message annunciates as either L or R, depending on the affected side. L-R applies to a condition affecting both sides simultaneously.

USE OF L(R) VERSUS 1(2)

L(R) terminology is used for systems that are located on the left or right side of the aircraft. An example is the engine anti-ice system, shown with either an L or R, preceding the associated CAS text. Other systems that are redundant but not associated with the left or right side use 1 or 2. An example is AHRS 1 which is a redundant system that can couple to the left or right side flight instruments.

NOTES, CAUTIONS, AND WARNINGS

This POM may use the following notations to categorize procedures addressing safety or airplane operation.

WARNING **Operating procedures or techniques which may result in personal injury or loss of life if not carefully followed.**

CAUTION *Operating procedures or techniques which may result in damage to equipment if not carefully followed.*

NOTE Additional, significant operating information requiring emphasis.

SECTION 1

SYSTEMS DESCRIPTION

TABLE OF CONTENTS

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GENERAL DESCRIPTION

INTRODUCTION

The HondaJet Model HA-420 aircraft, manufactured by Honda Aircraft Company, is a single-pilot certified, carbon fiber fuselage, all metal wing with a twin pylon mounted turbo fan Over-The-Wing Engine Mount (OTWEM) configuration monoplane with a T-Tail empennage.

The high-aspect ratio wings are constructed with a combination of conventional riveted techniques and milled wing skins containing integrated structures providing an airfoil with Natural Laminar Flow. The under-fuselage wing carry through joining the left and right wings is aluminum with the aircraft fuselage mounted above. Primary flight controls are fully reversible ailerons, rudder, and elevators that are manually controlled through cables, bell cranks, and push pull tubes. Electrically-actuated trim tabs are installed for all three axes. Flaps are electrically actuated.

The carbon fiber fuselage is constructed with a combination of co-cured and honeycomb sandwich structures allowing for light weight structure and a fuselage nose shape maximizing Natural Laminar Flow to reduce aerodynamic drag. There are two external baggage compartments, one in the nose and the other in the tail. The cabin holds four passengers in a club seating arrangement and is equipped with a lavatory in the aft section.

Thrust is provided by two GE Honda HF-120 turbofan engines producing 1997 lbs. of thrust. Fuel is provided by each respective wet wing and additional fuel can be stored in the under fuselage carry through and an aft fuselage tank.

The landing gear is a fully retractable tricycle-type trailing link design with rudder pedal controlled steer-by-wire nosewheel steering and an antiskid braking system.

The cabin environment is maintained using conditioned bleed air. Two independent temperature zones are provided inside the pressure vessel. Two aft pressure bulkhead outflow valves control pressurization to a scheduled cabin altitude for the flight deck, cabin, and aft lavatory.

Electrical power is managed via a split bus system with onside batteries, generators and power distribution.

The avionics system includes an integrated Garmin® G3000® three-screen system with dual, pedestal-mounted touchscreen Control Display Units (CDU). A three-axis auto-flight system is included.

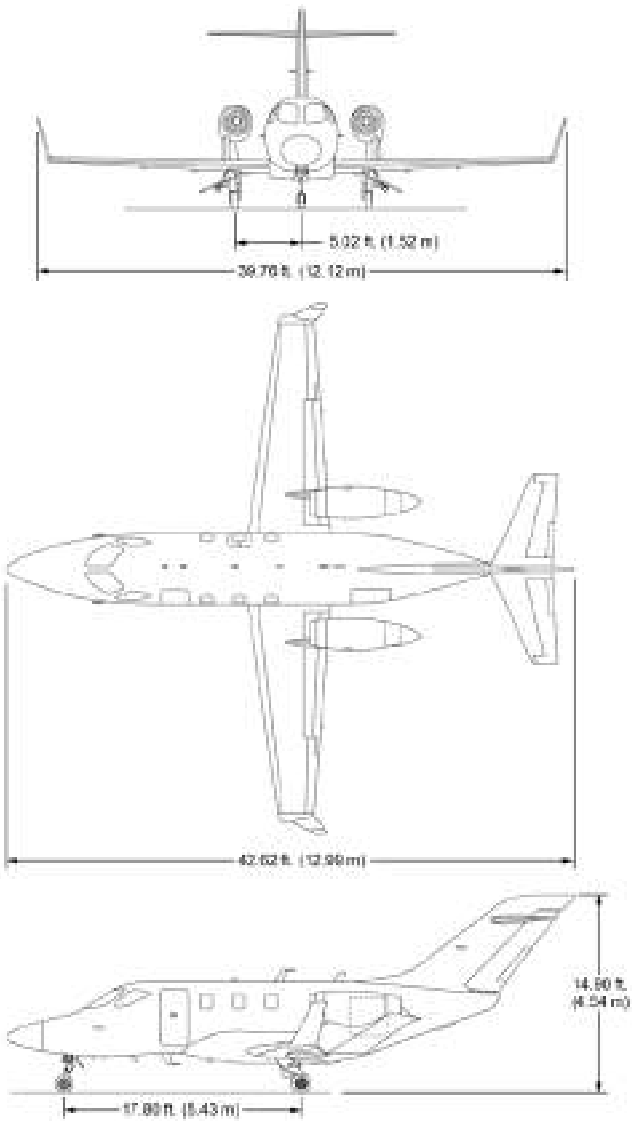

Figure 1-1. Three Views of Aircraft

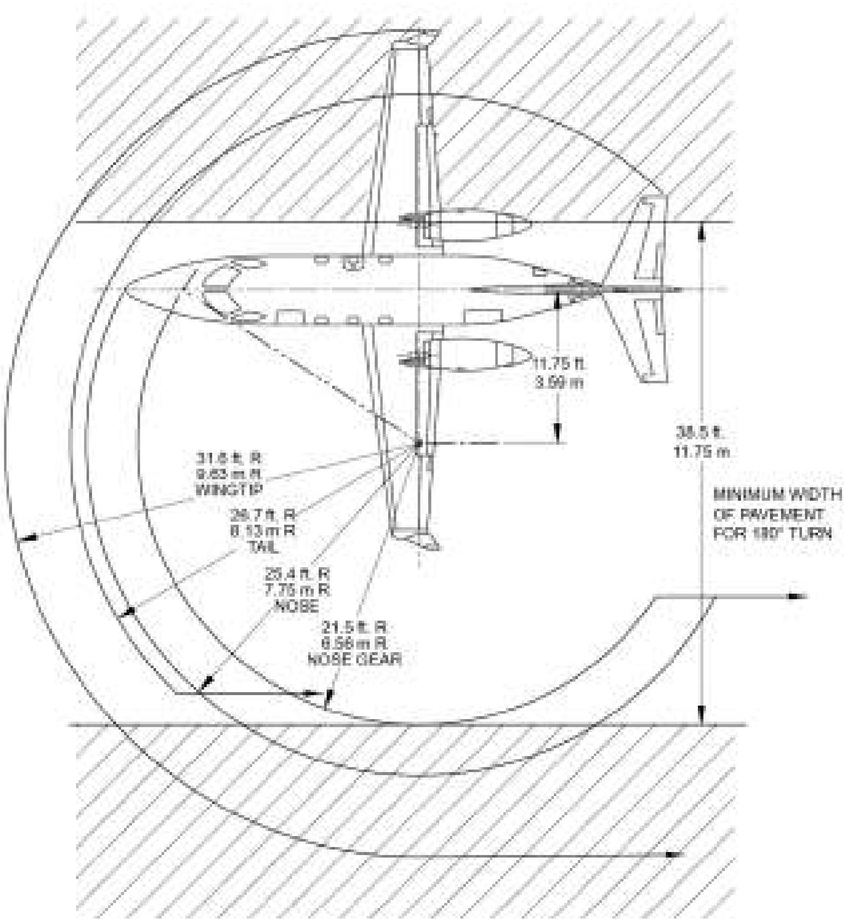

Figure 1-2. Turning Radius

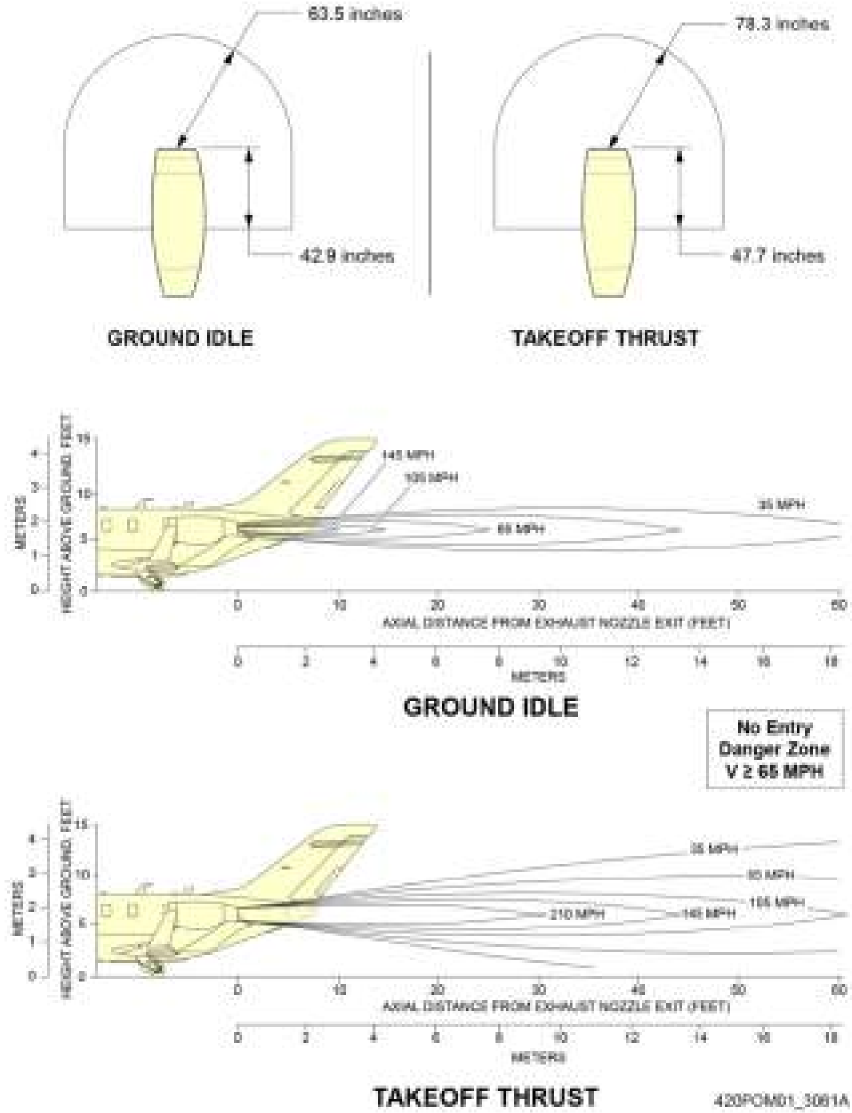

Figure 1-3. Engine Inlet / Exhaust Danger Areas

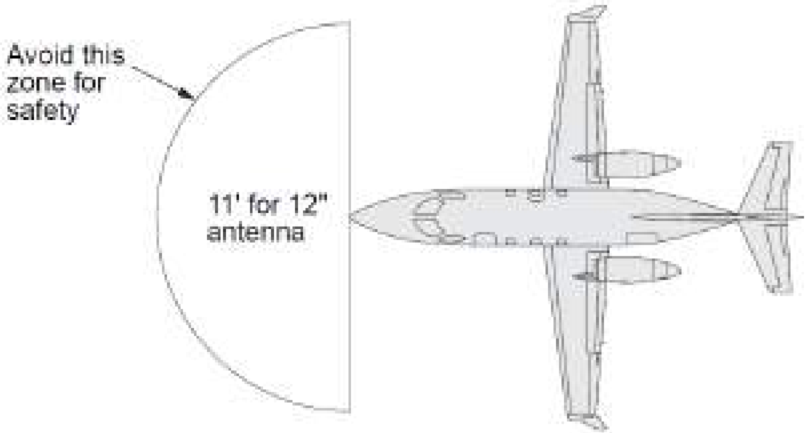

Figure 1-4. Weather Radar Danger Areas

FUSELAGE

The fuselage structure is made from a cured carbon/epoxy material, with metal fittings for concentrated load transfer. The cabin section between the forward and aft pressure bulkheads is pressurized and contains a passenger door on the left side, an emergency exit door on the right side and includes two sky-view windows in the lavatory. A fuel bladder tank is installed on the aft pressure bulkhead structure behind the pressurized cabin.

EMPENNAGE

The empennage is a T-tail configuration. The stabilizers and control surfaces are aluminum structures that contain spars, ribs, and stringers. The yaw control surface contains a single mass balanced rudder with an electric trim tab actuator. The pitch control surfaces are split mass balanced elevators with two electro-mechanically actuated trim tabs.

WING

The wing is a conventional aluminum design that contains a front spar, mid spar, rear spar, ribs, upper skin, lower skin and stringers. Most of the wing structural parts are machined from a solid piece of aluminum.

Each wing incorporates an integral fuel tank. The center wing assembly contains a sealed upper and lower skin and ribs at each end that make an integral center fuel tank.

The bottom of the outboard wing includes 14 vortex generators to energize the airflow across the lower surface of the aileron. A "bump" device is mounted to the upper wing skin to improve airflow at high Mach number. Each inboard leading edge has a wedge-shaped stall strip to improve airflow at high angles of attack.

There are leading edge triangles on each winglet, a winglet fence and mid-aileron span vortilon to improve airflow during sideslips.

A single mass-balanced aileron incorporating an electric trim tab actuator is mounted on the outboard trailing edge of each wing.

NACELLE AND PYLON

Engine nacelles are streamlined aerodynamic panels used to house and protect engine components, direct airflow and decrease aerodynamic drag. The engine nacelles contain the forward and aft firewalls that comprise the fire zone.

The engine pylon contains a front engine mount, rear engine mount, firewall, spars, stringers, ribs and skins. Titanium and steel materials are used on the engine mount and firewalls where a fireproof material is necessary. The pylons house the Full Authority Digital Engine Control (FADEC) computers and the fire extinguisher bottles.

DOORS

Introduction

The aircraft is equipped with multiple doors and access panels to allow ingress/egress, inspection and maintenance.

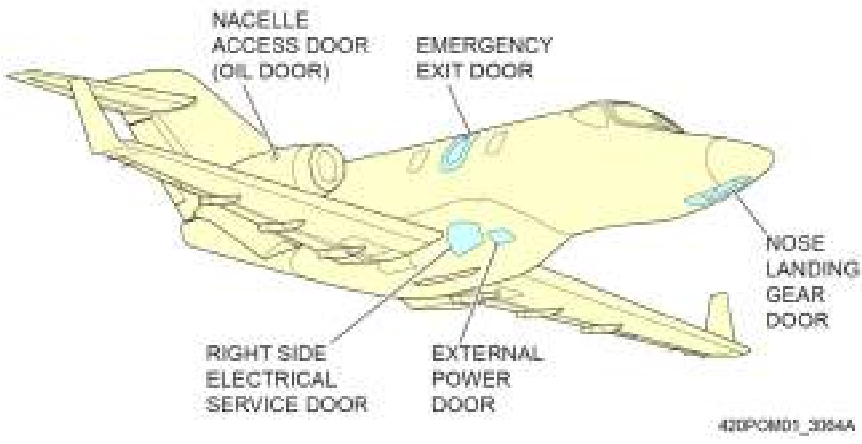

Figure 1-5. Forward Right Side Doors

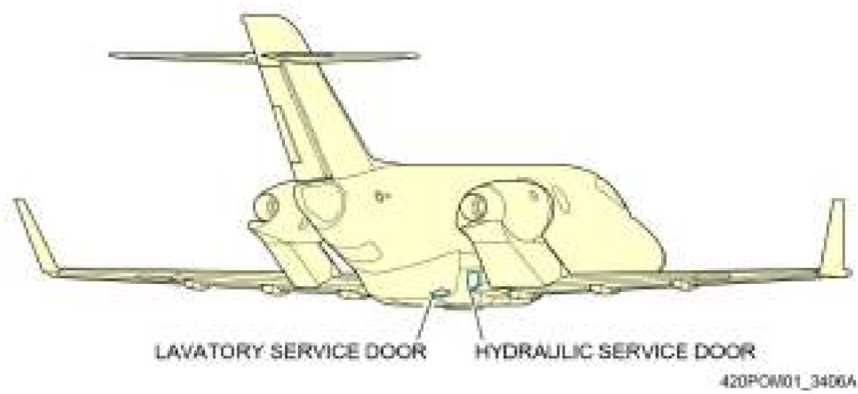

Figure 1-6. Aft Right Side Doors

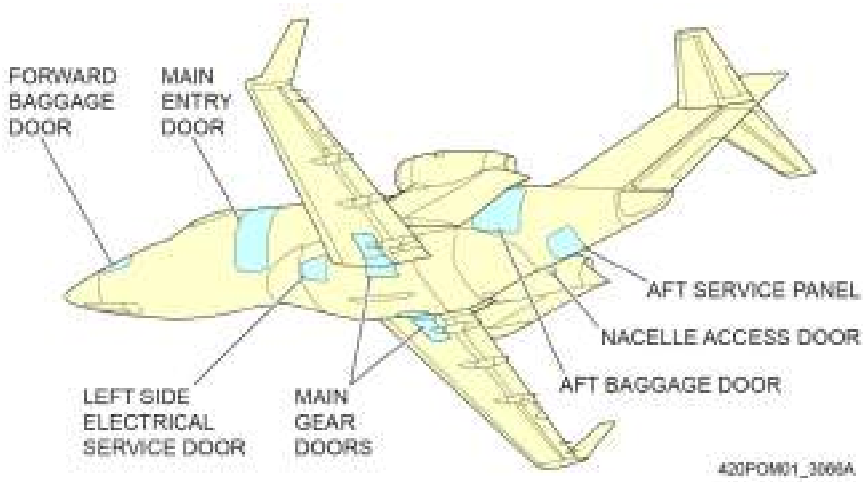

Figure 1-7. Left Side Doors

Main Entry Door

A single piece main entry door (MED) with integral stairs is mounted on the left side of the fuselage just aft of the cockpit.

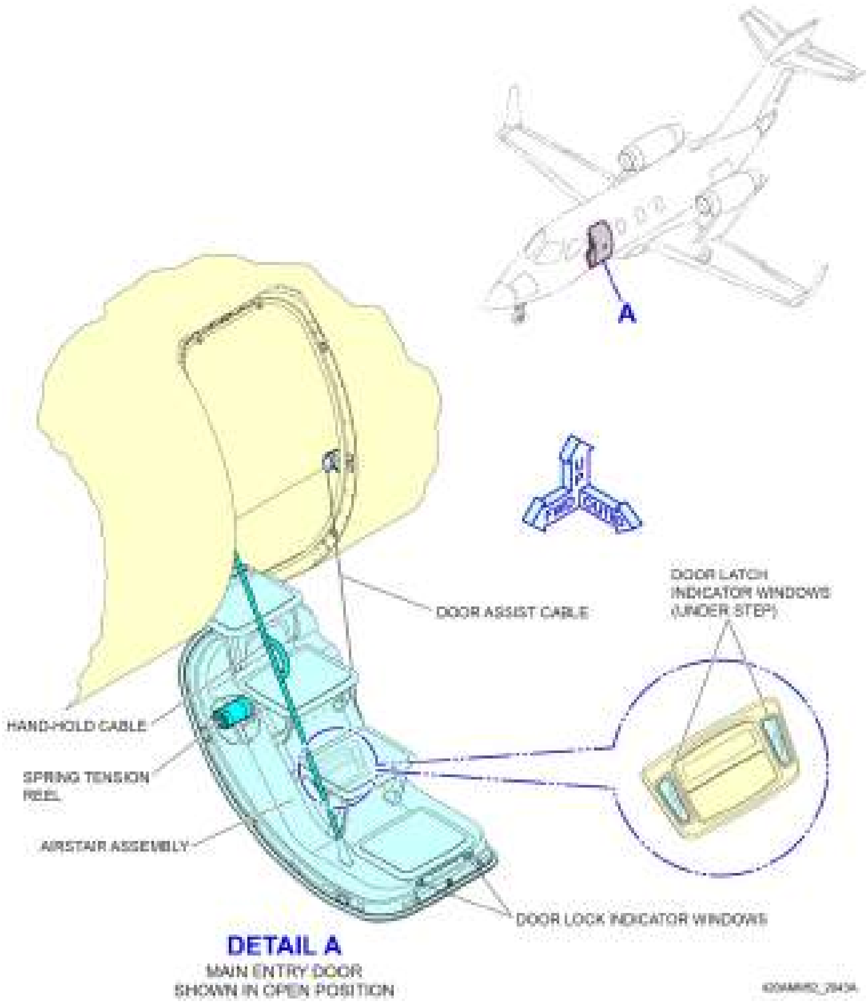

Figure 1-8. Main Entry Door – Airstair

The MED has a latch/lock system with latch and locking handles that actuate the door mechanisms. The lock system has a key-lock security feature which can be used to secure the aircraft from unauthorized entry. When the door is operated from the inside, the door key-lock does not interfere with the operation of the latch and locking system of the door. The locks and latches on the primary latching system have a switch that provides status information to the flight deck. There is an inspection window to examine the primary and secondary locking system status.

From the outside, a disengaged latch is indicated by the latch handle not being flush with the airplane skin, exposing a red surface. On the inside of the cabin, a disengaged latch is indicated by bright orange surfaces on the inside of the latch opening and the latch handle.

When the door latch system is disengaged, gravity assists opening the door. A spring and cable system, located in the door, assists closing the door.

The door has an integral stair that is installed on the door structure. The second step can be manually moved down to expose the interior latch/lock handles as the door is closed.

EFFECTIVITY: 011-040

Two passively inflated seals are mounted on the fuselage structure (inboard seal) and on the door structure (outboard seal) respectively. Only the outboard seal acts as a primary door seal to form a pressure boundary once the door is closed, and the cabin is pressurized. Although the inner seal is pressurized, it only functions as an acoustic seal.

EFFECTIVITY: 041-999

A passively inflated seal is mounted on the door structure (outboard seal). The outboard seal acts as a primary door seal to form a pressure boundary once the door is closed, and the cabin is pressurized

A pressure relief valve provides pressure equalization prior to opening and enhances the resistance to unlocking when cabin pressure is increased.

Emergency Exit Door

The Emergency Exit Door (EED) is located on the right side of the fuselage. This door is hinged on the bottom and opens inward.

The door is operated by pulling a latching handle mounted behind an interior cover. Switches are mounted in the latching mechanism to provide cockpit feedback of status. On the outside, there is an integral pressure valve that can be depressed to unlatch the door. This pressure valve will equalize cabin pressure with ambient when actuated. The door can be secured from the inside by means of a stand-alone security device.

The door has a window and a passively inflated seal, which is pressurized by cabin pressure.

CAUTION *Be careful installing the EED after removal. Verify the interior operation is free of interference. The posts installed on the fuselage can cause damage to the seal.*

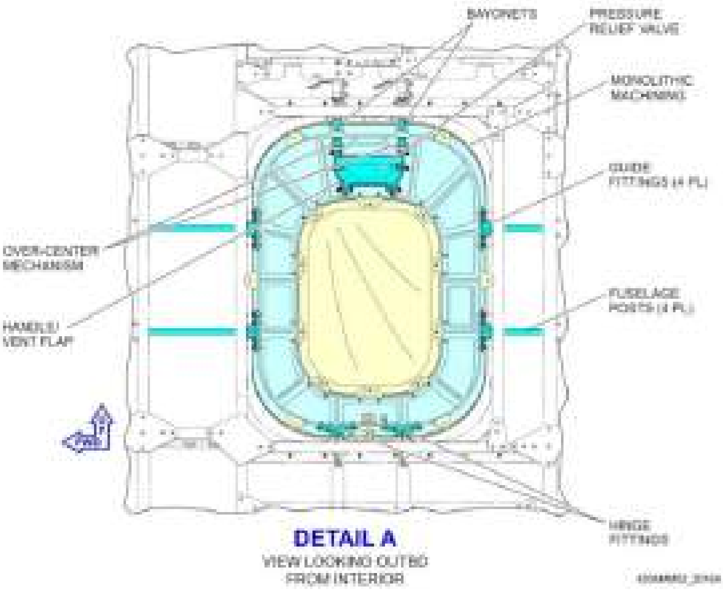

Figure 1-9. Emergency Exit Door

Aft Baggage Door

The aft baggage door is mounted on the aft left side of the unpressurized fuselage. The door is equipped with four latches and a handle. The door is hinged on the forward edge so that when the handle is pulled it moves first out and then translates forward and latches in place. A key-lock, independent of the latches is also provided. Two switches located on the fuselage side tripped by the forward latches provide cockpit feedback of status.

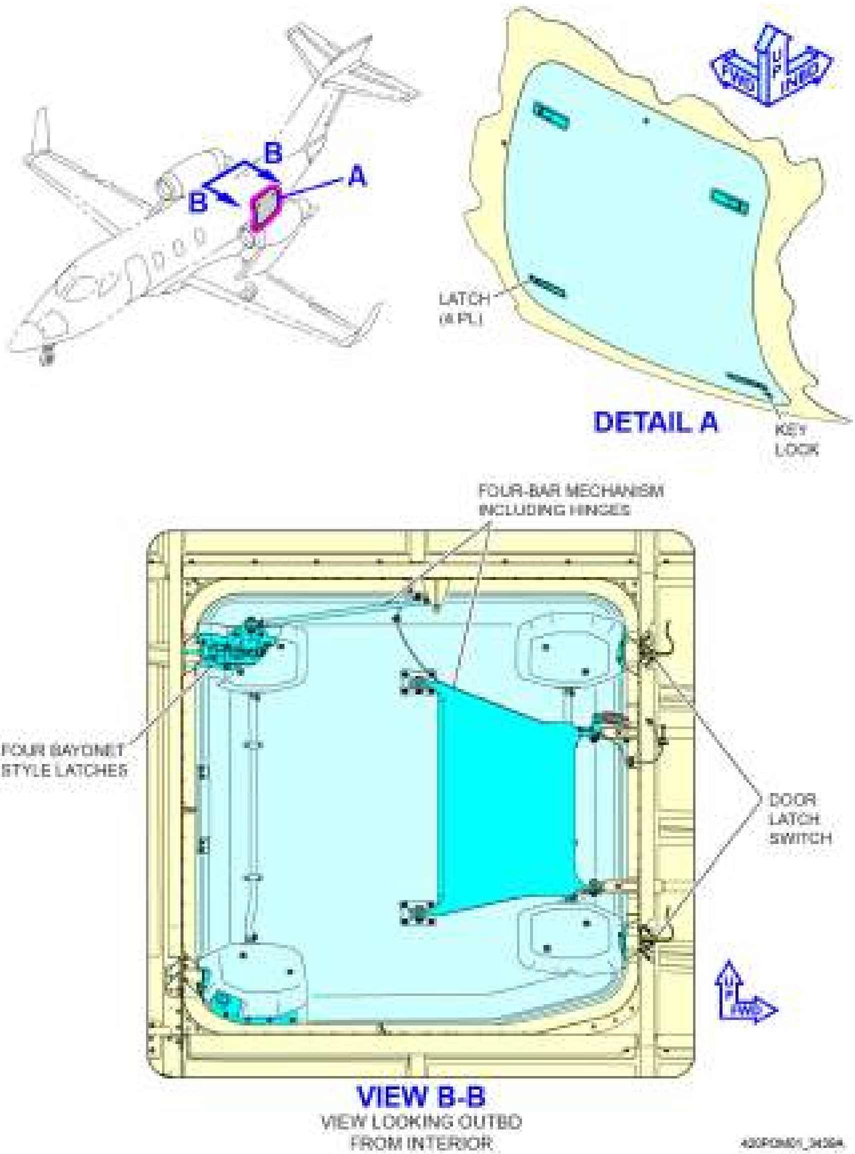

Figure 1-10. Aft Baggage Door

Forward Baggage Door

The forward baggage door in the HA-420 is located at the left-hand side, in the un-pressurized nose section. The baggage door is an outward opening door hinged with two goose neck hinges. The door is latched by means of four (4) latch/lock units. The latch/lock units have an independent locking feature to lock the latching features. The latches mounted on the forward side of the door are equipped with a switch guarding the locking feature of the latch. A door closed switch is mounted on the forward outboard side of the fuselage detecting positive door closure.

All switches provide annunciation to the flight deck. The forward two latches activate and deactivate the baggage compartment light.

The door has a key lock feature that can secure the aircraft when not attended.

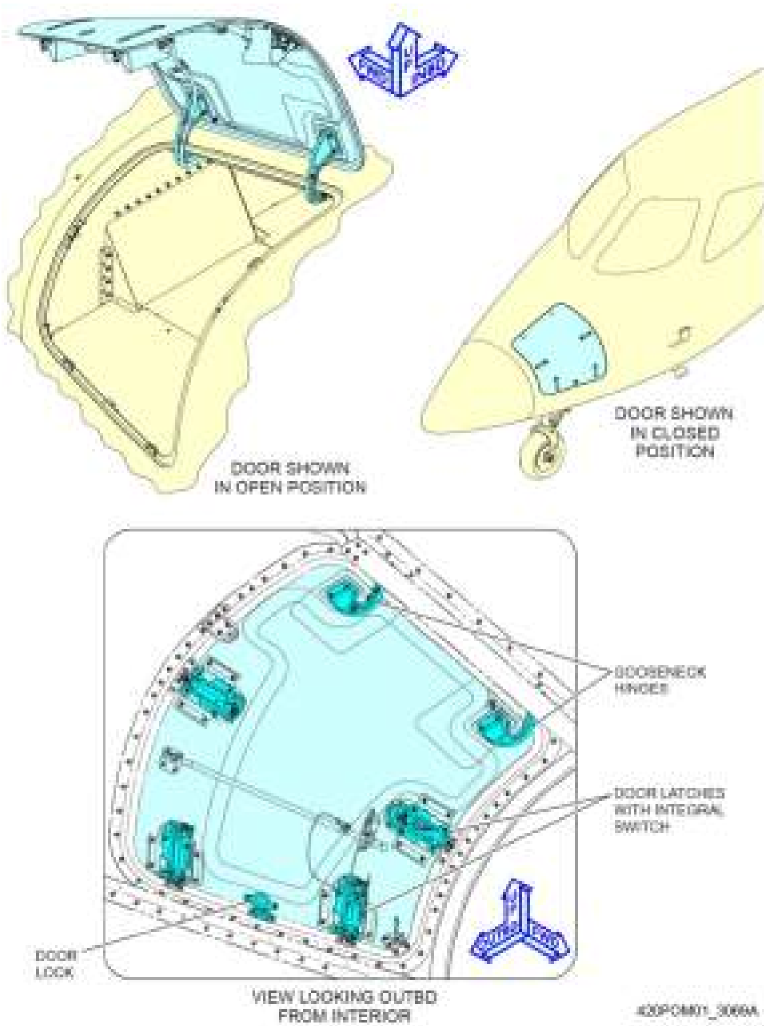

Figure 1-11. Forward Baggage Door

External Power Access Door

The external power access door is located on the right side in the forward section of the wing-to-body fairing. The door is hinged on the forward edge and is held closed by a one-push latch. The door contains a dual-pole switch to provide cockpit feedback of status.

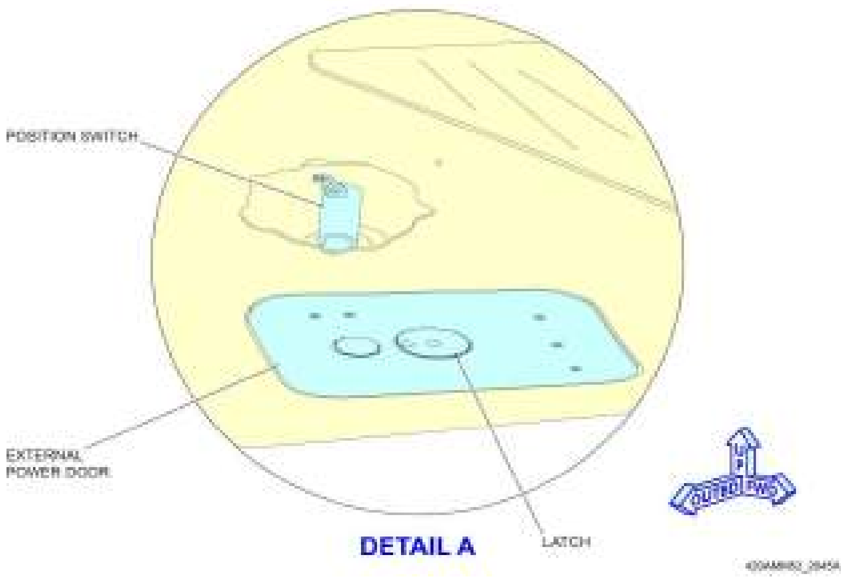

Figure 1-12. External Power Door

Lavatory Service Door

The optional lavatory service door is located on the right side of the fuselage in the aft section of the wing-to-body fairing. The door is hinged along the forward edge and is held closed by a button latch.

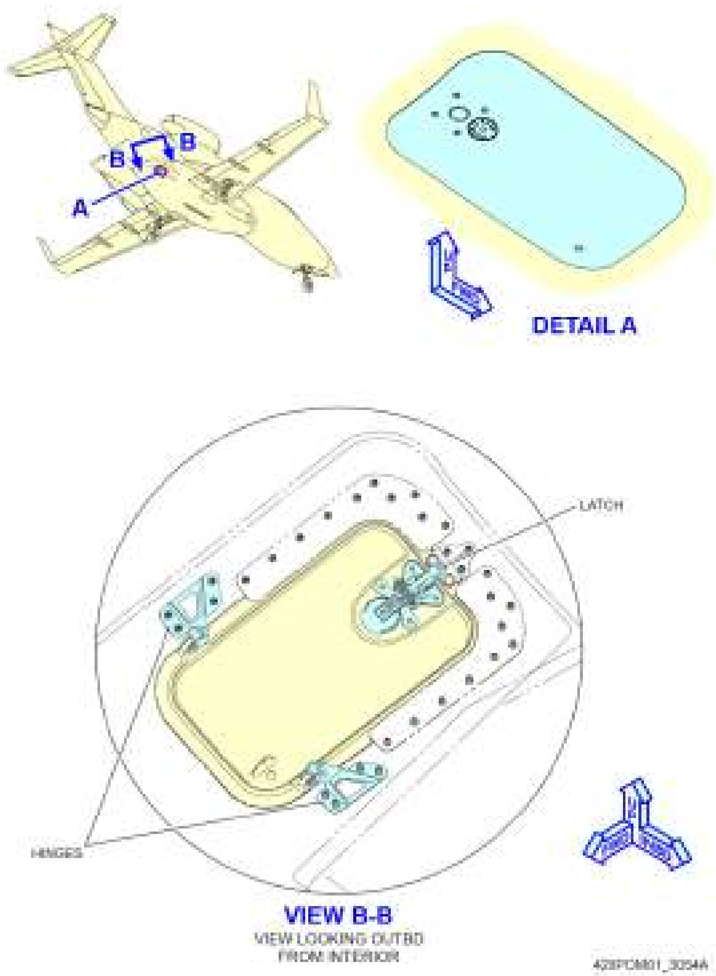

Figure 1-13. Lavatory Service Door

HJ1-29000-005-001

Electrical Service Doors

Electrical service doors are located in the left and right wing-to-body fairing forward of the wing. Each electrical service door is hinged at the forward side with two goose neck hinges and is held closed with two button latches. Each door contains a dual-pole switch to provide cockpit feedback of status.

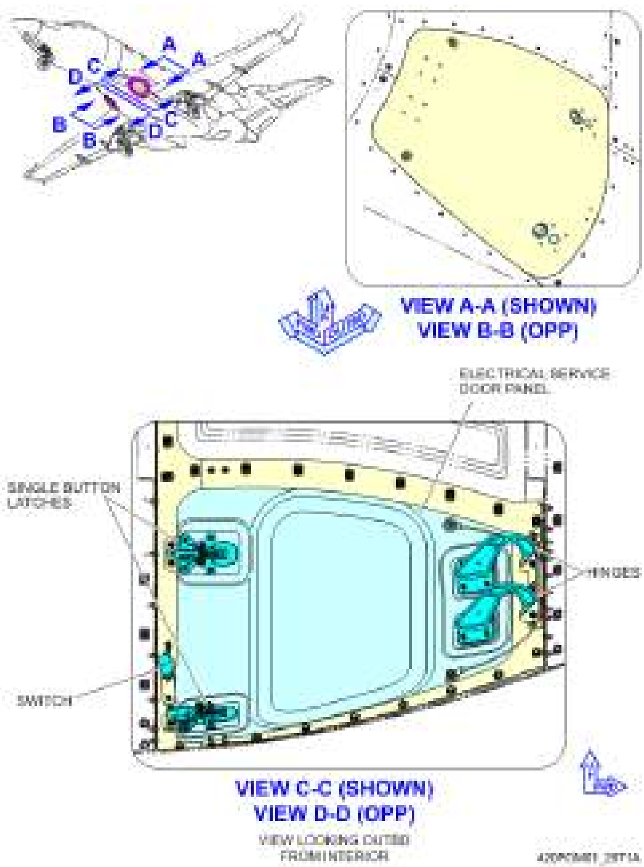

Figure 1-14. Electrical Service Door

Nacelle Access Doors

Access doors are located on the outboard side of each engine nacelle. Each nacelle access door is hinged on the forward edge and is held closed by a dual button latch. An additional access door is located on the inboard side of each engine nacelle. A pressure relief function opens the door when pressure in the respective nacelle exceeds 2 psi.

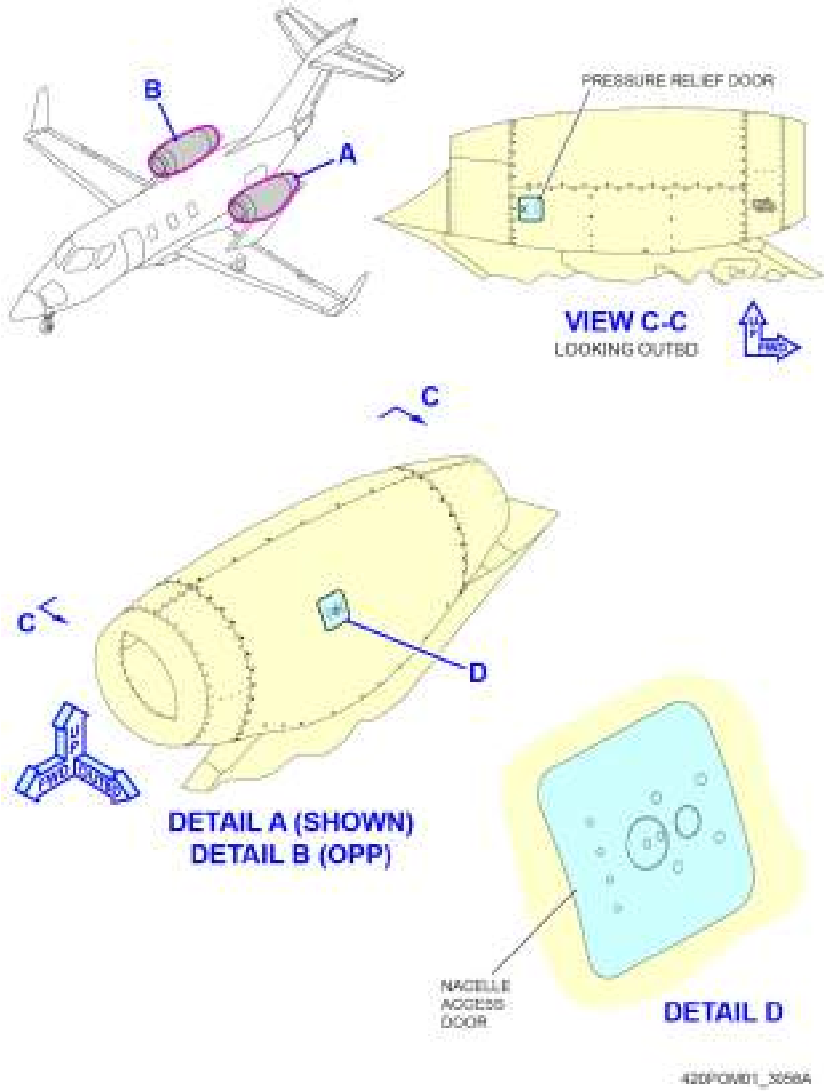

Figure 1-15. Nacelle Access Door

Indications

Status of all monitored doors can be viewed on the STATUS synoptic page. Doors that are expected to be open during normal operations are shown in cyan. Doors that are not expected to be open are shown in amber. Any door that is not secured is also indicated by an advisory or caution level CAS message.

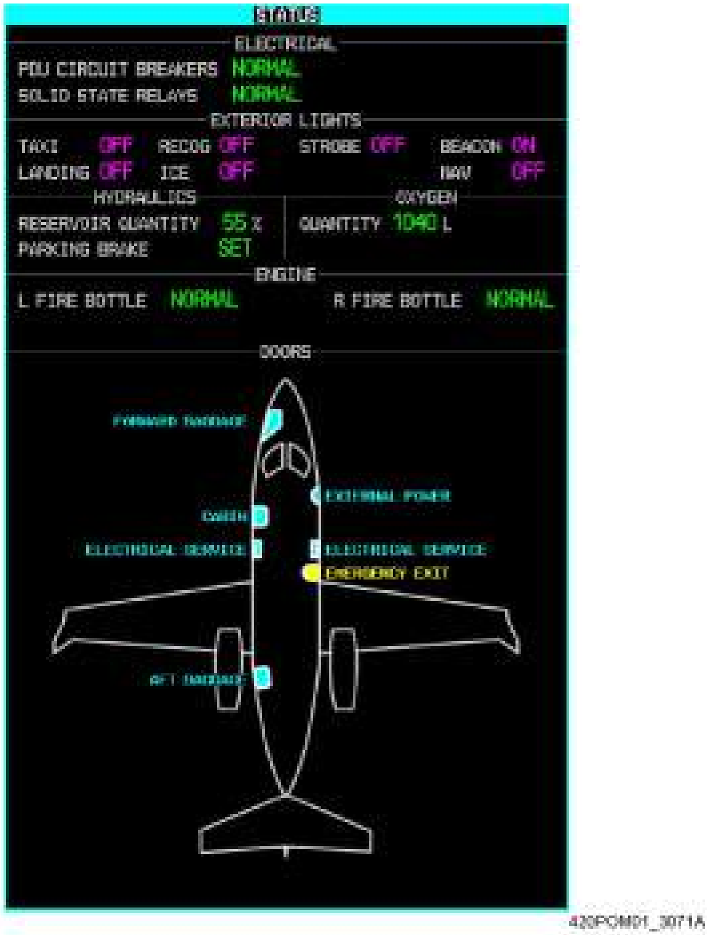

Figure 1-16. Example STATUS Synoptic Page

CAS Messages

Message	Description
AFT BAG DOOR UNSAFE	The aft baggage door is not closed and latched with an engine running and the parking brake not set, on ground or in flight.
CABIN DOOR UNSAFE	The main cabin door is not closed and latched with an engine running and the parking brake not set, on ground or in flight.
EMER EXIT DOOR UNSAFE	The emergency exit door is not closed and latched, on ground or in flight.
EXT PWR DOOR UNSAFE	The external power door is not closed with an engine running and the parking brake not set.
FWD BAG DOOR UNSAFE	The forward baggage door is not closed and latched with an engine running and the parking brake not set, on ground or in flight.
AFT BAG DOOR OPEN	Door open and parking brake set on ground
CABIN DOOR OPEN	Door open and parking brake set on ground
ELEC SRVC DOOR OPEN	Door open
EXT PWR DOOR OPEN	Door open and parking brake set on ground
FWD BAG DOOR OPEN	Door open and parking brake set on ground

WINDOWS

Flight Compartment

Cockpit Windshield

The cockpit is equipped with two windshields made from a laminated, fail-safe, curved and stretched acrylic as well as two side windows. All windows are de-fogged by means of warm air. Windshields also have internal heating elements for de-fogging and de-icing.

Passenger Compartment

Cabin Windows

There are six cabin windows, three on each side of the fuselage. The cabin windows are laminated stretched acrylic.

Electrically dimmable cabin window shades are installed at the five cabin mounted window locations. The emergency exit window also uses an electrically dimmable shade. As an option, the cabin mounted windows can also be equipped with pleated fabric shades.

Controls to operate the electrically dimmable shades are installed in the overhead passenger service units. They can also be controlled by means of an optional cabin management system.

Lavatory Skylight Windows

There are two skylight windows installed in the lavatory.

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FLIGHT DECK, CABIN AND COCKPIT

GENERAL

The flight deck of the HondaJet Model HA-420 has been designed with advanced avionics and touch screen display control technologies to improve situational awareness and reduce pilot work load.

The cockpit electronic displays consist of three 14-inch widescreen flight displays (two Primary Flight Displays and one Multi-Function Display), an electronic standby display, and two touch-screen Control Display Units.

Figure 1-17. Flight Deck Diagram

DISPLAYS

Primary Flight Display

A Primary Flight Display (PFD) is mounted in front of each crew station. The PFD displays primary flight and navigation data and a Display Pane.

Figure 1-18. Primary Flight Display

Multi-Function Display

A single Multi-Function Display (MFD) is mounted between the PFDs. The MFD is divided into a full-time Engine Information System (EIS) and Aircraft System Information (ASI) display area and two Display Panes.

Figure 1-19. Multi-Function Display

Control Display Unit

Two centrally mounted Control Display Units (CDUs) provide control of the avionics systems. Inputs are done using a combination of touch-screen and control knobs. The touch-screen can be used while wearing gloves. A bezel is located around the front face of the CDU units and includes a small visor along the top edge (directly under the MFD) to reduce glare as well as a center groove between the CDUs to provide hand stabilization.

Figure 1-20. Touch Screen CDUs

Standby Instrument

A standby instrument is mounted on the glare-shield panel in front of the pilot. The instrument displays airspeed, altitude, Mach, attitude, and heading data full-time using dedicated sensors. VHF navigation data from the avionics system can also be displayed.

Figure 1-21. Standby Instrument

CONTROL PANELS AND CONTROLS

Controls

Cockpit switches and controls are grouped by system, and arranged to provide a workload-reducing cockpit “flow” during normal and emergency operations. Push button switches and rotary knobs are used for the majority of the controls.

Push button switches display white illuminated text to indicate a normal switch state, while a non-normal state is illuminated amber text. Switches that, due to their location, could interfere with crew duties if illuminated are dark in their normal state. Switches indicate NORM in their normal (depressed) state except when there are two alternate normal states.

Rotary three-position switches are used where more than two selections are available. The normal operating position is labeled NORM and is positioned forward / up in the 12 o’clock position.

Gaspers
Two air gaspers, one on each outboard section of the instrument panel, provide air to each pilot. The gaspers pivot in place and can be angled as desired. Airflow can be adjusted by rotating the front edge of the gasper.

Push-To-Talk
A push-to-talk control is mounted on each outboard side of the glare-shield. This is a black momentary push-button switch and is labeled MIC.

Pressurization Panel
The Pressurization Panel is located on the left side of the instrument panel and is labeled PRESSURIZATION.

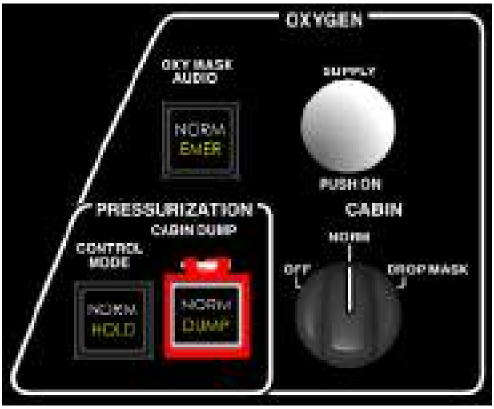

Figure 1-22. Oxygen and Pressurization Panel

The CONTROL MODE switch is an alternate-action push-button switch. The normal state is white NORM and the non-normal state is amber HOLD.

The CABIN DUMP switch is an alternate-action push-button switch with a red flip guard. The normal state is white NORM and the alternate state is amber DUMP.

Oxygen Panel

The Oxygen Panel is located on the left side of the instrument panel and is labeled OXYGEN.

The OXY MASK AUDIO switch is an alternate-action push-button switch. The normal state is white NORM and the alternate state is amber EMER.

The SUPPLY knob control is a locking pull cable. The supply "on" position is pushed forward. The "off" position is pulled aft.

The CABIN control is a three-position knob attached to the cabin oxygen valve. The normal state is up and is labeled NORM. Rotating the knob counter-clockwise selects the OFF position and rotating it clockwise selects the DROP MASK position.

NOTE Since the CABIN knob operates the cabin oxygen valve directly, rather than an electrical switch, the force required to rotate it is higher than the other rotating switches. The required force is reduced when oxygen is flowing.

Electrical Panel

The Electrical Panel is located on the left side of the pilot knee bolster and is labeled ELECTRICAL.

Figure 1-23. Electrical Panel

The BATTERY switch is an alternate-action push-button switch. The normal state is white ON and the non-normal state is amber OFF.

The L and R GENERATOR switches are alternate-action push-button switches. The normal state is white NORM and the non-normal state is amber OFF.

The BUS TIE switch is an alternate-action push-button switch with a grey flip guard. The normal state is dark and the alternate state is amber OPEN.

The CABIN POWER switch is an alternate-action push-button switch with a grey flip guard. The normal state is dark and the alternate state is amber OFF.

ELT Panel

The Emergency Locator Transmitter (ELT) Panel is located on the pilot's knee bolster.

Figure 1-24. ELT Panel

The ELT control is a three-position knob. The normal state is up and is labeled NORM. Rotating the knob counter-clockwise selects the momentary TEST-RESET position and rotating it clockwise selects the ON position.

An indicator light is situated to the right of the control. The light is normally dark, and the non-normal state is illuminated red.

Landing Gear Panel

The Landing Gear Panel is located on the pilot's knee bolster.

Figure 1-25. Landing Gear Panel

The NOSE WHEEL STEERING switch is an alternate-action push-button switch. The normal state is white NORM and the non-normal state is amber OFF.

The landing gear switch is a two-position lever switch that has to be pulled out before being moved between the UP and DN positions. A solenoid mounted behind the panel prevents motion under certain conditions.

Alternate Gear Release

The ALTERNATE GEAR RELEASE control is located on the left side of the center pedestal, below the CDUs.

The ALTERNATE GEAR RELEASE control is actuated by pulling the handle approximately 4.4" outward. After activation, the control can be pushed back into the pedestal. The control is colored red. An illuminated ALT GEAR label is located on the adjacent ENGINE START panel.

Engine Start Panel
The ENGINE START control is centrally located on the center pedestal, just aft of the CDUs.

Figure 1-26. Engine Start Panel

The L and R ENGINE START switches are momentary push-button switches with green rings around the switch cap that illuminate.

The push to disconnect control is a momentary-action push-button switch. The normal state is dark and the non-normal state is white PUSH TO DISC.

Parking / Emergency Brake
The Emergency/Parking Brake control is located on the right side of the center pedestal, below the CDUs.

The EMERGENCY BRAKE control is actuated by pulling the handle outward to a maximum of approximately 2.25 inches. The Parking Brake is actuated by depressing the SET/RELEASE button on the EMERGENCY BRAKE handle, pulling the handle fully and then releasing the SET/RELEASE button. The Parking Brake is released by pulling the handle, then pushing the SET/RELEASE button and allowing the handle to return to the stowed position. The control is colored red.

An illuminated BRAKE label is placed on the adjacent ENGINE START panel.

Thrust Lever Quadrant

The Thrust Lever quadrant is located in the center pedestal.

Figure 1-27. Thrust Lever Quadrant

The optional SPEED BRAKE switch is a toggle type of electro-mechanical latching switch. The normal (RET) state is in the forward position and the alternate (EXT) state is in the aft position. A switch in the thrust lever control allows for releasing the switch to the RET position when the Thrust Levers are moved beyond a certain position.

The Thrust Lever controls are lever type controls that can be moved forward / aft. Four positions are labeled CUTOFF, IDLE, MCT and TO. A soft detent is incorporated at the MCT position. A ramp to a physical stop is incorporated at the TO position. The thrust lever assembly includes a non-adjustable friction device. The thrust levers are gated with an upward finger-trigger movement required to move the thrust levers between the IDLE and CUTOFF positions.

The TO/GA switches mounted on the outboard side of each thrust lever are momentary push-button switches. The switches are not illuminated.

The Flaps control is a lever type control that can be selected to one of three positions; UP, TO/APPR, and LDG. The lever requires a pull on the handle before it can be moved from any position. A flap gate is incorporated at the TO/APPR position to prevent a single-action selection from LDG to the UP position.

Ice Protection Panel

The Ice Protection panel is located on the left side of the center pedestal and is labeled ICE PROTECTION.

Figure 1-28. Ice Protection Panel

The WING ANTI-ICE control is a three-position knob. The normal state is forward and is labeled NORM. Rotating the knob counter-clockwise selects the OFF position and rotating it clockwise selects the ON position.

The WING FLOW control is a three-position knob. The normal state is forward and is labeled NORM. Rotating the knob counter-clockwise selects the FROM L position and rotating it clockwise selects the FROM R position.

The L ENGINE ANTI-ICE and R ENGINE ANTI-ICE controls are alternate-action push-button switches. The normal state is white OFF and the alternate normal state is white ON.

The TAIL DE-ICE control is a three-position knob. The normal state is forward and is labeled NORM. Rotating the knob counter-clockwise selects the OFF position and rotating it clockwise selects the ON position.

Fuel Panel

The fuel panel is located on the center pedestal and labeled as FUEL.

Figure 1-29. Fuel Panel

The L PUMP and R PUMP controls are three-position knobs. The normal state is forward and is labeled NORM. Rotating the knob counter-clockwise selects the OFF position and rotating it clockwise selects the ON position.

The CROSSFEED control is a three-position knob. The normal state is forward and is labeled NORM. Rotating the knob counter-clockwise selects the L ENG position and rotating it clockwise selects the R ENG position.

Trim Panel

The trim panel is located on the center pedestal and labeled as TRIM.

Figure 1-30. Trim Panel

The PITCH MODE control is an alternate-action push-button switch. The normal state is white NORM and the non-normal state is amber STBY.

The ROLL POWER control is an alternate-action push-button switch. The normal state is white NORM and the non-normal state is amber OFF.

The YAW POWER control is an alternate-action push-button switch. The normal state is white NORM and the non-normal state is amber OFF.

The YAW control is a three-position knob. The normal state is up and is labeled NORM. Rotating the knob counter-clockwise selects the momentary NOSE L position and rotating it clockwise selects the momentary NOSE R position.

The STANDBY PITCH control is a dual-pole split toggle switch. The normal state is centered and is not labeled. Moving the switch forward selects the momentary NOSE DN position and moving it aft selects the momentary NOSE UP position.

Windshield Heat Panel

The Windshield Heat panel is located on the right side of the center pedestal and labeled WINDSHIELD HEAT.

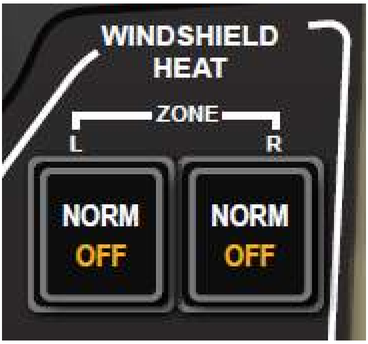

Figure 1-31. Windshield Heat Panel

The L ZONE and R ZONE controls are alternate-action push-button switches. The normal state is white NORM and the non-normal state is amber OFF.

Pneumatic Panel

The Pneumatic panel is located on the right side of the center pedestal and labeled PNEUMATIC.

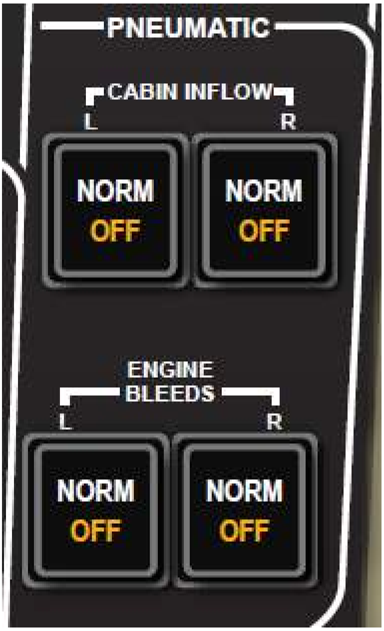

Figure 1-32. Pneumatic Panel

The CABIN INFLOW - L and CABIN INFLOW - R controls are alternate-action push-button switches. The normal state is white NORM and the non-normal state is amber OFF.

The ENGINE BLEEDS - L and ENGINE BLEEDS - R controls are alternate-action push-button switches. The normal state is white NORM and the non-normal state is amber OFF.

Annunciator Panel

An Annunciator Panel is located on the glareshield above each of the PFD displays in the primary field of view.

Figure 1-33. Annunciator Panel

The DISPLAY REVERSION switch is an alternate-action push-button switch. The normal state is dark and the non-normal state is amber REV.

The CHIME switch is a momentary-action push-button switch. The normal state is dark and the non-normal state is amber MUTE. The two CHIME switches are synchronized, and pushing either will toggle the mode of both switches.

The master WARNING / CAUTION switch is a momentary-action push-button switch. The normal state is dark and the non-normal state is amber CAUTION or RED WARNING. The two WARNING/CAUTION switches are synchronized; pushing either (when illuminated) will extinguish the light in both switches.

The BARO SET is a rotary control with multiple detents (“clicks”). The knob also has a momentary type push action.

Fire Panel

The Fire Panel is located in the upper center of the glare-shield panel.

Figure 1-34. Fire Panel

The L ENGINE FIRE and R ENGINE FIRE switches are momentary-action push-button switches with a red flip guard. The normal state is dark and the non-normal state is red L (or R) ENGINE FIRE PUSH.

The fire extinguisher switch, located just inboard of the associated ENGINE FIRE switch, is a momentary-action push-button switch. The normal state is dark and the non-normal state is white FIRE EXT PUSH.

AFCS Mode Control Panel

The Automatic Flight Control System (AFCS) Mode Control panel is located in the lower center of the glare-shield panel just below the Fire panel.

Figure 1-35. AFCS (Autopilot) Control Panel

The AFCS Mode Control panel contains 14 momentary-action push-button type switches. These switches are labeled but are not illuminated.

The CRS1 and CRS2 controls are rotary controls with multiple detents ("clicks"). Each knob also has a momentary push type action.

The HDG SEL control is a rotary control with multiple detents ("clicks"). The knob also has a momentary push type action.

The ALT SEL control is a rotary control with multiple detents ("clicks").

The SPD SEL control is a rotary control with multiple detents ("clicks"). The knob also has a momentary push type action.

The UP/DN wheel control is a scroll wheel control with multiple detents.

The pushbuttons on the AFCS control panel are defined in AVIONICS AND AFCS.

AFCS Servo Power Panel

The AFCS SERVO POWER Panel is located on the glare-shield panel to the right of AFSC Control Panel.

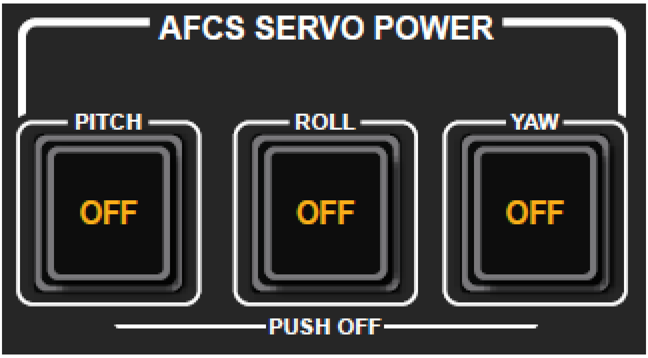

Figure 1-36. AFCS Servo Power Panel

The PITCH switch is an alternate-action push-button switch. The normal state is dark and the non-normal state is amber OFF.

The ROLL switch is an alternate-action push-button switch. The normal state is dark and the non-normal state is amber OFF.

The YAW switch is an alternate-action push-button switch. The normal state is dark and the non-normal state is amber OFF.

CEILING

Overhead Console

The overhead console is located in the center of the cockpit directly over the center pedestal.

Figure 1-37. Overhead Console

Two grab handles are located in the aft outboard section of the overhead console.

A cockpit dome light is centrally mounted on the aft section of the overhead console.

Two map lights are mounted just forward of the grab handles. The lighting pattern is designed to illuminate the lap area of the on-side crew member. The ON/OFF switch is a momentary action switch. The brightness slider is a slider type control that can be moved laterally.

Two speakers are mounted just in front of the map lights.

A limitations placard is mounted centrally between the speakers.

Two air gaspers are mounted on the forward outer part of the overhead panel. The gaspers pivot in place and can be angled as desired. Airflow can be adjusted by rotating the front edge of the gasper.

Sun Visor

Two sun visors are located in the cockpit headliner above the pilot's and co-pilot's heads. The visors have the ability to translate along an embedded rail to provide coverage from the side windows to the forward window. The visor shuttle has release buttons on each side that allow single-handed operation by depressing the buttons. The visor will translate and rotate until the buttons are released. The visors stow into recessed pockets in the headliner. The visor lenses are tinted to decrease transmission of light, but are still optically true for visibility.

SIDE WALLS

Side Ledge

The side ledge is located to the outboard of each crew station along the sidewall.

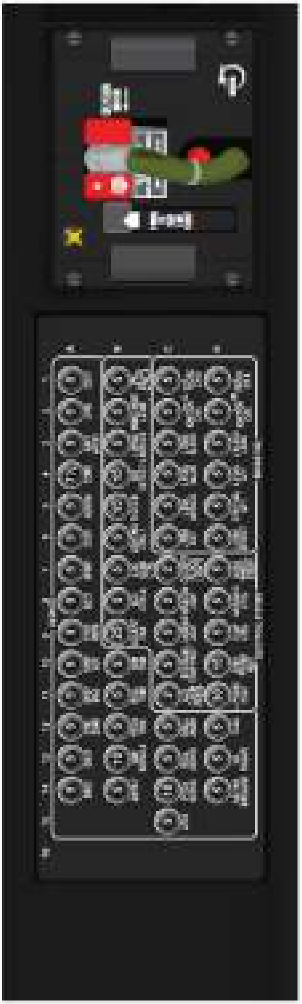

Figure 1-38. Side Ledge (Pilot)

Clipboard

A flat area with a spring-loaded clip is placed on the forward section of the side ledge.

Cup Holder

A cup holder is mounted just aft of the clipboard.

Oxygen Mask Container

An oxygen mask container is mounted just aft of the cup holder on the side ledge. In addition to the quick-don oxygen mask, the stowage container holds a pair of smoke goggles.

Circuit Breaker Panel

A circuit breaker panel is located in the aft portion of the side ledge. The panel is covered by a hinged lid. The circuit breakers are grouped by system and individual breakers are indexed by grid location.

Figure 1-39. Circuit Breaker Panel (Pilot)

420POM01_3090A

Figure 1-40. Circuit Breaker Panel (Co-Pilot)

Storage

The cockpit sidewalls house general storage provisions. Additional map and chart storage can be found in the optional forward left cabinet, directly behind the pilot's seat, within reach of the pilot.

Audio Connection Panel

Headset audio connections are located on the forward side of each forward cabinet, just aft of the side ledge.

Fire Extinguisher

A fire extinguisher is installed behind the pilot on the left side of the plane. The fire extinguisher is a portable hand fire extinguisher that dispenses a halogenated hydrocarbon liquefied gas agent, also known as Halon. The Halon is a 1211/1301 type mixture. To use the fire extinguisher, remove it from the holder, remove the pin, and squeeze the handle to release the high pressure Halon stream.

Flashlight
A flashlight is installed behind the copilot on the right side of the plane. The flashlight has LED bulbs and will recharge when it is installed to the holder with the shed bus powered.

FLIGHT CONTROLS

Yoke
The control yokes are located on control columns at each pilot station. The column is hinged at the bottom and rotates forward/aft and the yoke rotates on a center pivot. The co-pilot yoke is symmetrically opposite from the pilot yoke.

A handheld microphone is located on the forward side of each control column.

Figure 1-41. Pilot Yoke

The PITCH/ROLL control is a black momentary 4-way articulating switch (up, down, left, right to control) located on the aft side of the outboard yoke grip.

The AFCS/TRIM MASTER control is a momentary red push-button switch located on the aft side of the outboard yoke grip.

The CHECKLIST control is an up/down scroll wheel switch with detents and a momentary push-action.

The MIC control is a momentary black push-button switch located on the forward side of the outboard yoke grip.

The CWS control is a momentary black push-button switch located on the aft side of the inboard yoke grip.

The AP DISC/ACK control is a momentary black push-button switch located on the aft side of the inboard yoke grip.

The SYSTEM CONTROL control is a momentary black push-button switch located on the aft side of the inboard yoke grip.

The IDENT control is a momentary black push-button switch located on the forward side of the inboard yoke grip.

Rudder Pedals

The rudder pedal arms are hinged below the floor and translate forward/aft. The pedals are hinged at the bottom where mounted to the rudder pedal arms. The pedals rotate forward when pushing on the top portion and return aft when released.

Figure 1-42. Pilot Rudder Pedals

The rudder pedals have two independently adjustable positions (forward and aft). The pedals are adjusted by pushing a white lever mounted on each pedal arm inboard and then moving the pedal to the desired location.

CREW SEATS

The pilot can reach the design-eye point by adjusting the seat so that the pilot, when sitting normally, can sight down the top of the glareshield. The seat should be adjusted fore/aft such that all controls can be easily reached and actuated.

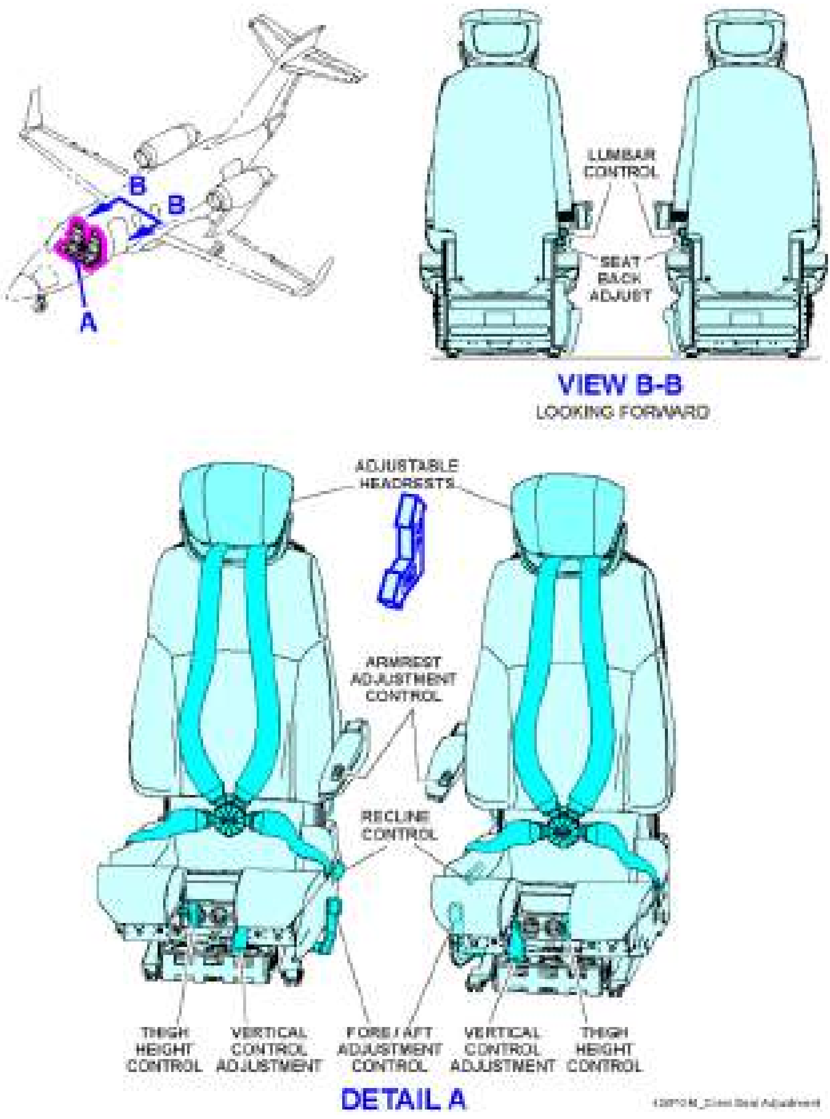

Figure 1-43. Crew Seats

Each crew seat is fully adjustable. Fore/aft position can be adjusted by moving a lever mounted on the inboard side by the floor aft and moving the seat to the desired location. When the lever is released, the seat will latch in place.

Up/down adjustment is actuated by lifting a lever mounted on the inboard side of the seat cushion cutout and adjusting the seat to the desired height. When the lever is released, the seat will latch in place.

Next to the up/down adjustment lever, on the outboard side, is a knob that when rotated adjusts the leg rests up/down.

Back rest recline is adjusted by means of a lever mounted on the aft inboard side of the seat cushion. When raised, the seat back can be adjusted to the desired angle.

Just above the recline lever, on the seat back are two buttons. The top button adjusts the lumbar support. Pushing the top button will initially fully inflate the lumbar support which can then be depressed to the desired inflation level. When the button is released the support will stay in that position. Pushing the lower button allows the seat back to be adjusted up/down.

The headrest can be adjusted by first pushing it outboard and then rotating it to the desired angle.

An arm rest is recessed in the inboard side of each seat back. It can be pulled out and rotated forward. On the bottom of the arm rest is a wheel that when rotated adjusts the arm rest up/down.

A four-point seat belt is provided for each seat. An optional life vest is mounted under each seat.

PASSENGER CABIN

The standard cabin interior configuration includes four belted passenger seats in a club arrangement. A luggage valet with retention straps or an optional side-facing seat is located opposite the main entry door. A lavatory is installed in the aft section of the cabin. Baggage space is provided in the forward and aft section of the fuselage.

Figure 1-44. General Floor Plan

Cabin Seats
When equipped with the optional Executive Seat Upgrade, the four main cabin seats can be adjusted fore/aft and inboard/outboard by lifting a lever mounted on the forward inboard side of the seat cushion and moving the seat to the desired location. When the lever is released, the seat will latch in place.

When equipped with the standard DX seats, the four main cabin seats are fixed in position and do not slide fore/aft or inboard/outboard.

Seat recline can be adjusted forward/aft by lifting a lever mounted on the aft inboard side of the seat cushion and moving the seat back to the desired angle. When the lever is released, the seat back will latch in place.

A three-point seat belt is provided for each seat.

The optional side-facing seat is non-adjustable. A lap belt is provided for this location.

Tables
A sidewall pullout table is installed in the RH side ledge between the RH forward and aft seat. An optional table can be installed on the LH side. Lifting the table up and rotating it inboard provides a half width working table. The upper section can then be rotated inboard to provide a full width table.

Lighting
Cabin lighting includes an entry door light, cabin up-wash lighting, window line sconce lights, table lights, and reading lights at each club seat. Several lights are also provided in the lavatory. The lights are controlled through switches mounted on the bulkhead or through a control panel mounted in the RH forward cabinet. An entry courtesy light

is switched on when the Main Entry Door is opened. The timer can be reset for 10 minutes by activating a switch located on the entry area sidewall. The light will be off when the door is closed unless commanded on by the lighting control panel in the forward RH cabinet.

Cabinets

A cabinet with equipment for storing beverages and snacks is installed directly in front of the luggage valet on the right side of the cabin and behind the RH crew seat. This cabinet also has a location for pilot storage in the lower section. A slim partition with limited storage is installed directly forward of the main entry door and behind the LH crew seat.

A RH luggage valet is located between the RH Forward Cabinet and RH Aft-Facing seat. This luggage valet incorporates two seatbelt style straps to restrain items of mass during flight.

Lavatory

A lavatory is installed in the aft section of the cabin and contains a side-facing, internally serviceable toilet located on the RH side. A standard vanity is located opposite the toilet on the LH side. A stowed curtain that can be pulled across the aisle for privacy separates the aft lavatory from the passenger cabin.

The following options may be installed:

- Externally serviceable toilet
- Water system
- Dual pocket doors that provide full privacy

Safety Equipment

Ordinance Signs and Placards

Appropriate placards are located throughout the cabin.

Illuminated Fasten Seat Belts, No Smoking and Return to Your Seat signs are placed at appropriate locations.

Life Vests and Raft

When equipped with the executive seat upgrade and optional life vests, the life vests are located in a drawer under the forward side of each seat. For the optional side facing seat, a life vest is located in the cabinet next to the seat.

A life raft can be secured to the side facing seat or luggage valet.

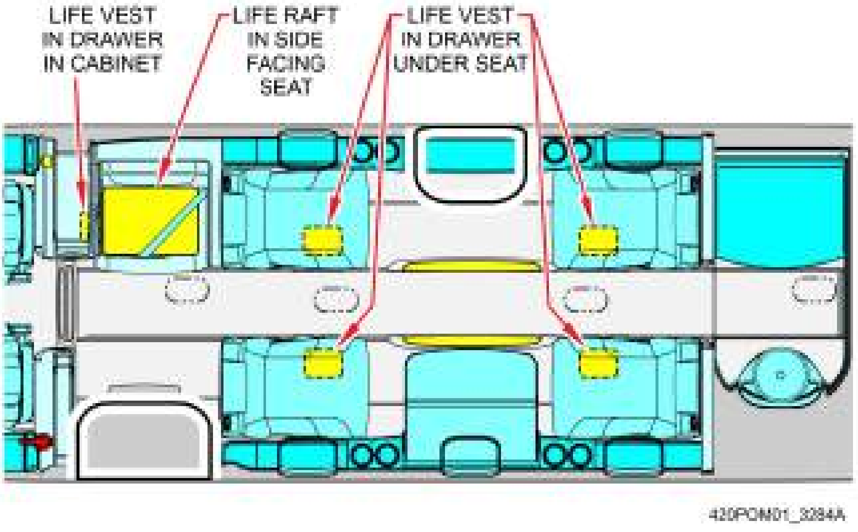

Figure 1-45. Life Vest Locations

Oxygen Masks

Drop down oxygen masks are available for each passenger location. The masks are the type that covers the nose and mouth and is held in place with an elastic strap. Four masks are available for the four cabin compartment passengers. Additional masks are mounted in the lavatory and above the optional side-facing seat.

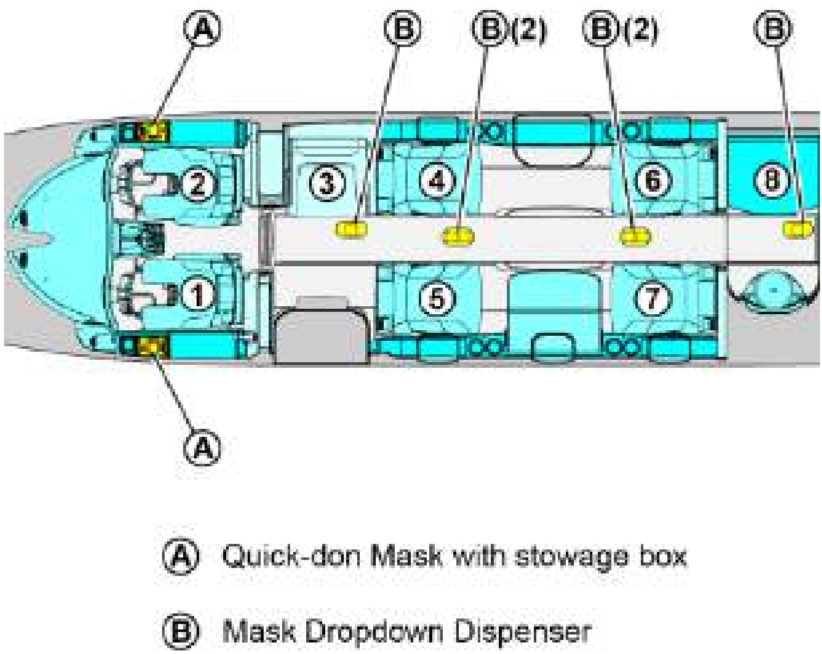

Figure 1-46. Oxygen Mask Locations

BAGGAGE COMPARTMENTS

Forward Baggage

The 9 cubic feet, forward baggage compartment is located just aft of the nose radome and has a single door mounted on the left side of the fuselage. The baggage space is unpressurized and unheated. Tie-down straps are provided.

Aft Baggage

The 57 cubic feet, aft baggage compartment is located just aft of the rear pressure bulkhead and has a single door located on the aft left side of the fuselage. The compartment is unpressurized. While not heated, the temperature is kept moderate due to cabin outflow air being vented into this space. Two divider nets are provided.

ENGINE, FIRE PROTECTION AND FUEL

ENGINE

Introduction

Two GE Honda Aero Engines HF120 turbofan engines are pylon mounted in a patented Over-The-Wing Engine Mount (OTWEM) configuration.

The GE Honda Aero Engines HF120 engine is a twin spool counter-rotating medium bypass ratio turbofan engine. The HondaJet HA-420 engine produces 1997 lbs. of thrust at sea level, flat rated to 77 ºF (25 ºC).

The engine features an advanced single stage wide-chord fan with a two stage axial low pressure (LP) compressor driven by a two stage axial low pressure (LP) turbine on the LP shaft. The single stage centrifugal compressor is driven by a single stage high pressure (HP) turbine on the HP shaft. The engine does not incorporate any variable geometry, but does have a Bleed Off Valve (BOV) in the HP compression section that is opened to increase compressor stability during acceleration. The HF120 has a fully mixed exhaust. Fuel is pumped to the reverse flow combustor from the gearbox driven pump and metering unit which is controlled by the Full Authority Digital Engine Control (FADEC). Thrust is managed via a throttle quadrant mounted Rotary Variable Differential Transformer (RVDT). The Exhaust Gas Temperature (EGT) is measured downstream of the second LP turbine and the FADEC calculates Interstage Turbine Temperature (ITT) from the measured EGT.

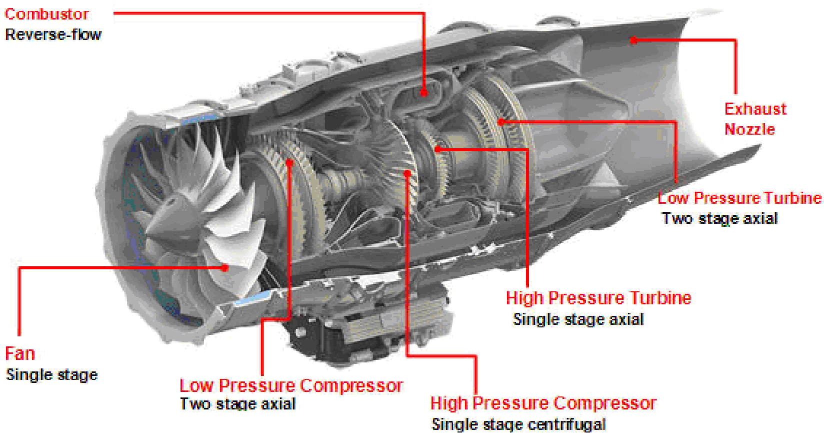

Figure 1-47. GE Honda Aero Engines HF120 Engine General Arrangement

Engine Control System

The engine control system is a dual-channel Full Authority Digital Engine Control (FADEC) based system. The system controls the engine response to thrust command inputs from the thrust levers and other cockpit controls and provides information to the aircraft for cockpit indication, dispatch status and maintenance reporting.

Power is provided to the FADEC by a dedicated, dual wound Permanent Magnet Alternator (PMA) which is integral to the Fuel Pump and Metering Unit (FPMU). During starting and operation near idle, power is supplied by the aircraft electrical system.

The engine control system incorporates hardware and/or software limits to prevent overpressure or overspeed of the engine. Limit protections are provided within the software for fan speed, core speed, fuel flow and HP compressor discharge pressure. Also, during ground starts only, the control system may limit fuel flow rate to prevent the engine from exceeding starting ITT temperature limits.

Engine Start

On the ground with the thrust levers in CUTOFF, engine start is initiated by pushing the engine start switch and then moving the thrust lever to IDLE. The starting sequence is automatically controlled by the FADEC which initiates fuel flow and ignition in response to engine core speed. After a light-off occurs, the system controls the FPMU fuel metering valve to accelerate the engine to the power setting calculated from the inputs.

In flight starts are performed as starter assisted or wind-milling according to which portion of the air start envelope is appropriate.

Starter assisted airstarts are performed in a similar manner to ground starts by pushing the engine start switch and moving the thrust lever to IDLE.

Wind-milling airstarts are performed by moving thrust lever to IDLE after establishing a minimum of 8% N_2.

During ground starting, the FADEC has the authority to abort a start if ITT operating limitations are exceeded.

CAUTION *For all operating conditions other than ground starting, the FADEC will not limit thrust, fuel flow or any other control output to prevent ITT exceedance. It is the responsibility of the pilot to reduce commanded thrust in response to an exceedance.*

Power setting

The FADEC software calculates the power management setting based on the thrust lever position and flight/ambient conditions.

Engine thrust is modulated by moving the thrust lever to select either a desired engine thrust rating or an intermediate thrust level. The thrust management settings incorporate detents which associate particular ranges of Thrust Lever Angle (TLA) setting with a particular engine thrust rating. The engine thrust ratings are:

- Idle (IDLE)
- Max Continuous Thrust (MCT)
- Takeoff (TO)

TO and IDLE are full forward and full aft respectively while MCT is a soft detent just aft of full forward position.

The Thrust Levers incorporate a gated stop at IDLE. Shutting down the engine is accomplished by selecting CUTOFF. This requires the guard on the back of the thrust lever to be lifted to move the lever past the IDLE stop into CUTOFF.

When the TLA falls within the angle ranges associated with one of these ratings, the engine control system will control the engine to achieve the target engine speed based on ambient conditions. Separate power setting schedules have been incorporated into the software for the different bleed levels.

When the TLA does not fall within the angle ranges associated with one of these “detents,” commanded N_1 will be interpolated between the IDLE and MCT ratings such that engine net thrust is approximately linear with TLA.

The following four idle modes are available:

- Ground idle
- Anti-ice ground idle
- Flight idle
- Ground APU mode

The FADEC will select between the idle modes based on the weight-on-wheels and whether engine and/or wing ice protection is selected on.

Ground APU Mode

The engine control system includes a ground APU mode that automatically increases the ground idle speed when one engine is operating in order to provide sufficient speed for a single generator to provide ground electrical power. When the second engine is started, the first engine automatically transitions to normal ground idle speed.

Takeoff Lock

The FADEC control logic incorporates a takeoff lock feature to minimize variation in thrust during takeoff. The takeoff lock is activated shortly after takeoff thrust is set and clears shortly after takeoff.

N_1 Synchronization

The N_1 synchronization function is used to set the N_1 command of the right (slave) engine to be the same as the left (master) engine. The FADEC will automatically engage synchronization when all the required parameters are met. The pilot can manually disable synchronization by use of the CDU Engine control page.

Engine Limits Protection

In addition to the start protection, the engine control system incorporates hardware and software limits to prevent overpressure or overspeed of the engine. Limit protections are provided within the FADEC software for fan speed, core speed, fuel flow and HP compressor discharge pressure.

The system also includes an independent rotor overspeed protection system (OSP) to prevent catastrophic engine failure due to failure modes not controllable by the FADEC system.

Engine Ignition System

The engine ignition system is self-contained and is automatically controlled by the FADEC. It consists of a dual channel ignition exciter, leads, and two igniters. The ignition exciter features a "burst" mode which produces a higher spark rate for a brief period following power application. The ignition system is automatically controlled by the FADEC for starting and also incorporates an automatic re-light feature.

Engine Oil System

The engine oil system is completely self-contained and separate from any other aircraft fluid system. The oil system provides lubrication for the engine bearing elements and also assists in providing engine cooling. The engine oil system is designed to allow the engine to operate satisfactorily with no detrimental effects during short periods of zero gravity operation, negative gravity operation, or low oil pressure caused by maneuvers. The engine oil tank capacity is approximately 6.1 quarts.

The engine incorporates an integral Fuel Oil Heat Exchanger (FOHX) that provides cooling for the oil system while simultaneously heating the fuel to prevent fuel filter icing. Heated fuel is then used by the engine. No heated fuel returns to the fuel tanks.

An oil pressure sensor is located on the engine accessory gearbox to measure the supply oil pressure. The engine low pressure and high pressure warning level is a variable value continuously calculated by the FADEC. An Engine Oil Temperature Sensor is also provided.

The engine incorporates an electronic oil level sensor which is the primary means of sensing oil level. Level is displayed on the STATUS synoptic page as amber LOW or green NORM whenever on the ground with the engine shut down (decluttered at other times). A higher resolution reading of oil quantity can be achieved by means of a sight glass on the outboard side of the engine visible through the oil service door.

The oil is electrically monitored by a chip detector which detects metallic debris in the lubrication system. The engine also incorporates an electronic sensor which indicates impending and actual oil filter bypass. The indication of both impending and actual filter bypass is suppressed if the engine oil is extremely cold to preclude nuisance bypass indications.

Engine Fuel System

An engine mounted, shaft-driven FPMU provides pressurized, metered fuel to the engine as well as pressurized fuel to the aircraft fuel system to be used for motive flow. Fuel passes through the FOHX before going to the engine. A fuel filter bypass circuit is provided to allow the fuel to continue flowing in the event of a blocked fuel filter. The FPMU incorporates a Fuel Metering Valve (FMV) that meters the fuel supply to the engine and also serves as the fuel flow meter for the engine.

A Pressurizing and Shutoff Valve serves as the fuel shutoff valve for the engine under all normal operating conditions. The shutoff valve also shuts off the fuel flow during certain failure cases. A separate firewall shutoff valve is incorporated into the fuel system supply line outside of the engine fire zone.

Engine Vibration Detection System

The engine incorporates a vibration detection system (VDS) that provides an indication to the cockpit if the engine vibration levels exceed the engine manufacturer’s certified vibration limits.

Engine Drain System

The engine drain system includes both oil and fuel drains routed to a drain mast on the underside of each pylon. During normal operations there is no drainage out of these drains.

Indications

Engine parameters are displayed full-time on the EIS in green color. Analog indications are provided for N_1 and ITT. Digital indications are available for N_1, ITT, N_2, Oil Pressure, Oil Temperature and Fuel Flow. Caution and warning ranges are displayed when appropriate on the analog displays. If a limit is exceeded for any displayed parameter the pointer and digital value changes color to amber or red as appropriate.

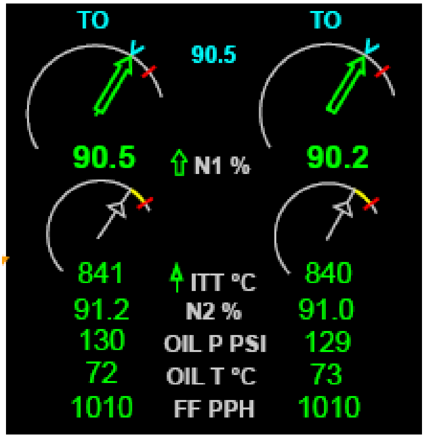

Figure 1-48. GE Engine Indication and Status (EIS) Display

On the ground or when a rated thrust is commanded, a cyan thrust mode icon is displayed above the N_1 gauge together with the associated target N_1 value and caret. On the ground, the rating is shown as a small TO at thrust settings below MCT. Whenever TO thrust is commanded, the TO icon is displayed in a larger font. MCT is displayed when Maximum Continuous Thrust is commanded and START is displayed when the engine is in the start mode.

A white SYNC icon is displayed between the thrust rating icons when the synchronization mode is active.

A white STARTER icon is displayed outboard of the secondary engine parameters when the starter is active.

A white IGN icon is displayed outboard of the ITT gauge when ignition is commanded on.

CAS Messages

Message	Description
L(R) ENG EXCEEDANCE	An exceedance of N_1, ITT, N_2, oil pressure, or oil temperature has been detected
L(R) ENG FLAMEOUT	An uncommanded N_2 deceleration of the associated engine has been detected
L-R ENG FLAMEOUT	An uncommanded N_2 deceleration of both engines has been detected
L(R) ENG OIL PRESS LOW	Engine oil pressure is below the minimum limit
L(R) ENG VIBRATION HIGH	Excessive engine vibration has been detected
L(R) ENG CONTROL FAIL	The FADEC has detected a loss of thrust control
L(R) ENG CONTROL FAULT	The FADEC has detected a fault that may result in degraded engine response
L-R ENG FUEL BYPASS	An impending bypass of the fuel filters on both engines has been detected
L(R) ENG OIL TEMP HIGH	Engine oil temperature is above normal limits

Message	Description
L(R) ENG OVERSPD PROT FAIL	The FADEC has detected a failure of the overspeed protection system
L(R) ENG START FAIL	The FADEC has detected starting abnormality or has automatically aborted a ground engine start, or the pilot has detected a reason to abort the start attempt
L(R) ENG CHIP DETECTED	Engine oil chip detected
L(R) ENG FAULT	Minor engine fault detected
L(R) ENG FUEL BYPASS	An impending bypass of the associated fuel filter has been detected
L(R) ENG SHUTDOWN	Engine is shutdown
ENG SYNC FAIL	Engine sync has failed
L(R) ENG TLD	Minor failure detected
L(R) ENG VIB DETECTOR FAIL	The associated engine vibration detector has failed
ENG SYNC OFF	Engine sync has been manually commanded off

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FIRE PROTECTION

Fire Isolation

Fire isolation is accomplished by firewalls incorporated as barriers between the nacelle fire zone and the pylon as well as firewalls at the forward and aft ends of the nacelle fire zone.

Engine Fire Detection System

The fire detector system for each engine is independent and functionally identical. Each consists of an engine mounted gas filled sensor element which is connected to a pressure sensor unit. When the sensor element is heated the increased pressure is sensed and indicated in the cockpit.

The Avionics System constantly monitors the Fire Detector Sensor integrity.

Engine Fire Suppression System

The fire suppression system for each nacelle consists of a single, pressurized, halon-filled fire extinguisher bottle located in the pylon outside of the lower firewall and a fire suppression nozzle located inside the fire zone below the engine. The discharge of extinguishing agent is executed by an electrically actuated squib. The electrical continuity of the squib ignition circuit is monitored by the aircraft avionics system as is bottle pressure. A hermetically sealed frangible rupture disc at the discharge outlet relieves the internal pressure should it increase to unsafe levels due to overheating. The discharge of the bottle is detected by a combination of the low pressure indication and the loss of electrical continuity in the squib ignition circuit.

Indications

The following alerts are activated when a fire is detected:

- Red “FIRE” indication in the lower center of the ITT gauge
- The L (or R) ENGINE FIRE PUSH switch illuminates
- L (or R) ENGINE FIRE warning level CAS
- *“LEFT (or RIGHT) ENGINE FIRE”* aural alert

Lifting the L (or R) ENGINE FIRE PUSH switch cover and depressing the switch:

1) Commands the firewall fuel shutoff valve to close
2) Removes the generator field
3) Arms the associated fire extinguisher (“FIRE EXT” push button switch illuminated).

Depressing the “ENGINE FIRE” switch a second time commands the fuel shutoff valve to re-open, resets the generator and disarms the fire extinguisher.

Pressing the “FIRE EXT” switch when illuminated activates the fire extinguisher.

The Fire Protection button on the CDU Systems Test page initiates an automatic test sequence of the system as well as illuminating the four switch-lights on the FIRE panel for pilot verification. A successful test is indicated by the lack of related CAS messages and a “Pass” in the Test button.

CAS Messages

Message	Description
L(R) ENGINE FIRE	A fire has been detected in the indicated engine
L(R) FIRE DETECTOR FAIL	The associated fire detection system has failed
L(R) FIRE BOTTLE DISCH	Affected fire bottle has been discharged
L(R) FIRE BOTTLE LOW	The associated engine fire extinguisher pressure is low and may not be adequate to extinguish a fire
L(R) FIRE EXT FAIL	Fire extinguisher has failed

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FUEL

Fuel Storage System

The storage system is comprised of four fuel tanks – an integral tank in each wing, an integral carry-through tank in the wing center section and a bladder fuselage tank in the fuselage.

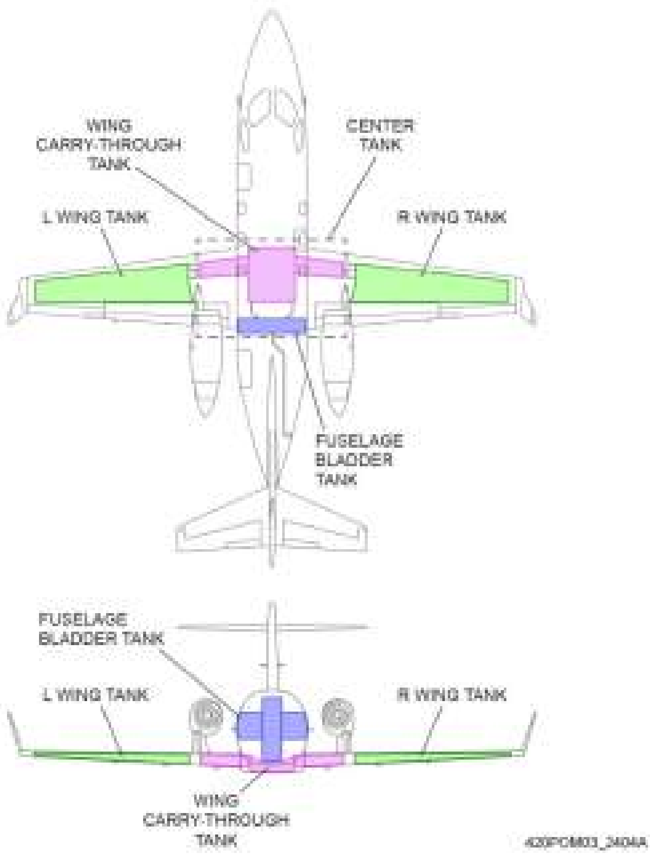

Figure 1-49. HA-420 Fuel Tank Arrangement

The fuel capacities are as listed below.

Table 1-1. Fuel Tank Capacity

Tank Capacities		
Tank	**Gal (US)**	**lbs (Jet A)**
Wing L/H	93.5	628
Wing R/H	93.5	628
CTR (C/T and Fuselage)	243.7	1635
Total	430.7	2890

A fuel temperature sensor is located in each collector tank. In addition to cockpit display, temperature data is used by the Engine Control System.

Wing Tanks

The wing tanks are integral to the wings and contain an internal collector tank in which a main jet pump and electric boost pump are located. The collector tanks supply fuel to the onside engine during normal operation. The collector tanks contain approximately 14.7 gallons of fuel each and are isolated from the wing tanks by flapper valves that allow fuel in the wing tanks to flow into the collector tanks but prevent it from flowing out. The collector tank is kept full by pumping fuel from the wing tanks using ejector scavenge pumps.

Carry-Through Tank

The carry-through (C/T) tank is located between the wings under the fuselage and is connected to both of the wing tanks and the fuselage tank.

Fuselage Bladder Tank

The fuselage tank is a bladder tank located aft of the fuselage pressure bulkhead. It is connected to the carry through tank and the fuel fill port.

Drain Valve Arrangement

The fuel tanks have 7 drains. Two drain valves are located near the inboard end of each wing tank and three valves are located on the center lower surface of the carry-through tank.

Fuel Distribution System

Motive flow returned from the engine driven fuel pump is used to power the main ejector (jet) pump in the collector tank. An electric boost pump is also available to automatically increase the fuel supply pressure if the fuel supply from the main ejector pump is insufficient.

The motive flow also powers three scavenge ejector pumps in each wing to pump fuel into that wing's collector tank. The scavenge pumps are distributed throughout the wing tank such that at least one scavenge pump is submerged under all aircraft attitudes.

Two transfer ejector pumps installed in the C/T tank pump fuel from the C/T to the L and R wing tanks continuously during operation. These pumps are powered by motive flow diverted from the main engine feed flow of either the main ejector pump or electrical boost pump.

Fuel from the fuselage bladder tank is transferred to the C/T tank by means of a tank level control system. This system consists of a series of float actuated shutoff valves (level control float valves), connected by fuel tubes that automatically control the fuel flow from the fuselage tank into the C/T tank to isolate the C/T tank from the head pressure of the fuselage tank.

A fuel isolation valve isolates the carry-through tank from the fuselage tank. The valve is commanded OPEN on-ground for refueling operations and is CLOSED at all other times to isolate the fuselage tank pressure head from the C/T tank. The valve is controlled automatically by aircraft avionics. Valve remains open on the ground, until commanded closed after first engine start.

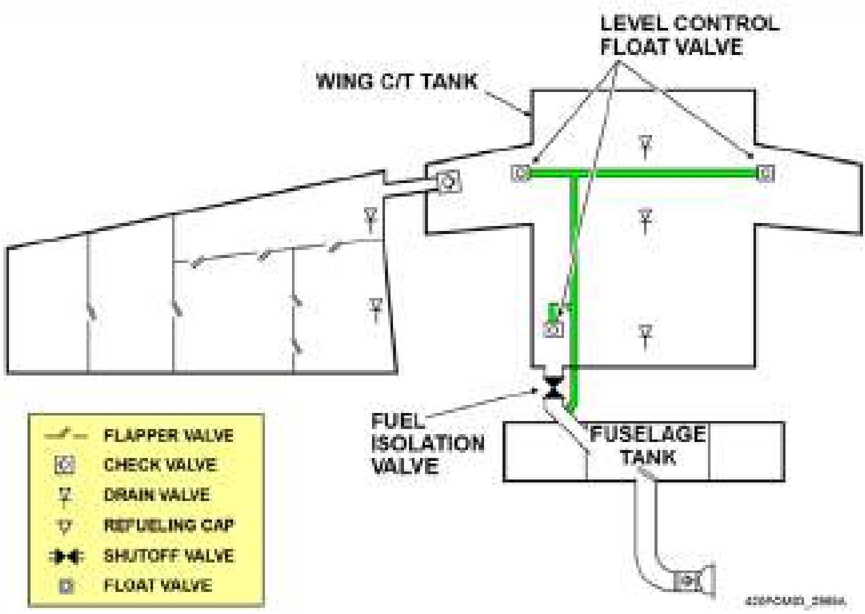

Figure 1-50. C/T Tank Level Control System

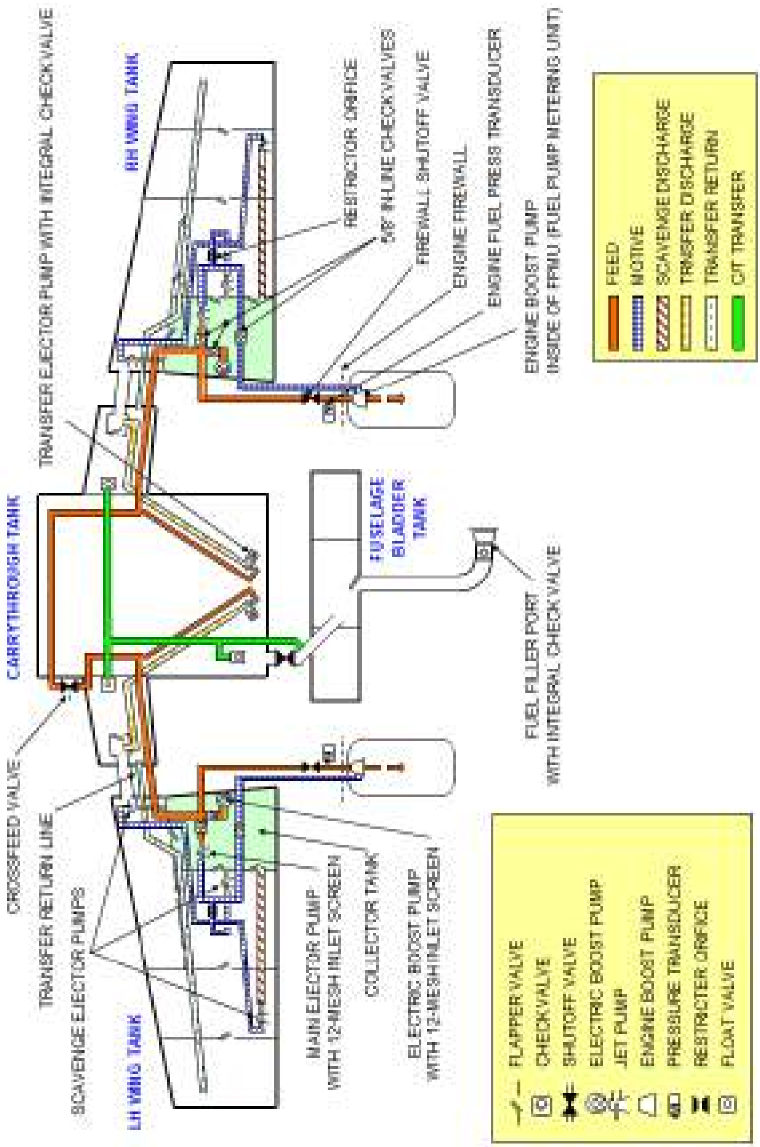

Figure 1-51. HA-420 Fuel Distribution System

Electric Boost Pumps

The fuel distribution system includes a backup Electric Boost Pump (EBP) in each collector tank. The pump is normally controlled automatically by aircraft avionics, but can be manually commanded ON or OFF using the L (R) Fuel Pump switch. The pump is automatically energized when an engine start has been commanded, during crossfeed operation, when wing tank fuel quantity is low, or when fuel supply pressure is low.

Fuel Crossfeed Function

The fuel crossfeed function allows both engines to be fed from a single collector tank in the event of a fuel feed system failure. When crossfeed is selected, the crossfeed valve is commanded open and the electric boost pump in the supplying wing tank is commanded on. Since much of the fuel fed to the engines is returned to the wing as motive flow, the operation of the fuel crossfeed system can also be used to correct a fuel imbalance.

Engine Firewall Shutoff Valve

A firewall shutoff valve is located in each pylon below the lower nacelle firewall and is operated by the associated L (or R) ENGINE FIRE PUSH switch as described in the FIRE PROTECTION section.

Fuel Consumption Sequence

Fuel is initially consumed from the C/T tank until the fuel drops below the operating level of the level control float valves (approximately 100 lbs. of fuel consumed from C/T), at which time the level control float valves open allowing fuel to transfer from the fuselage tank to the C/T tank. The level control float valves continue to open and close to maintain this level of fuel in the C/T tank as fuel is consumed from the fuselage tank.

Fuel is consumed from the fuselage tank until the level of fuel in the fuselage tank reaches the water line of the level control float valve.

At that time fuel from the C/T tank is consumed until the fuel level in the C/T tank drops below the level control float valve installed at the low point in the C/T tank. This float valve then opens allowing the remaining fuel in the fuselage tank and the trapped fuel in the line to drain into the C/T and be transferred to the wing tanks. The fuel in the wing tanks is consumed last as it drains or is pumped into the collector tank.

Fuel Venting System

The fuel venting system is symmetrical about the aircraft center line. There are two ram air scoops located on the side of the wing to body fairing to provide ram air pressure to the expansion space. The expansion space is located within the fuselage bladder tank.

Vent lines connect the expansion space to all other tanks. A vent drain valve is located in the carry-through tank at the lowest point of each vent line system. It opens when fuel in the carry-through tank falls below the level of the drain valve and allows trapped fuel or moisture in the vent line to drain into the carry-through tank.

Vent Float Valves

Vent float valves installed in the wing and C/T tanks allow air to evacuate the fuel tanks during refueling or climb, and to allow air to enter the fuel tanks to replace consumed fuel. Two valves are installed in each wing tank at inboard and outboard locations, and two valves are installed in the C/T tank on the L and R sides. During refueling, the rising fuel level pushes air into the vent lines. When the fuel level rises to the actuating level of the float valves, the valves close to prevent any fuel from entering the vent lines. During operation, as the fuel level in the fuel tanks decreases, the valves open and allow air to enter the fuel tanks to replace consumed fuel.

The inboard wing tank and the C/T tank vent float valves incorporate an integral pressure relief valve which opens to relieve positive pressure build-up in the wing tank such as caused by thermal expansion of fuel.

Vent Surge Tank

The vent system incorporates a surge tank on the L and R wing vent lines to allow air that may become trapped in the C/T tanks to vent to the atmosphere during climb. If air becomes trapped in the C/T tank due to the presence of fuel in the vent lines, then during climb the trapped air pressure will push fuel through the lines and into the surge tank. The fuel vent system includes a single float level switch installed in the L surge tank to detect a dual failure of the L and R outboard wing vent valves.

Flame Arrestor

The vent system incorporates flame arrestors in the left and right fuel vent lines leading from the fuel vent ram air inlets. A positive / negative pressure relief valve is installed in the vent system. In the event both flame arrestors become blocked, the positive / negative pressure relief valve will open to relieve excessive pressure differentials between the fuel tank and the atmosphere.

Expansion Space

Each left and right vent line connects the wing tank directly to the respective vent outlet. A branch-off tee is incorporated into each vent line to allow any fuel in the vent line to dump into the expansion space. If the fuel expands enough such that the level of fuel in the vent line reaches the level of the tee branch-off to the expansion space, fuel will flow into the expansion space.

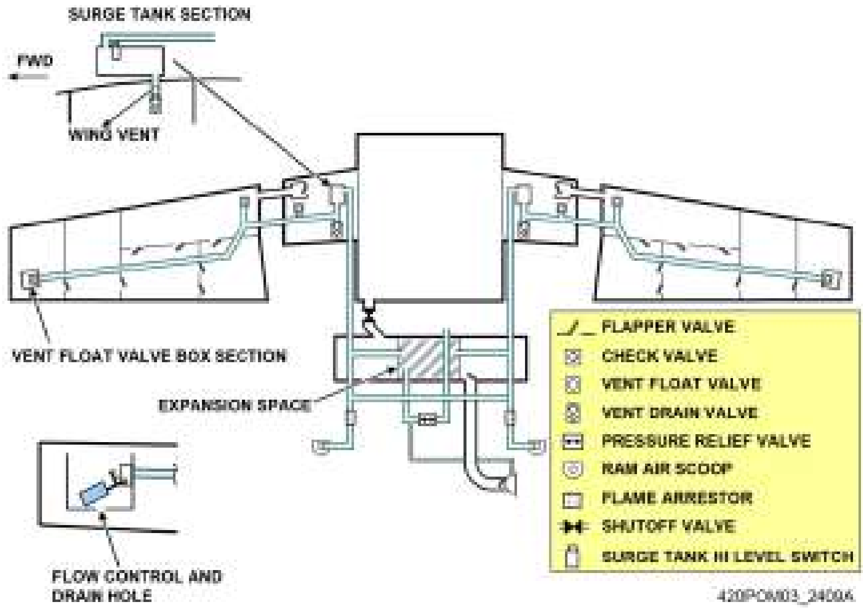

Figure 1-52. Fuel Venting System

Aircraft Refueling System

A single refueling port distributes fuel to all four fuel tanks. The refuel system relies on gravity driven flow to feed fuel to each of the fuel tanks. The aircraft refueling system consists of the refuel tubes, filler port, fuel isolation valve and an optional external fuel gauge. The filler port is designed to accept a standard AS1852 Turbine Fuel Nozzle. The filler port is covered with a lightning-proof cap mounted flush with the fuselage skin.

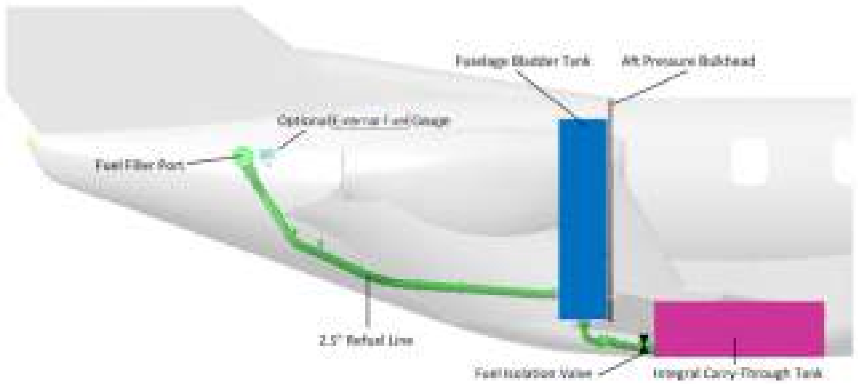

Figure 1-53. Refueling System (Side View)

An optional refueling panel and refuel master switch are located adjacent to the filler port. The external fuel gauge has a numeric fuel quantity display which shows the total fuel quantity in the fuel tanks, three LED lights to indicate when each of the tanks is full and two LED lights to indicate if the displayed fuel quantity units are pounds or kilograms. A refuel master switch is used to energize the external fuel gauge.

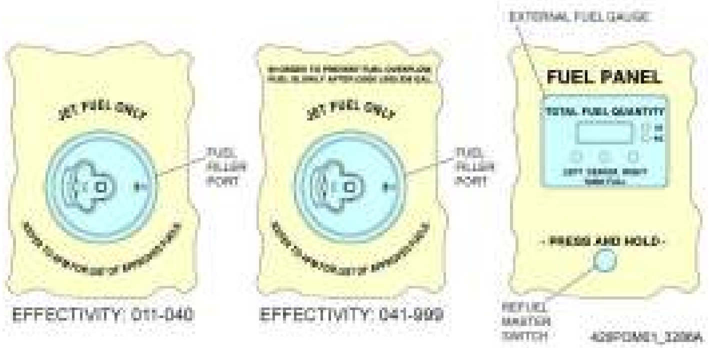

Figure 1-54. Fuel Filler Port and External Fuel Gauge

The primary refueling tube extends from the filler port on the aft fuselage to the bladder tank. Connecting the bladder tank and the carry-through tank is a tube containing the fuel isolation valve which is open during refueling operations. An interconnect tube with a one-way check valve installed allows fuel to gravity feed from the C/T tank into the wing tanks during refuel operations.

The refueling system also incorporates an integral check valve in the fuel filler adapter and a flapper valve at the fuselage tank. The integral check valve prevents fuel from siphoning overboard should the fuel cap be inadvertently left off after fueling, and the flapper valve limits the amount of fuel that could leak into the tailcone in the event of a leak or separation of the refuel line.

Fuel Gauging System

The fuel system incorporates a fuel gauging system to measure and display the quantity of fuel in the tanks for cockpit and external fuel gauge indication purposes. The system incorporates a series of fuel quantity probes and a fuel quantity signal conditioner unit. The system also uses an optical low fuel level sensor in each wing that detects when the fuel quantity in the wing tank is less than approximately 150 lbs. The carry-through and fuselage bladder tanks are combined into a single center tank for fuel gauging purposes.

The fuel quantity gauging system incorporates 15 capacitance type probes (5 per tank) distributed throughout the fuel tanks. There are 5 probes located in each Wing Tank (L and R) and 5 probes located in the Center Tank (4 probes in the Carry-through Tank and one probe in the Fuselage Bladder Tank). The locations of the fuel quantity probes in the fuel tanks were selected to allow the system to accurately sense the quantity of fuel in the tanks under a wide range of aircraft attitudes.

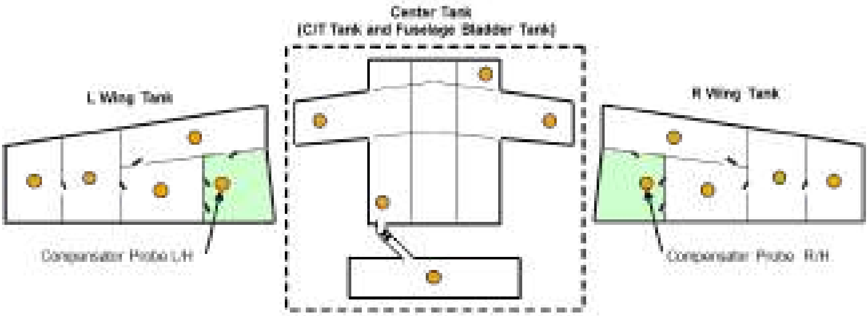

Figure 1-55. Fuel Quantity Probe Locations

In addition, the fuel quantity probe located in each collector tank functions as a compensator probe to measure the fuel dielectric constant.

Indications

Fuel system information is displayed full time on the ASI in green color. Total quantity as well quantity of each tank is displayed together with left and right tank fuel temperature.

Wing tank quantity is displayed in amber when below 220 lbs and red when zero. Fuel temperature is displayed in amber when exceeding limits.

An amber IMBALANCE icon is displayed in addition to a CAS message when the difference in quantity between the wing tanks exceeds 100 lbs.

When crossfeed is active, a white XFEED icon is displayed together with a white arrow indicating the direction of the operation.

Figure 1-56. Fuel ASI Display

The Fuel System Synoptic Page provides additional detailed fuel system information to the crew such as pump operation, valve positions, engine inlet fuel pressure, and fuel used in addition to fuel quantities and temperatures.

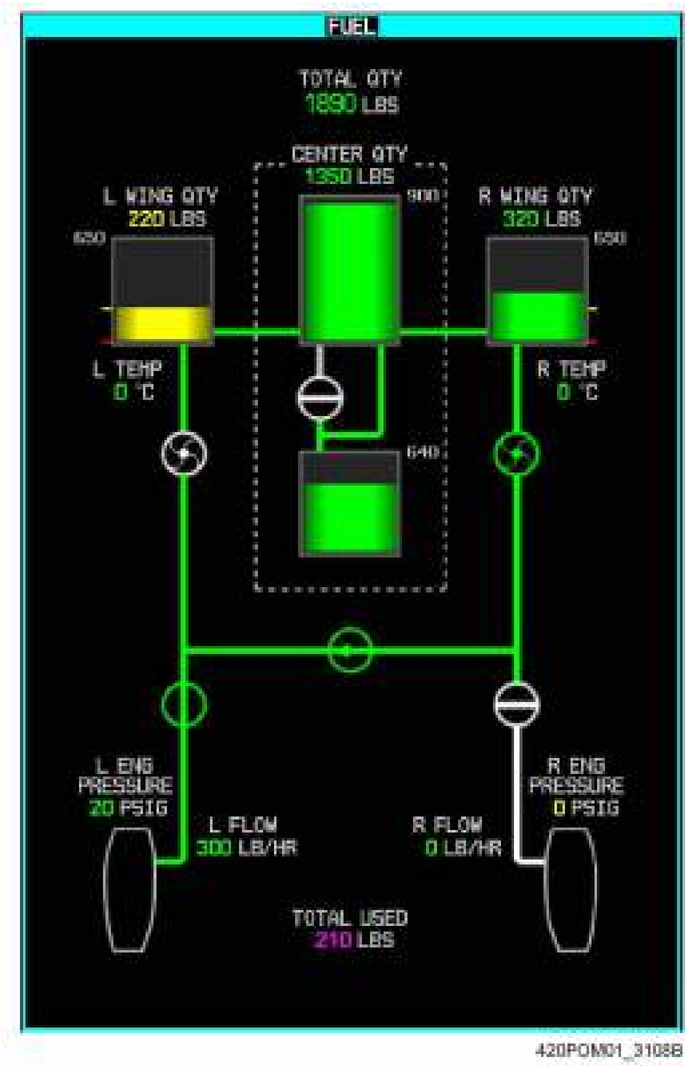

Figure 1-57. Fuel Synoptic Page Display

CAS Messages

Message	Description
FUEL CROSSFEED	Fuel Crossfeed has been selected for more than 5 minutes with both engines running, or for 15 minutes with only one engine running
FUEL CROSSFEED FAIL	Fuel crossfeed has been selected but is not functioning
FUEL IMBALANCE	A 100 lb fuel imbalance between the left and right wing tanks has been detected
FUEL LEVEL CTRL FAULT	A fault has been detected in the fuel level control system
L-R FUEL PRESSURE LOW	Fuel pressure is below minimum allowable limits for both engines
L(R) FUEL PRESSURE LOW	Fuel pressure is below minimum allowable limits
L(R) FUEL PUMP FAIL	Fuel pump has failed to function as commanded
FUEL QTY FAULT	A failure of fuel quantity system has been detected which affects the left, right, or center fuel quantity indication
L-R FUEL QTY LOW	Approximately 220 lbs or less of fuel remains in both wings based on either the optical low level sensor, or the fuel quantity indicator

Message	Description
L(R) FUEL QTY LOW	Approximately 220 lbs or less of fuel remains in one of the wings based on either the optical low level sensor, or the fuel quantity indicator
FUEL TEMP HIGH	The left and/or right wing fuel temperature is above 60 °C
FUEL TEMP LOW	The left and/or right wing fuel temperature is below -40 °C
FUEL CROSSFEED OPEN	Fuel Crossfeed valve is open when commanded closed
FUEL ISO VALVE CLOSED	Isolation valve has failed in the closed position
FUEL ISO VALVE OPEN	Fuel isolation SOV has failed in the open position
L(R) FUEL PUMP OFF	Affected FUEL PUMP switch selected OFF
L(R) FUEL PUMP ON	Affected fuel pump is commanded on automatically or via the switch
L(R) FUEL QTY DEGRADE	A single fuel quantity probe has failed in the affected fuel tank
L(R) FUEL SOV CLOSED	The Fuel SOV Valve is closed
L(R) FUEL SOV FAIL	Fuel shutoff valve has failed to achieve commanded position
FUEL CROSSFEED	Fuel crossfeed is active

FLIGHT CONTROLS

The primary flight control system on the HA-420 airplane is a reversible system using cables, bellcranks, sectors and pushrods which provide mechanical link from the cockpit to the applicable flight control. The primary flight control system is comprised of the ailerons, elevators and rudder.

The secondary flight control system includes the flaps, speedbrakes, and elevator, aileron and rudder trims.

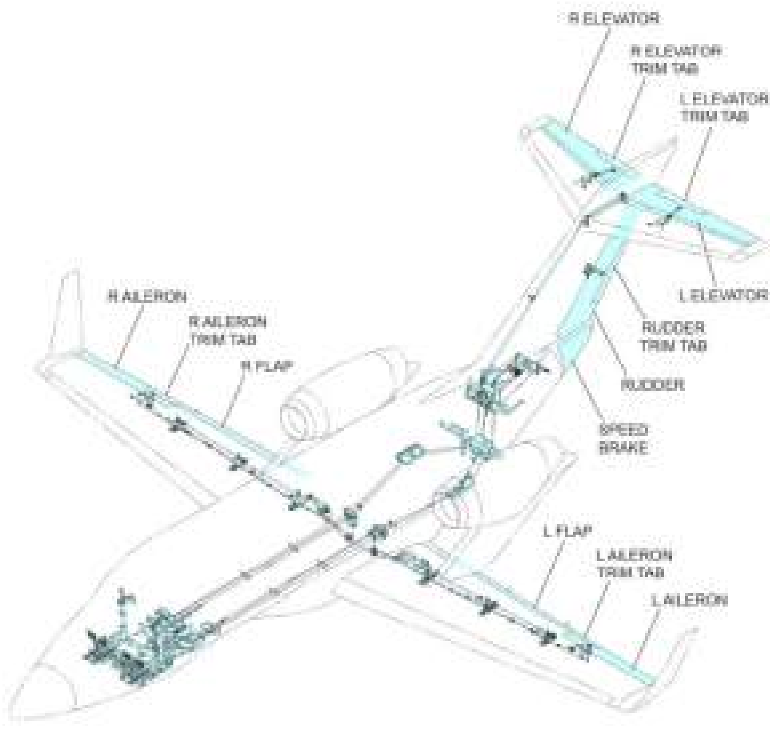

Figure 1-58. Flight Control System

PRIMARY FLIGHT CONTROLS

Pitch Axis

The dual elevator control system is a manually-driven closed-loop cable and pushrod system.

Two control columns allow control of the elevator system. The bottom of each column assembly, located below the floor, is connected by a horizontal tube. The left control column includes a stick shaker which interfaces with the Automatic Flight Control System (AFCS) to provide stall warning.

Roll Axis

The roll control system consists of two ailerons manually-driven by a closed-loop cable system. The ailerons are controlled via two yokes installed on respective control columns. The control yokes move simultaneously.

Yaw Axis

The single rudder is manually-driven by a closed-loop cable system.

The rudder system is controlled by dual adjustable pedal assemblies. The pilot and co-pilot pedals are both connected to a forward sector with rudder interconnect pushrods.

Gust Locks

An internal yoke mounted and an external rudder lock device is provided to secure the flight controls when parked in windy conditions. The cockpit mounted device is strapped on top of the yoke and then secured to the rudder pedals. The exterior device clamps the rudder to the fuselage to prevent movement.

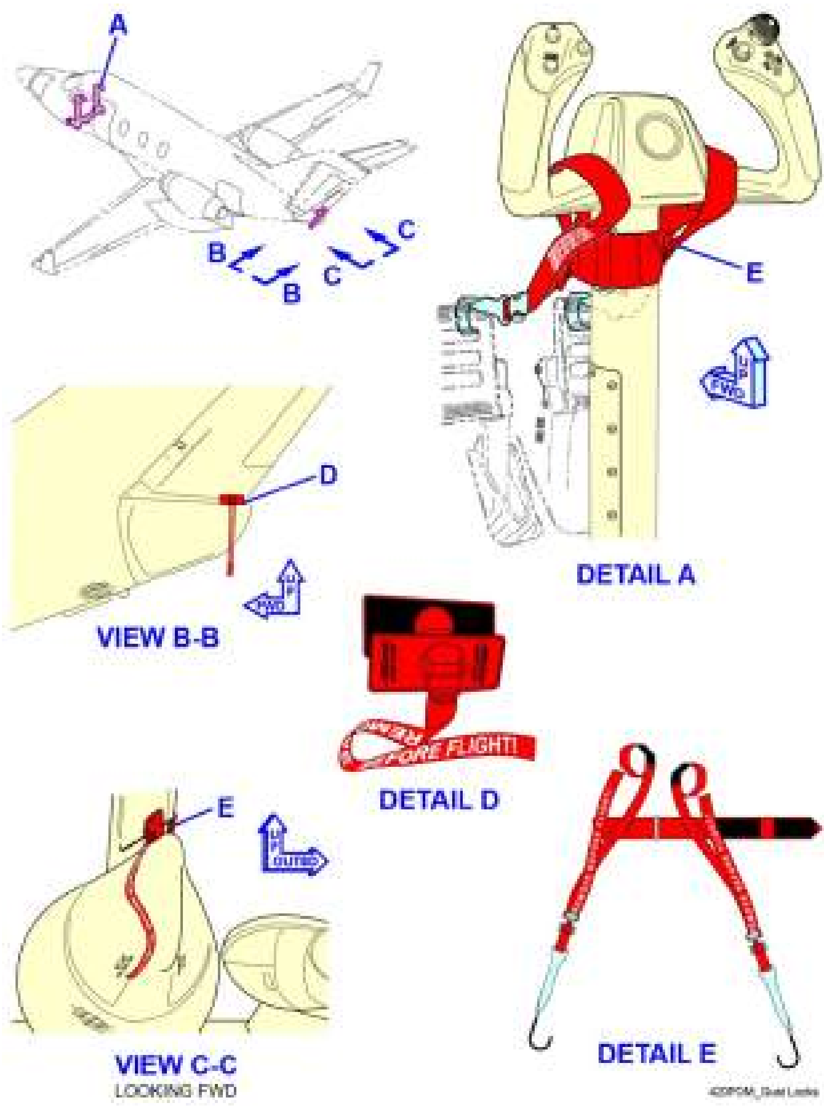

Figure 1-59. Gust Locks

SECONDARY FLIGHT CONTROLS

Pitch Trim System

Each elevator is equipped with one trim tab driven by a single electrical trim actuator installed in the horizontal stabilizer. An actuator position sensor provides position feedback to the avionics system. The primary pitch trim is actuated by trim switches installed on each yoke. Primary trim is fully monitored and trim rate is scheduled with airspeed. Left and right trim tab positions are continuously synced whenever they are in motion.

Selecting the PITCH MODE switch to STBY activates the standby pitch trim mode that bypasses the normal trim drive circuit and provides single speed, direct drive of the actuator.

Roll Trim System

Each aileron is equipped with one trim tab driven by a single electrical trim actuator installed in the aileron. An actuator position sensor provides position feedback to the avionics system. The roll trim is actuated by trim switches installed on each yoke.

Roll trim can be disabled by selecting the POWER – ROLL switch to OFF.

Yaw Trim System

The rudder is equipped with one trim tab driven by a single electrical trim actuator installed in the rudder. An actuator position sensor provides position feedback to the avionics system. The yaw trim is actuated by a trim switch mounted on the aft pedestal.

Yaw trim can be disabled by selecting the POWER – YAW switch to OFF.

Flaps

Each wing is equipped with a 30%-chord, double-slotted fowler flap. The flaps can be commanded to one of three positions: UP, TO/APPR, and LDG.

The Flap Actuation System (FAS) includes the aft pedestal mounted flap lever, an electronic Flap Actuation Controller (FAC), and identical left and right electrical flap actuators. Flap panels are synchronized electronically by the FAC. In the event of an asymmetric flap malfunction, the FAS locks the flaps in position.

Flap position is commanded by moving the flap lever to one of three positions; UP, TO/APPR, and LDG. The lever requires a pull on the handle before it can be moved from any position. A flap gate is incorporated at the TO/APPR position to prevent a single-action selection from LDG to the UP position.

Speed Brake

A hydraulically actuated, dual-panel speed brake is installed in the tailcone.

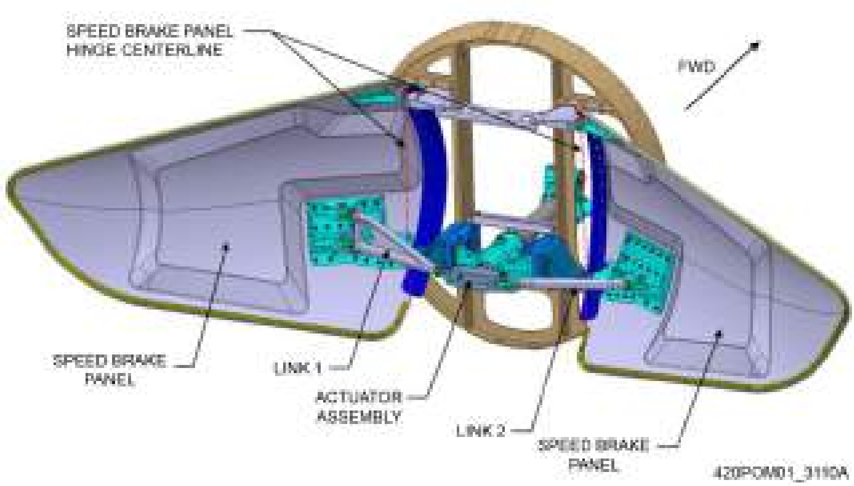

Figure 1-60. Speed Brake

The single position speed brake system is designed to “blow back” as speed increases to provide constant drag independent of speed. Speed brake deployment is commanded by moving the SPEED BRAKE switch aft to the EXT position where it will latch in place. To retract speed brakes, move the lever back to the RET position. Speed brakes are also automatically retracted if either thrust lever is advanced beyond a position close to the MCT detent. A switch in the actuator determines when the speed brake is fully retracted.

Indications

Trim, speed brake and flap information is displayed at the bottom of the ASI.

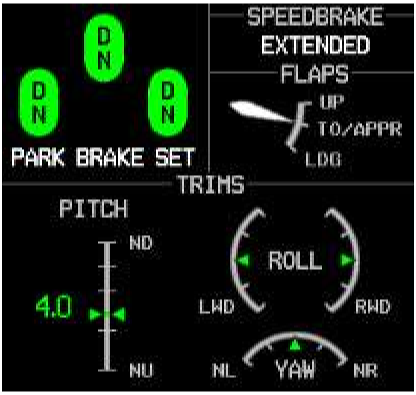

Figure 1-61. ASI Secondary Flight Control Display

Pitch trim position is displayed in both analog and digital form. One pointer is displayed for each tab. The digital value is the average of the two tab positions. On the ground, a takeoff green band is displayed along the axis and the pointers, and value changes color from white to green when the trim is set within this band. In air, the pointers and value are displayed in white. If a trim actuator has failed, the associated trim pointer is displayed in amber. A white STBY icon is displayed when the trim is operating in the standby mode.

Roll and yaw trim position is displayed in analog form with a pointer for each tab. The pointers are white except when centered on the ground in which case they are green.

Flap position is displayed as a white pointer. If the flap position does not match the commanded position, a white box is shown around the selected position. The pointer is displayed in amber if the flaps are failed. The flap display is decluttered above 20,300 feet.

Speed brake position is indicated by a white EXTENDED or RETRACTED icon. The icon is decluttered 10 seconds after retraction.

CAS Messages

Message	Description
FLAP FAIL	The flap system has reported a failure
FLAP FAULT	The flap system has reported a fault or has been powered for three days without performing the Built-In Test
PITCH TRIM FAIL	The primary pitch trim has failed, or a stuck switch has been detected
SPEEDBRAKE EXTENDED	Speedbrake is not fully closed when commanded to close
FLAP DEGRADE	Minor flap fault detected
FLAP LEVER DISAGREE	The flap handle does not match the flap position after initial power-up
PITCH TRIM FAULT	A fault has been detected by the pitch trim system One side of pitch trim indication displaying “X” indicates a failure of one trim tab. In this case the trim rate will be degraded
ROLL TRIM FAIL	Roll trim has failed or a stuck switch has been detected and disabled

Message	Description
ROLL TRIM FAULT	A fault has been detected by the roll trim system
ROLL TRIM OFF	Roll trim is selected OFF
SPEEDBRAKE FAIL	Speedbrake has failed
STBY PITCH TRIM ON	Standby pitch trim has been selected
YAW TRIM FAIL	Yaw trim has failed or a stuck switch has been detected
YAW TRIM FAULT	A fault has been detected by the yaw trim system
YAW TRIM OFF	Yaw trim has been selected OFF

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HYDRAULICS AND LANDING GEAR

HYDRAULIC SYSTEM

The hydraulic power system contains one electrical-motor-driven hydraulic pump (DCMP), a hydraulic reservoir-and-filter module, three accumulators, check valves, pressure transducers and pressure and temperature switches. The Main accumulator supplies the landing gear and optional speed brake, the Brake accumulator supplies the normal and anti-skid brakes and the Emergency accumulator supplies the emergency/parking brake and the nosewheel steering. Each accumulator is isolated by a check valve.

Control of the hydraulic system is fully automatic and no cockpit controls are incorporated.

The single hydraulic pump is a fixed displacement, motor pump which maintains the aircraft hydraulic system at a pressure between 2500-2950 psig except when the aircraft is on the ground on battery power at which time it is regulated at 1725-1875 psig. Pressure switches installed on the hydraulic reservoir-and-filter module control the system pressure. An unloading valve in the system will open to release pressure at 3200 psig.

The reservoir holds approximately 1.27 gallons of hydraulic fluid at maximum full level (all three accumulators depressurized and landing gear extended). An electronic volume indicator is installed to allow monitoring of volume in the cockpit.

There are two types of thermal protection; the DC motor over-temperature switch and hydraulic fluid high temperature switch. Both protection functions remove electrical power from the DCMP if the temperature limit is exceeded.

One pressure transducer is mounted on the hydraulic reservoir and one is mounted on each of the accumulators.

A fluid temperature switch is mounted on the reservoir.

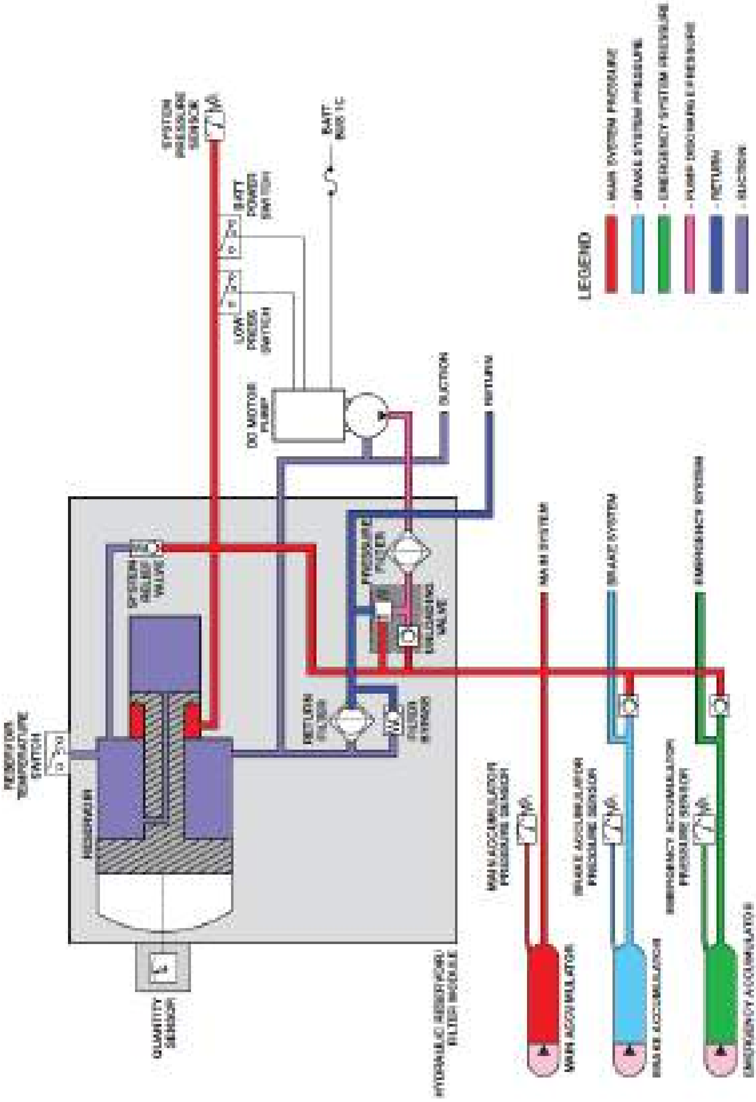

Figure 1-62. Hydraulic Power System Schematic

Indications

Systems and accumulator pressures, reservoir volume and pump running status can be monitored on the HYDRAULIC synoptic page. Values and flow lines are normally depicted in green color but change to amber or red when outside the normal operating range.

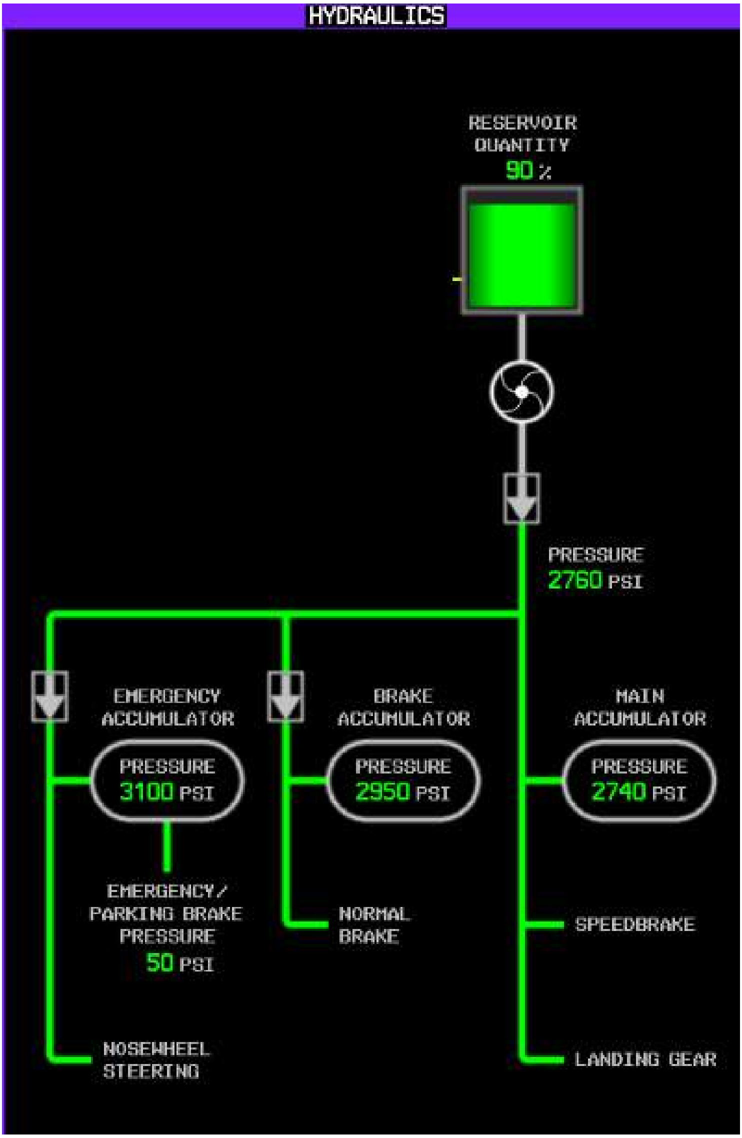

Figure 1-63. Hydraulic Power System Synoptic

CAS Messages

Message	Description
HYD PRESSURE LOW	Main system hydraulic pressure is below allowable limits
HYD PUMP FAIL	The Hydraulic Pump has failed
HYD FLUID LEVEL LOW	The hydraulic reservoir fluid level is below allowable limits
HYD FLUID OVERFILL	The hydraulic reservoir fluid level is above allowable limits
HYD PUMP FAIL ON	Hydraulic pump has failed on

LANDING GEAR

The tri-cycle landing gear system is hydraulically actuated and each landing gear is equipped with a single wheel. The nose landing gear uses an air/oil shock strut and has a steer-by-wire system that is electrically controlled and hydraulically actuated. The main landing gear is a trailing-link design incorporating hydraulically actuated anti-skid brakes.

Landing gear extension/retraction is commanded by moving the landing gear switch to the UP or the DN position. A ground safety function using the left main gear WOW switch prevents landing gear switch movement from the DN position to the UP position.

Main Landing Gear

Each main landing gear (MLG) strut attaches to the wing and retracts inboard into the wing wheel well. Inboard and outboard gear doors retract to cover the wheel well opening.

The MLG contains a trunnion, shock strut and trailing link, side brace actuator, outboard door linkage rod, wheel and tire, brake assembly, wheel-speed transducer, WOW switch, hydraulic brake tubes including swivel joints, and an electrical harness. WOW signals are used by various aircraft systems.

The MLG side-brace actuator has a downlock mechanism to hold the landing gear in the down position. A downlock sensing device is installed on the downlock mechanism. The gear is held in the up position by the inboard door.

The MLG doors contain separate inboard and outboard doors. The outboard doors are mechanically operated and are attached to the strut. The inboard doors are hydraulically operated and have an uplock mechanism to lock the inboard door in the closed position. Door uplock and door-open switches are attached to the inboard door actuator and send signals to the landing gear position and warning system and to the retraction and extension system.

Nose Landing Gear

The Nose Landing Gear (NLG) supplies shock absorption, support and directional control of the airplane during ground operations. The NLG strut attaches to the fuselage and retracts forward into the nose wheel well. After gear up or down operation, the NLG assumes a locked position. The NLG drag brace actuator has a downlock mechanism to lock the nose landing gear in the down position and a NLG uplock roller engages a latch on the uplock retract actuator hook after the NLG retracts. Forward and aft doors retract to cover the wheel well opening.

The NLG includes an oleo pneumatic shock, drag brace actuator, forward doors linkage rod, WOW switch, torque link, steering actuator, hydraulic tubes for steering control, and an electrical harness. Centering cams in the shock strut insures that the nose wheel will automatically center when the NLG shock strut is fully extended.

The NLG contains left and right forward doors and an aft center door. All doors are operated mechanically and the two forward doors are closed with the NLG extended.

During towing operations with the NLG torque links disconnected, the nose wheel can swivel through 360 degrees of rotation. If the NLG torque links remain connected, a 60-degree deflection limit either side of center must be observed.

Alternate Gear Extension

Pulling the Alternate Gear Release handle mechanically actuates a dump valve and releases the uplocks. The landing gear starts to extend by gravity and is assisted by aerodynamic loads. The inboard doors remain open after emergency extension. The system cannot be reset in flight but the handle can be partially stowed.

Indications

Landing gear status is displayed on the ASI.

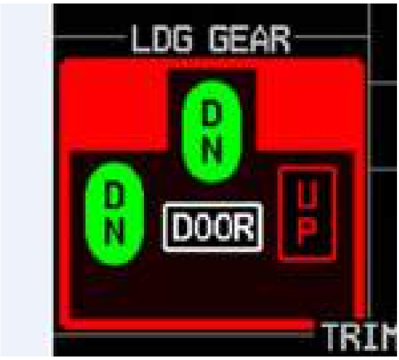

Figure 1-64. ASI Landing Gear Display

The landing gear status indicators will show one of three landing gear states based on the position of the landing gear switch and the switches in the landing gear system. The three gear positions are: “UP”, “DN”, or Cross Hatch (unknown/in transit). The color is green if the landing gear is down and locked, white if up or in transit, amber if failed and red if gear warning is active. A white DOOR icon is displayed when either of the main landing gear inboard doors are not closed.

If the landing gear is not down and locked when the aircraft is positioned/configured to land an aural "*LANDING GEAR*" alert will play and gear position will be displayed in red color with a solid red box around the gear indications. Logic inputs to the landing gear warning system include the landing gear position, landing gear switch position, flap position, aircraft altitude/height, airspeed, and thrust lever angle. Under certain conditions the aural alert can be silenced by acknowledging the alert, under others the alert will continue to play but at a reduced repeat rate.

CAS Messages

Message	Description
LDG GEAR UNSAFE	One or more landing gear is not safe for landing
LDG GEAR FAIL	The landing gear has not reached the handle commanded position after 20 seconds
LDG GEAR DOOR FAIL	Landing gear door failed to close

WHEELS AND BRAKES

Main Landing Gear Wheel and Tire Assembly
A single 17.5 x 5.75 R9, tubeless, radial tire with a speed rating of 190 mph (165 kts) is mounted on each MLG. If the brakes become overheated, three fusible plugs on the wheel will melt to decrease the tire pressure.

Nose Landing Gear Wheel and Tire Assembly
The single nose tire is a 16 x 4.4 R8, tubeless, radial, dual chined tire with a speed rating of 190 mph (165 kts). A pressure release plug on the wheel releases tire pressure to prevent over pressurizing.

Normal Brakes
Each main landing gear is equipped with a multiple-disc brake that uses four rotating steel discs and three stationary steel discs.

Two brake wear indicator pins are installed on the pressure plate and protrude through the cylinder housing. When the wear indicators are flush with the cylinder housing with the brakes fully applied, the brake pads are worn and need replacement. An automatic adjuster keeps clearance as brake wear occurs.

Brake application is initiated by applying a force to the top of the rudder pedals, which supplies a control pressure at the master cylinders. The amount of braking force is proportional to the force applied to the rudder pedals.

Antiskid protection is available when the aircraft wheel speed is above approximately 10 knots and below approximately 165 kts (190 mph). Wheel skid, as measured by the wheel-speed transducer, is signaled to the control unit which outputs a signal to the power brake/antiskid control valve to release both brake pressures at the same time. The automatic antiskid function resumes its standby mode after any wheel skid stops or brake pedal pressure is decreased below the wheel skid threshold level. Power brakes will still be available if the antiskid system fails.

Touchdown protection prevents brake application until wheel spin-up occurs. After weight-on-wheels has been true for three seconds, power braking is enabled with or without a wheel speed signal.

Locked wheel crossover protection starts if either wheel slows significantly below the speed of the other when aircraft speed is above 25 kts. When the sensed speed of either main landing gear wheel slows to 30% or less when compared to the other wheel speed, a full brake release occurs which removes the locked wheel condition.

Wheel spin-down braking applies minimum wheel braking pressure during landing gear retraction to insure that the main landing gear wheels have stopped rotating before they retract into the wheel well.

Emergency/Parking Brake

The emergency/parking brake system is a mechanically actuated power brake valve that meters brake pressure to both brakes in proportion to the emergency/parking brake handle movement.

Parking brake function is supplied by locking the emergency/parking brake handle at the parking position.

The emergency/parking brake system has a thermal relief valve to prevent over-pressurization of the hydraulic tubes and brake assemblies when there is a change in thermal environment.

Indications

A white PARKING BRAKE icon is displayed below the landing gear indicator and on the STATUS synoptic page when the parking brake is set and pressure is sufficient. The color changes to amber if the brake is set but the pressure is insufficient or the brake is set in flight. Emergency/parking brake pressure is displayed on the HYDRAULICS synoptic page.

NOSEWHEEL STEERING

The nosewheel steering (NWS) system contains one steering control unit (SCU), one steering control valve and actuator assembly (SCVA) installed on the nose landing gear, and two pedal stroke transducers (XDCR) installed on the rudder pedal mechanism. The nosewheel steering angle is scheduled based on pedal deflection and ground speed. Maximum steering angle is +/- 60°. The nosewheel is free castering during landing until approximately 2 seconds after NLG weight on wheels.

The NWS can be disabled by selecting the NOSE WHEEL STEERING switch to OFF or setting the parking brake.

CAS Messages

Message	Description
NORMAL BRAKES FAIL	Normal wheel brakes have failed
ANTI-SKID FAIL	The antiskid braking system has failed
NOSEWHEEL STEER FAIL	The nosewheel steering system has failed, or is selected OFF during taxi operations
PARK BRAKE FAIL	Brake pressure is less than 1450 psi with the PARK BRAKE set
PARK BRAKE ON	The parking brake is pressurized during flight
EMER BRAKE FAIL	Emergency brake accumulator pressure is less than 1650 psi
NOSEWHEEL STEER FAULT	A fault has been detected in the nosewheel steering system
NOSEWHEEL STEER OFF	NOSE WHEEL STEERING switch selected OFF
WOW FAULT	WOW system disagree

PNEUMATICS AND ENVIRONMENTAL

Bleed air is supplied by each engine high-pressure compressor section and is used for the environmental system, wing and engine inlet anti-ice, cockpit window defog, and cabin pressurization.

BLEED AIR SUPPLY SYSTEM

Un-conditioned bleed air is ported from two interconnected engine bleed ports to the Cowl Anti-Ice Valve (CAIV) and the High Pressure Regulating Shutoff Valve (HPRSOV).

The CAIV regulates the un-conditioned bleed air pressure to approximately 25 psig. From the CAIV, the un-conditioned bleed air is then ported to the engine inlet for ice protection.

The HPRSOV regulates the bleed air pressure to approximately 60 psig. From the HPRSOV, the bleed air is ported to the engine Pre-Cooler (PC). A solenoid function on the HPRSOV will close the valve if commanded.

The PC is an air-to-air heat exchanger that functions as the first stage of bleed air conditioning (cooling). The conditioning results from the use of engine fan air supplied to the PC through the Fan Air Valve (FAV). The FAV flow is controlled by the Fan Air Valve Controller (FAVC) which receives the bleed air temperature from the Fan Air Valve Temperature Sensor (FAVTS) located downstream of the PC. The FAV regulates the cold side air flow through the PC to maintain a bleed air temperature exiting the PC at approximately 400 ºF during non-wing anti-ice operations and wing anti-ice operations on the ground. During wing anti-ice operations in flight, the FAV regulates the bleed air temperature exiting the PC at approximately 550 ºF. The fan air exiting the PC is exhausted through the fan air outlet. From the PC, the conditioned bleed air is ported to the Nacelle Pressure Regulating Shutoff Valve (NPRSOV).

The NPRSOV functions as a redundant regulator to the HPRSOV and will remain in the full open position under normal operation conditions. In the event of a failed open HPRSOV, the NPRSOV will regulate the conditioned bleed air pressure to approximately 70 psig. From the NPRSOV, the conditioned bleed air is ported to the environmental and wing anti-ice systems.

The HPRSOV and NPRSOV can be closed by selecting the associated L ENGINE BLEED or R ENGINE BLEED switch to OFF.

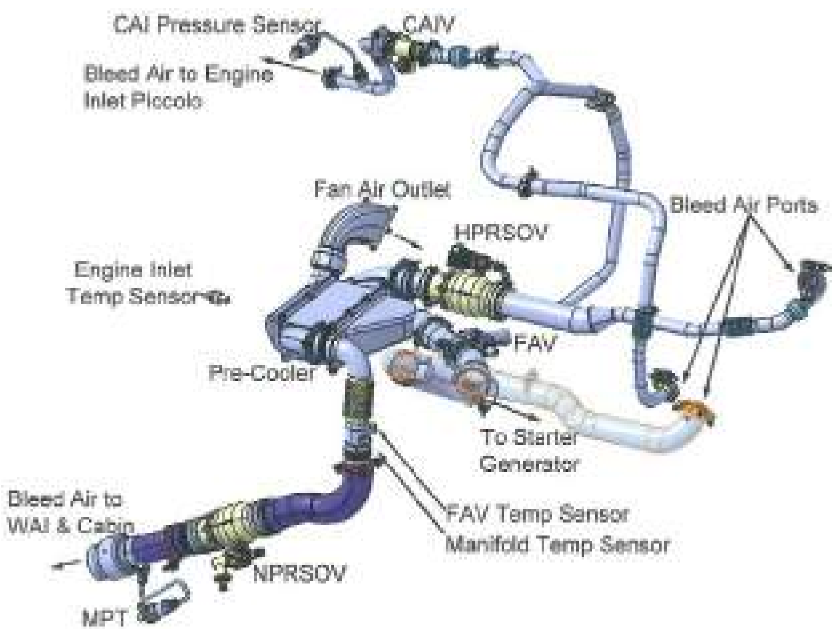

Figure 1-65. Bleed Air Supply System Components

Indications

HPRSOV status as well as manifold temperature and pressure can be observed on the ENVIRONMENTAL synoptic page.

ENVIRONMENTAL CONTROL SYSTEM

A FCSOV regulates the conditioned bleed air from the Bleed Air Supply flow to either approximately 3 pounds per minute (ppm) or approximately 5 ppm depending on whether low or high flow condition is required. A solenoid function on the FCSOV will close the valve if commanded. The FCSOVs can be closed by selecting the associated L CABIN INFLOW or R CABIN INFLOW switch to OFF.

From the FCSOVs, conditioned bleed air is ported to two Temperature Modulating Valves (TMV), and the HXP. Each TMV has two bleed air inlets and one outlet. The inlets are controlled together such that at least one inlet is always fully open (and the other closed) or the two inlets are partially open. One of the ports is supplied with hot bleed air directly from the FCSOV, the other port is supplied with cooled bleed air from the HXP.

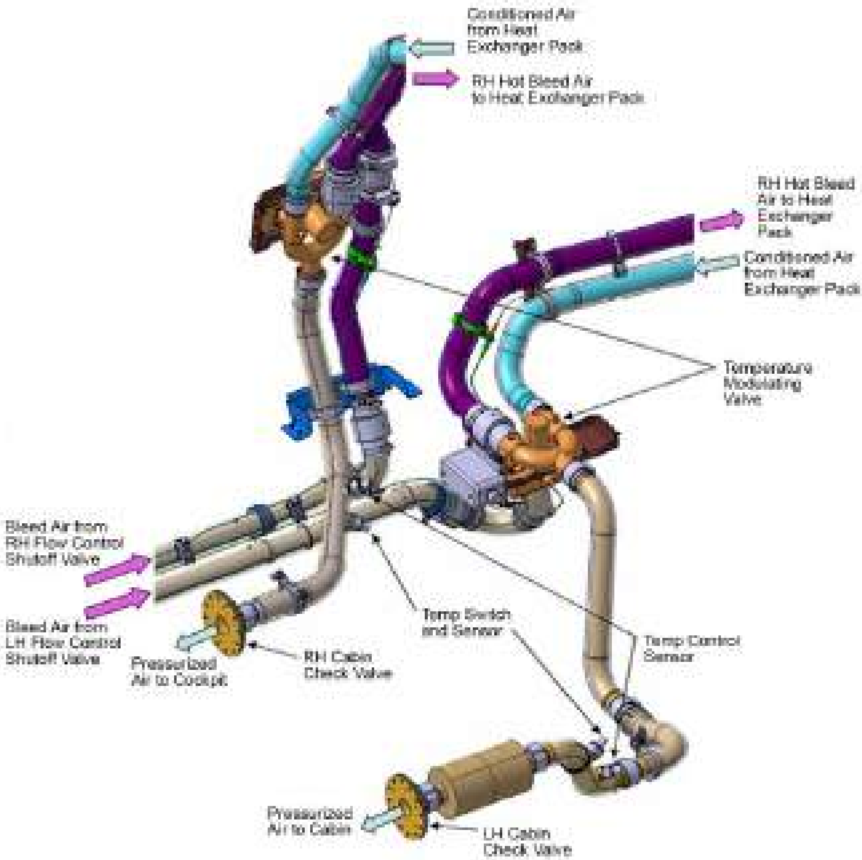

Figure 1-66. Temperature Modulating Valves

The HXP is comprised of three Heat Exchangers (HX). Ambient (cooling) air entering the HX Pack first passes through a VCS condenser. The condenser exhaust air then passes through the LH and RH HX which are in parallel. There are two sources for ambient (cooling) air; the Ground Cooling Fan (GCF) on the ground and two ram air inlets located at the base of the vertical stabilizer in flight. The GCF draws air in close proximity to the inlet grille. The ambient air is exhausted overboard on the RH side of the AFT baggage compartment. Operation of the GCF is automatic based on the demand for air conditioning in the cabin, or bleed air cooling.

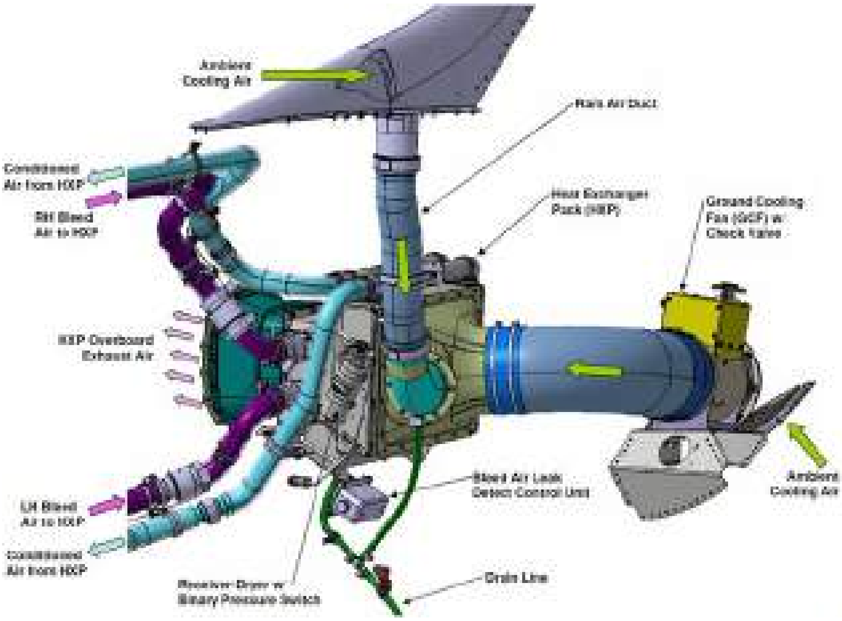

Figure 1-67. Heat Exchanger Pack

When maximum bleed air heating or cooling is required in the cabin or cockpit, the TMV either bypasses all bleed air flow from the HX or directs all bleed air flow through the HX. The bleed air exiting the TMV is ducted into the aircraft pressure vessel through check valves mounted on the AFT Pressure Bulkhead (APB).

Air Conditioning

Air conditioning (cooling) of the conditioned air is performed using a Vapor Cycle System (VCS).

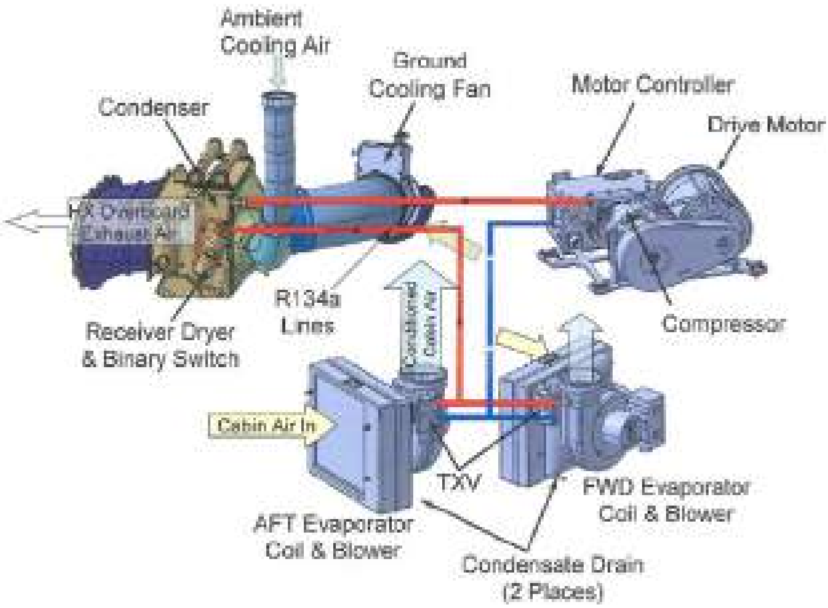

Figure 1-68. VCS System

A Compressor Drive Module (CDM) delivers high temperature, high pressure gas to the condenser via refrigerant hoses. In the condenser, the refrigerant changes phase to a high temperature, high pressure liquid as ambient (cooling) air passing through the condenser. The liquid refrigerant exits the condenser and passes through a receiver dryer designed to remove small amounts of moisture within the refrigerant system. The refrigerant flows to an expansion valve on the Forward evaporator and to the expansion valve on the Aft evaporator. The expansion valves provide a pressure drop for the liquid refrigerant and each evaporator vaporizes the low temperature, low pressure refrigerant causing the evaporators to become cold, extracting heat and moisture from the aircraft cabin air. This cool, dry air exits the evaporator and is then forced through the aircraft system distribution ducts via the evaporator fans. If the Air Conditioner is off, the evaporator fans will only recirculate cabin air. Evaporator coil condensation is drained overboard. The refrigerant vapor travels back to the compressor inlet from the evaporator outlets as a low temperature, low pressure gas where the cycle is repeated.

Temperature Control

When the Environmental system is selected to the Normal mode operation of the Air Conditioner is automatic based on the cockpit and cabin target temperatures set using the CDU Thermostat page. Evaporator fan speed is normally controlled by the system to one of the eight speeds. Fan speed can be manually controlled by selecting the Manual mode. Cabin target temperature and fan speed can also be controlled, within a limited range, from the cabin if the Cabin Control mode has been selected on the Thermostat page.

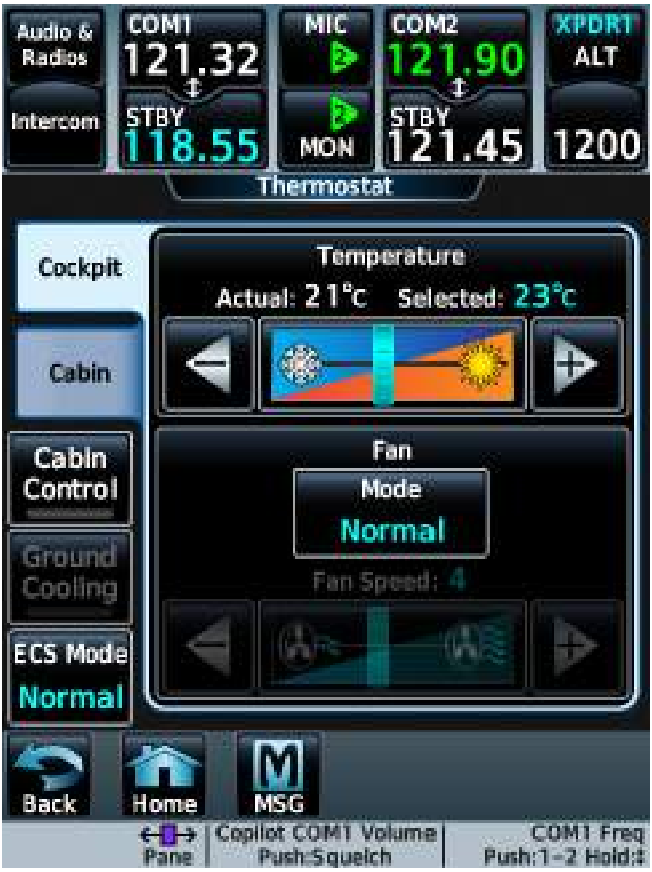

Figure 1-69. CDU Thermostat Page

If the Environmental system is selected to the Manual mode, the crew can directly adjust each TMV. Each push of the Cold or Hot button drives the valve in the appropriate direction for a short time. If the duct temperature is driven beyond approximately 93 °C, the valve will automatically drive to the full cold position after which the valve position can be adjusted again. Duct temperature is not an indicator of air temperature entering the cockpit.

Bleed air is available from either or both engines during ground operations. The Air Conditioner can operate on the ground with at least one generator operating or with external power. When operating on a single generator Ground Cooling Mode has to be selected through the CDU. When in Ground Cooling Mode certain electrical loads will be shed. On battery power when on-ground, the Air Conditioner and GCF are not powered and the Cabin and Cockpit evaporator fans are speed limited.

During single engine operations on the ground, bleed air does not automatically flow into the cabin. Manual activation of bleed air is possible; however, it requires one engine to be operating. If it is desired to heat or cool the aircraft prior to taxi, start either engine and select Ground Cooling mode.

The Air Conditioner is not available if a generator is lost in flight.

Cabin Air Distribution

There are two climate zones: the cockpit and the cabin.

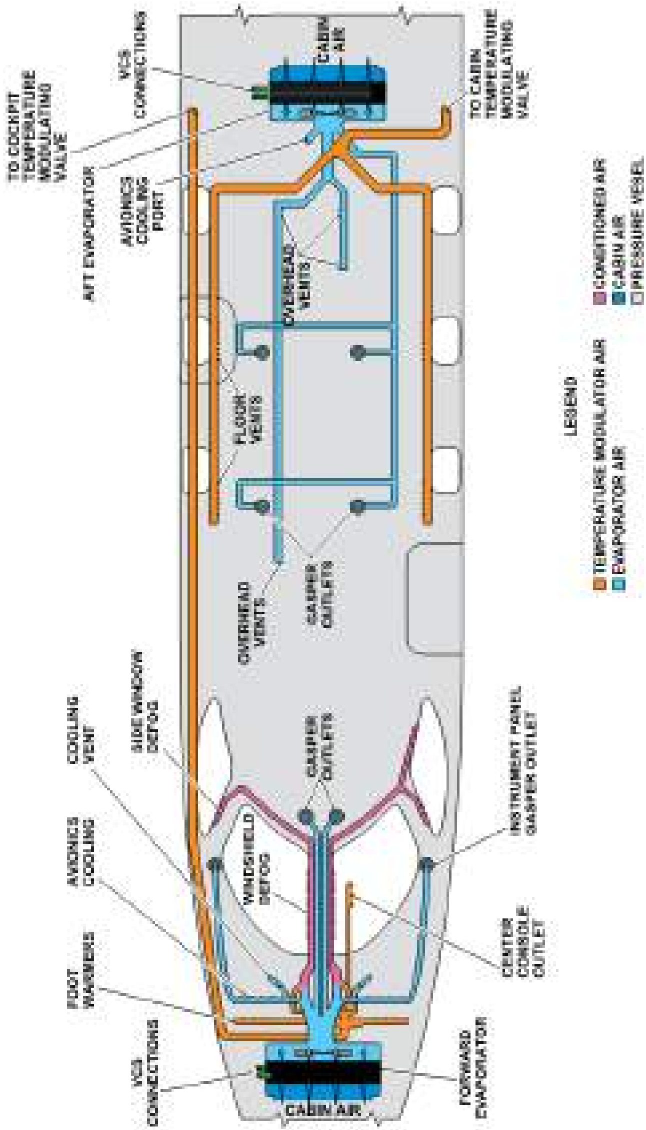

Figure 1-70. Cabin Air Distribution System

Cockpit Climate Zone

The RH BAS conditioned bleed air is ducted to pilot and co-pilot foot warmers, aft through the center console and to the windshield and side window defog outlets. Circulated cockpit air, via the evaporator fan, mixes with the conditioned bleed air that is ducted to the windshield and side window defog outlets.

The circulated cooling air exits the evaporator fan and is ducted to the pilot overhead and panel gaspers, two cooling vents, the co-pilot overhead and panel gaspers, the windshield and side window defog outlets and the avionics cooling outlets.

Cabin Climate Zone

The LH BAS conditioned bleed air is ducted to three floor vents along the LH distribution duct and two floor vents along the RH distribution duct which are open at all times.

The circulated cooling air exits the evaporator fan and is ducted to the passengers' overhead panel gaspers, overhead cooling flood ducts and electronics cooling.

Indications

FCSOV status and duct temperature downstream of the TMVs can be viewed on the ENVIRONMENTAL synoptic page. Target and actual cabin/cockpit temperature is displayed on the synoptic page in addition to the CDU Thermostat page. Fan speed is displayed in magenta on the synoptic page when in Normal mode and in cyan when in Manual mode. The target temperature value is replaced by a MANUAL icon when the Environmental system is in Manual Control mode.

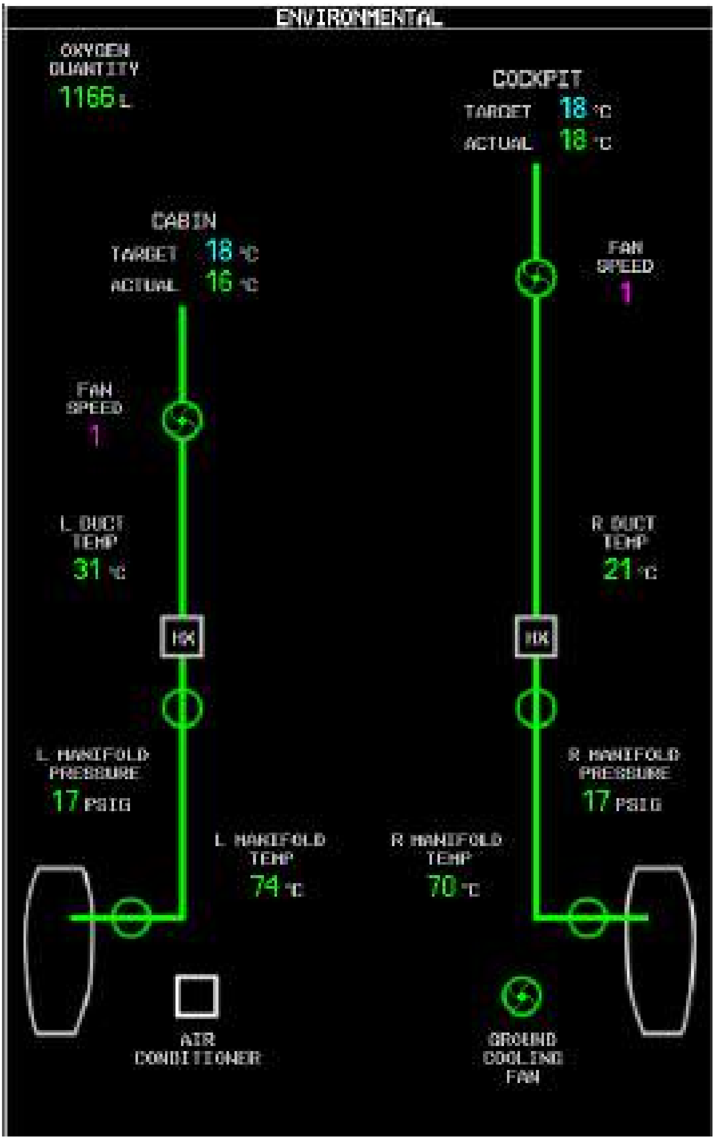

Figure 1-71. Environmental Synoptic Page

CAS Messages

Message	Description
L(R) CABIN BLEED FAIL	There has been a failure of the cabin bleed system
L(R) CABIN BLEED TEMP HIGH	The cabin bleed temperature is above normal operating limits when operating in Manual Mode
ECS AIR COND FAIL	The Temperature Control system has detected a failure of the automatic system
ECS GND COOLING FAN FAIL	Ground cooling fan has failed to operate when commanded
L(R) ENG BLEED FAIL	There has been a failure of the bleed system, or the aircraft was powered up with a high bleed manifold temperature
L(R) CABIN BLEED FAULT	A fault in the affected cabin bleed system detected
L(R) CABIN INFLOW OFF	Associated inflow selected OFF
ECS AIR COND FAULT	Either the cockpit or cabin evaporator fan has failed
ECS TEMP CONTROL MANUAL	ECS manual mode has been selected
L(R) ENG BLEED FAULT	A fault in the affected engine bleed system detected
L(R) ENG BLEED OFF	Bleed selected off
CABIN FAN CONTROL MANUAL	Cabin fan manual mode has been selected
CKPT FAN CONTROL MANUAL	Cockpit fan manual mode has been selected

Message	Description
ECS GND COOLING MODE	Ground cooling mode has been selected

PRESSURIZATION

The cabin pressurization control system (CPCS) is comprised of the following: a Primary Outflow Valve (POFV), Secondary Outflow Valve (SOFV), a Cabin Pressurization Data Unit (CPDU), and pneumatic tube assemblies.

Primary Outflow Valve

The Primary Outflow Valve (POFV) incorporates an Electronic Control Unit (ECU), mechanical cabin altitude regulator, cabin altitude limiter, cabin differential pressure limiter, and negative differential pressure relief function.

The POFV ECU provides pressurization data to the aircraft avionics system, including cabin pressure altitude, cabin pressure altitude rate, and cabin differential pressure.

Secondary Outflow Valve

The SOFV opens and closes along with the POFV. Similar to the POFV, the SOFV also incorporates a mechanical cabin altitude limiter, a cabin differential pressure limiter, and a negative differential pressure relief function that are all independent of the POFV. There are no electrical components in the SOFV.

Limiters

In the event of a malfunction of the CPCS, the cabin altitude will be maintained at 13,500 ±500 feet via independent mechanical cabin altitude limiters on each OFV.

Mechanical positive and negative differential pressure limiters in each outflow valve will limit differential pressure within a safe range.

Cabin Pressurization Data Unit

The Cabin Pressurization Data Unit (CPDU) provides a redundant, and independent, set of cabin pressure data to the avionics system.

Normal Operation

When the Thrust Levers are advanced for takeoff, the CPCS enters a pre-pressurization mode in which the CPCS maintains the cabin rate until a small differential pressure is achieved. If the takeoff is aborted, the CPCS depressurizes the cabin.

During climb and cruise, the POFV continuously selects a cabin altitude and altitude rate based on aircraft altitude, Landing Field Elevation (LFE) and the pressurization schedule. LFE is automatically determined from the destination airport in the flight plan. LFE can also be manually entered by selecting the Manual mode on the CDU Pressurization page and entering the desired value.

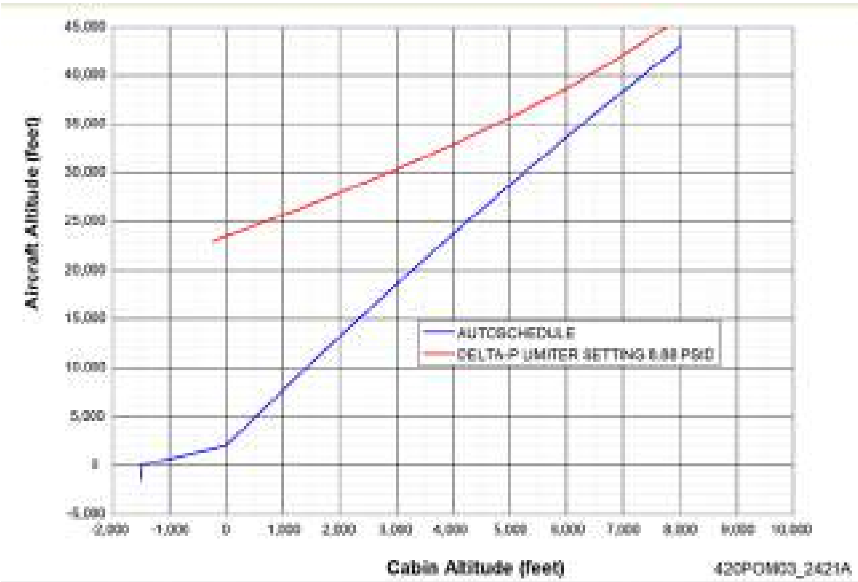

Figure 1-72. CPCS Cabin Altitude Schedule

The pressurization schedule ensures the cabin is depressurized upon landing. If the cabin was to be pressurized before landing, the CPCS will automatically depressurize it after touchdown.

High Field Operation

The CPCS incorporates a High Field mode that activates when the following is true:

a. The aircraft is on the ground and the cabin pressure altitude is above 8,000 feet, or

b. The aircraft is in flight at an aircraft altitude less than 24,500 feet, the cabin pressure altitude is above 8,000 feet, and the landing field is set above 8,000 feet elevation, or

c. The aircraft is in flight at an aircraft altitude less than 24,500feet, the cabin pressure altitude is above 8,000 feet, and the aircraft has taken off from an elevation of greater than 8,000 feet.

In addition to revising the pressurization schedule to accommodate the high field operation, the normal cabin altitude alerting threshold is raised from 10,000 feet to 15,000 feet in the high field mode. The allowed cabin rate of change is also increased from +575 / -485 feet per minute to +1,740 / -1,500 feet per minute.

Cabin Dump

Selecting the CABIN DUMP switch to DUMP depressurizes the cabin. Cabin altitude will be limited to 13,500 ±500 feet by the cabin altitude limiters.

Cabin Altitude Hold Mode

If the pressurization control signal from the aircraft avionics system fails, the CPCS will automatically enter a Cabin Altitude Hold Mode (Hold Mode). Hold Mode maintains the current cabin altitude and regulates cabin pressure within the positive and negative differential pressure limits. Hold Mode is also activated by selecting the CONTROL MODE switch to HOLD.

Indications

Cabin altitude, cabin altitude rate and differential pressure are displayed in green color full-time on the ASI. LFE is displayed in magenta when derived from the flight plan destination, and in cyan if entered manually. Cabin altitude and differential pressure changes color from green to red if a limit is exceeded. If the cabin altitude limit is exceeded a "*CABIN ALTITUDE*" aural alert is played in addition to the visual indications. The alert cannot be cancelled while the condition is true but the repeat rate is reduced after the alert is acknowledged.

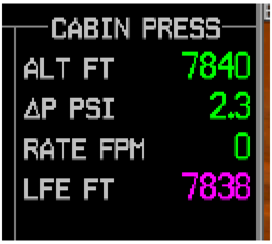

Figure 1-73. Cabin Pressurization ASI Indications

If Dump or Hold mode is active, the LFE indication is replaced by a white DUMP or HOLD icon.

CAS Messages

Message	Description
CABIN ΔP HIGH	Cabin differential pressure has exceeded 9.2 psid
CABIN ALT HIGH	Cabin altitude has exceeded 10,000 ft (15,000 ft in High Field Mode)
CABIN ALT CTRL FAIL	The Cabin Pressurization system automatic operation has failed
CABIN ALT CTRL FAULT	A fault has been detected which affects the cabin dump function
CABIN ALT HIGH FIELD	The Cabin Pressurization system has been operating in the High Field Mode for more than 30 minutes
NO LDG FIELD ELEV	The Cabin Pressurization system does not have landing field elevation information
CABIN ALT ABOVE 10K	Cabin altitude exceeds 10,000 feet when operating in high LFE mode
CABIN ALT DUMP	Pressurization selected to DUMP mode
CABIN ALT FAULT	Fault in the cabin pressurization system
CABIN ALT HOLD	Pressurization selected to HOLD mode

BLEED AIR LEAK DETECTION

A Bleed Air Leak Detection (BALD) system runs the length of the bleed air system. The BALD system runs through the hot side inlet of the Temperature Modulating Valve, including the heat exchanger inlets and the wing anti-ice system.

Each BALD sensor is comprised of a conductive tube filled with an extruded eutectic salt around a core. As the temperature surrounding a sensing element reaches its alarm point, the BALD Controller activates a discrete alarm output.

The following areas are monitored:

1. Left Bleed Air Duct between the horizontal firewall and the Left FCSOV
2. Right Bleed Air Duct between the horizontal firewall and the Right FCSOV
3. Left FCSOV to the Left Temperature Modulating Valve / Heat Exchanger in the tailcone
4. Right FCSOV to the Right Temperature Modulating Valve / Heat Exchanger in the tailcone
5. Wing Anti-ice System

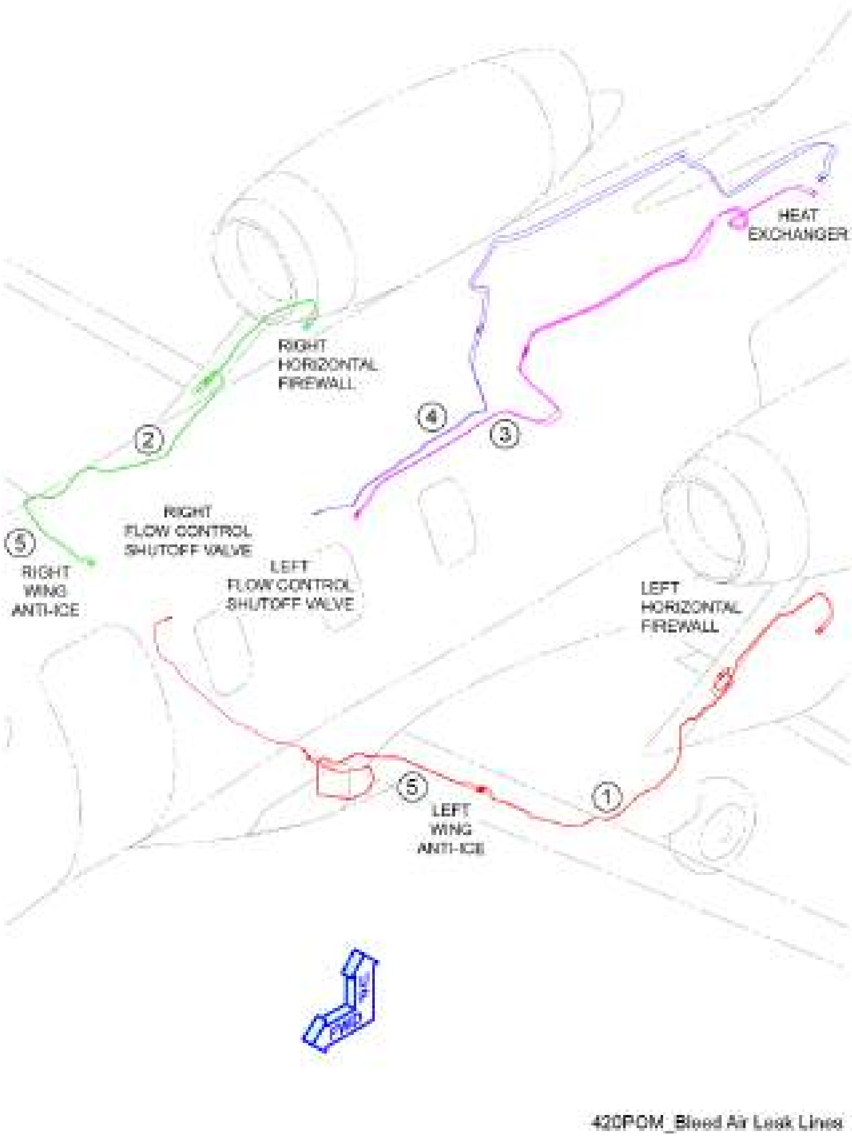

Figure 1-74. Bleed Air Leak Detection Lines

Each area uses two sensor loops except for the Left FCSOV zone and the Right FCSOV zone that use a single loop.

Over Temperature Switches located in the engine inlet are used to monitor for leaks in the inlet assembly.

Indications

In addition to CAS alerts bleed leaks are indicated by associated flow lines on the ENVIRONMENTAL and ICE PROTECTION synoptic pages changing from green to red color.

CAS Messages

Message	Description
L(R) CABIN BLEED LEAK	A leak has been detected in cabin bleed air system
L(R) ENG BLEED LEAK	A leak has been detected in engine bleed air system or the engine anti-ice system
WING BLEED LEAK	A leak has been detected in wing anti-ice system

OXYGEN

The Crew and Passenger Oxygen System (CPOS) consists of an oxygen source, servicing connections and gauges, crew oxygen distribution and control and cabin oxygen distribution and control.

Oxygen is stored in a single 50 cubic foot, 1850 psig oxygen bottle. Attached to the oxygen bottle is a pressure regulator that regulates the oxygen pressure supplied to the crew and passengers to approximately 80 psig. Integrated into the pressure regulator is an over pressure relief system. In the event the oxygen bottle is subjected to an overpressure, a burst disk will rupture venting the oxygen overboard removing a green disc located on the lower left hand skin of the nose of the aircraft. The low pressure supply is provided with a pressure relief valve that provides a back-up to the oxygen pressure regulator.

Pushing/pulling the SUPPLY knob opens/closes a mechanical valve at the high pressure source. All low pressure oxygen is vented when the valve is closed. A temperature/pressure transducer is used for providing the volume of oxygen remaining.

When the CABIN knob is in the NORM position, the cabin masks will automatically deploy at a cabin pressure altitude of 14,500 ± 500 feet. Deployment of the cabin masks can be commanded by selecting the DROP MASK position. Selecting the OFF position isolates the cabin from the oxygen supply.

Crew Oxygen

Both crew positions are provided with a Pressure Demand, Quick Don crew oxygen mask. The regulators are part of the mask. Masks are stored in stowage boxes (one for each pilot) specifically designed for quick mask donning to allow the crew to don the mask in under 5 seconds. Pushing the red levers on the side of the mask together allows a pneumatic harness to be filled with oxygen, which expands the harness and facilitates donning of the crew oxygen mask with one-hand operation. Releasing the levers deflates the harness to provide a tight fit of the mask.

Crew oxygen masks operate on three modes: Normal, 100% Oxygen, and Emergency. There is a red toggle-style switch to select between Normal and 100% Oxygen. A red knob is used to select Emergency. A microphone is installed in the masks.

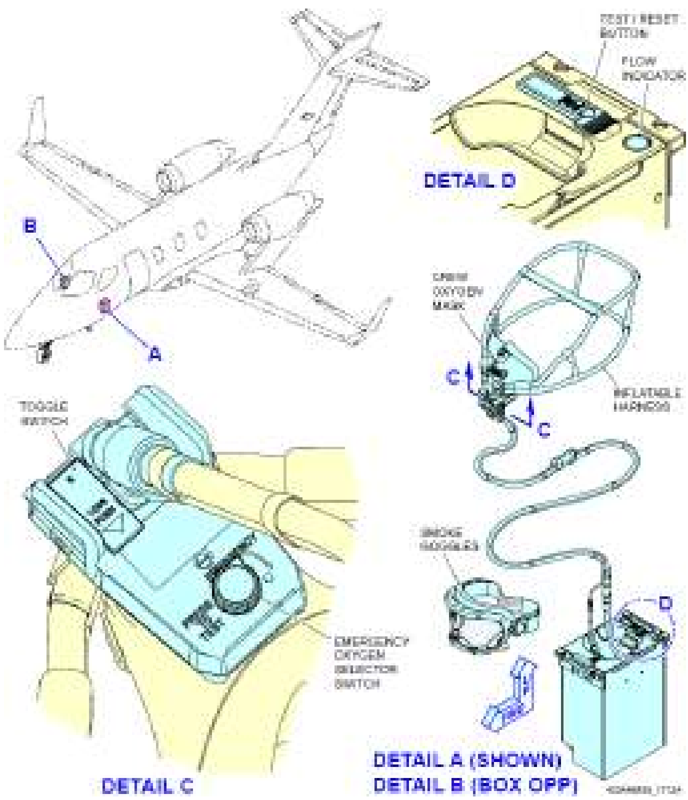

Figure 1-75. Crew Mask

Normal Mode

At cabin altitudes between 8,000 and 30,000 feet, the regulator delivers oxygen diluted with ambient air when the user inhales. At cabin altitudes between 30,000 and 35,000 feet, the regulator delivers 100% oxygen. At cabin altitudes above 35,000 feet, the regulator delivers 100% oxygen through positive pressure.

100% Oxygen Mode

At cabin altitudes below 35,000 feet, the regulator delivers 100% oxygen when the user inhales. At cabin altitudes above 35,000 feet, the regulator delivers 100% oxygen through positive pressure.

Emergency Mode

The regulator delivers 100% oxygen through positive pressure regardless of cabin altitude.

Crew Mask Storage

The mask stowage provides the ability to test the flow of oxygen and test the microphone without removing the mask from the stowage box. Opening the doors of the stowage box (or pushing the test button) starts the flow of oxygen to the mask mounted regulator. The face of the stowage box provides a flow indicator that is used to confirm flow of oxygen. Integral to the mask stowage box is a valve which prevents low-pressure oxygen from feeding the mask-mounted regulator when the mask is stowed.

Smoke goggles, designed to fit with the crew oxygen mask, are stored in the bottom of the stowage box. The smoke goggles are vented with oxygen from a vent on the crew oxygen masks.

Audio

Opening the stowage box doors selects the on-side mask microphone on.

Selecting the OXY MASK AUDIO switch to EMER forces the overhead cockpit speakers on at a preset volume and both pilots' microphone inputs to the oxygen mask microphones. Toggling the switch back to NORM selects both speakers and both oxygen mask microphones off.

The oxygen mask microphones can be toggled on/off using the CDU Audio & Radios page when the stowage box doors are open and the OXY MASK AUDIO switch is in the NORM position.

A noise suppressor is mounted on each oxygen hose. When the ON/OFF switch is selected ON, it filters out some of the breathing noise when the mask is in use.

Passenger Oxygen

The cabin oxygen system consists of four passenger oxygen masks in the main cabin (five if the side facing seat is installed) and one additional passenger oxygen mask in the lavatory.

Each passenger mask features vinyl reservoirs and molded silicone rubber face pieces. Upon deployment of the passenger masks, the act of donning the mask pulls a pin from the dispenser, which opens a valve and immediately starts the flow of oxygen to that mask.

Indications

The ENVIRONMENTAL and the STATUS synoptic pages show the available oxygen quantity in liters.

CAS Messages

Message	Description
CABIN OXYGEN OFF	Cabin oxygen is off and cabin altitude is greater than 15,500 ft
OXYGEN LOW	Oxygen quantity is less than 465 liters
OXYGEN QTY FAIL	The oxygen pressure transducer is indicating out of range
OXYGEN UNAVAILABLE	Oxygen quantity is depleted
CABIN OXYGEN ON	Cabin oxygen system is on
OXYGEN QTY FAULT	A fault has been detected in the oxygen quantity display

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ICE AND RAIN PROTECTION

The ice and rain protection system contains five subsystems: wing ice protection system, engine inlet ice protection system, horizontal tail ice protection system, heated air data probes and windshield vision protection system. The airplane also incorporates an ice detection system, a standard left side ice inspection light and an optional right side ice inspection light.

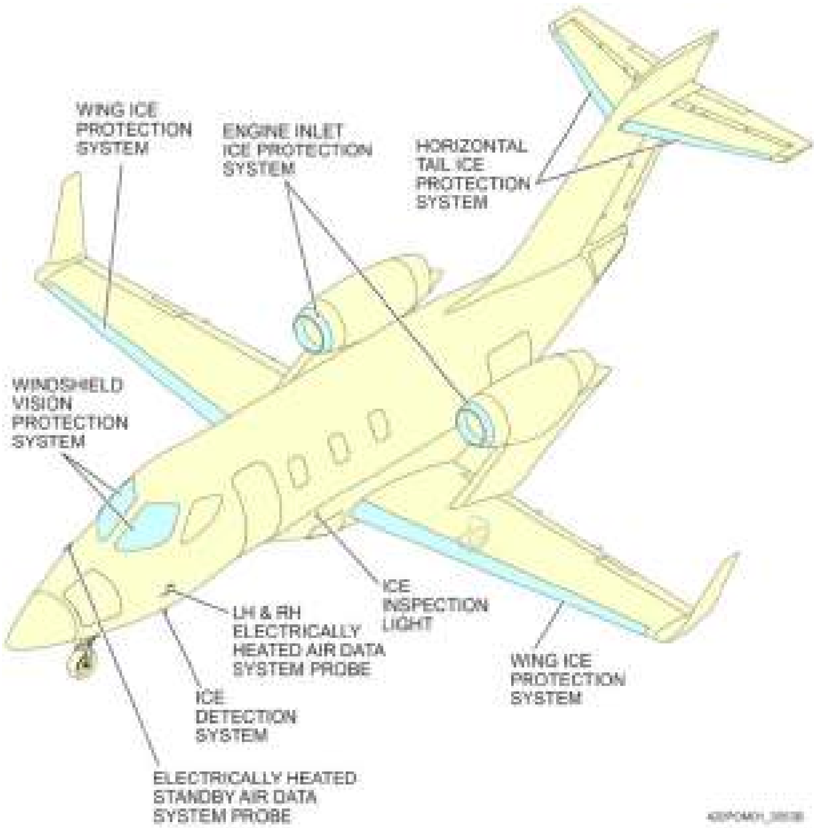

Figure 1-76. Ice and Rain Protection Sub-system Locations

Wing Ice Protection System

Conditioned air from the Bleed Air Supply system is routed to L and R Wing Anti-Ice Air Valves (WAIV) and to the Wing Anti-Ice Cross Flow Valve (WAIXV). From the WAIVs, the air is distributed through a pair of piccolo tubes and then vented through holes in the inboard lower wing area and a vent on the outboard lower wing. Wing temperature sensors are located in the inboard and outboard section of the leading edge. A high flow mode is automatically commanded on when the system is activated and commanded off when both outboard temperature sensors reach a pre-determined threshold. The WAIXV is used to supply engine bleed air to both wings when only one bleed source is available. The system is automatically tested on the ground following the second engine start.

The system can be manually commanded on by selecting the WING ANTI-ICE switch ON position and de-activated by selecting the OFF position. In the ON position, both WAIVs are commanded open, except when operating on single bleed in the keep out zone; then a **WING ANTI-ICE UNAVAIL** caution CAS message is posted. On the ground, when the switch is selected to the ON position a **CONFIG WING ANTI-ICE** advisory CAS message is posted until the wing is warm enough to support a takeoff in icing conditions. Attempting a takeoff with a **CONFIG WING ANTI-ICE** advisory CAS message will result in activation of the takeoff configuration warning.

When the WING ANTI-ICE switch is in the NORM position, the WAIVs automatically open when ice is detected by either ice detector, and the system will remain active for three minutes after ice is no longer detected.

Automatic wing anti-ice activation is inhibited in the following cases:

- On the ground
- During the first 30 seconds after liftoff
- At or above FL340
- In the Keep Out zone

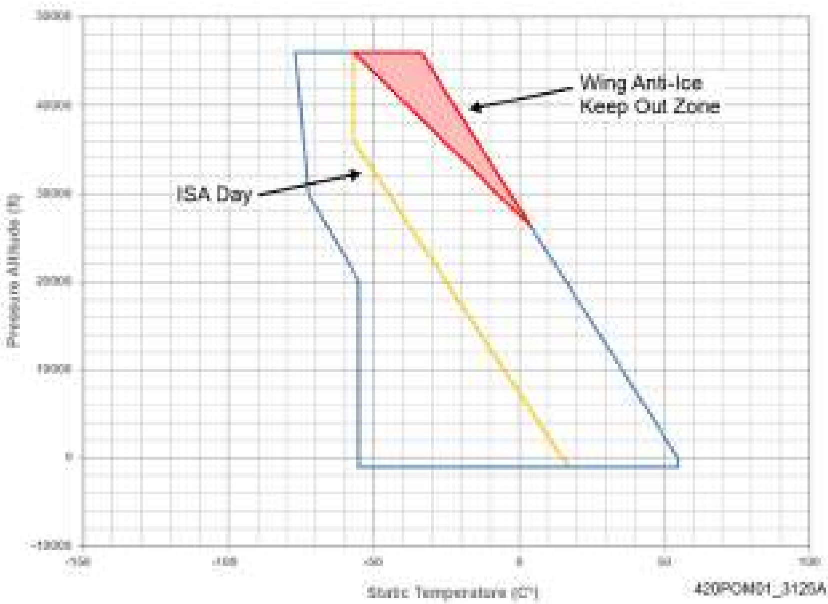

Figure 1-77. Wing Anti-Ice Keep Out Zone

If the WING FLOW switch is selected to FROM L or FROM R, the WAIV on the opposite ("to") side is commanded closed and the WAIXV is commanded open. In the NORM position, the system will automatically command the WAIXV open if a loss of bleed flow is detected on either side.

Engine Inlet Ice Protection System

The Engine Inlet Ice Protection System (EIIPS) uses high-pressure bleed air that is regulated by a pressure-regulating Cowl Anti-Ice Valve (CAIV).

Selecting the L or R ENGINE ANTI-ICE switch to ON opens the associated CAIV, allowing bleed air to flow into the inlet lip. The bleed air exhausts overboard through vent openings at the bottom aft edge of the engine inlet lip.

The engine anti-ice system is monitored by a pressure sensor in the bleed tube downstream of the CAIV and an air temperature sensor inside the engine inlet lip.

The system is automatically tested on the ground following the second engine start.

Horizontal Tail Ice Protection System

The Horizontal Tail Ice Protection System (HTIPS) is an Electro-Mechanical Expulsive De-icing System (EMEDS). The system is composed of the De-ice Control Unit (DCU), the Energy Storage Bank (ESB), and 20 actuators (10 per side, 5 top and 5 bottom). The actuators use an electromagnetic field to create a mechanical force that causes small amplitude, high acceleration deflection of the horizontal stabilizer leading edge skin to shatter the ice.

When the TAIL DE-ICE switch is selected to NORM, the system will automatically activate when ice is detected by either ice detector. The system can be manually commanded on by selecting the ON position or be de-activated by selecting the OFF position.

When activated, the EMEDS begins to fire in a 2-minute cycle with 20 seconds of “active firing” and a 100-second period of “dwell” between firings. If operating in the NORM mode, once the ice detected signal is removed, the HTIPS will complete the present cycle and then complete one additional cycleAir Data Probes

Windshield Ice and Rain Protection System
Each windshield has two heating zones (L and R). Each pair of heating zones has a dedicated windshield heat controller. Each zone has two temperature sensors, one for control and one for monitoring. Heating is achieved by sending electrical current through a thin gold film. The windshields are made from hydrophobic material to assist in rain removal.

When the windshield L or R ZONE switch is in the NORM position, the associated zones will be heated in low power mode whenever an engine is running on the ground or in flight. R zones are heated on external power on the ground. When ice is detected by either ice detector in flight, the two inboard zones will operate in a high heat mode. Selecting a switch to OFF disables heating for the associated zones.

If one generator is lost, heating of the L zone of each windshield is disabled.

Ice Detection System
The dual ice detector system is the primary means of detecting icing conditions. One ice detector probe is located on each side of the forward lower fuselage.

An **ICE DETECTED** advisory CAS message posts when either sensor detects icing conditions. If one or more ice protection systems are selected off or are not operational, an **ICE PROT NOT ACTIVE** caution CAS message will post.

Ice Inspection Lights

The aircraft is equipped with a single ice inspection light on the left side of the fuselage. An optional right side ice inspection light is also available. The light will automatically illuminate at night when ice is detected or can manually be commanded on or off. When commanded on, the light illuminates the on-side leading edge of the wing.

Indications

Status of the ice protection systems is provided on the ICE PROTECTION synoptic page

Wing Ice Protection System

WAIV and WAIXV positions are shown on the ICE PROTECTION synoptic page, as are L and R wing temperature. The temperature is normally an average of the inboard and outboard temperature sensor readings but will change to the lowest reading if an under-temperature reading is detected or the highest if an over-temperature reading is sensed. A green leading edge indicates that the system temperature is high enough to provide anti-icing. The leading edge changes to an amber color if the temperature is too low to provide anti-icing or is over-heating. The wing is white when warming up or commanded off.

Engine Inlet Ice Protection System

L and R CAIV positions are shown on the ICE PROTECTION synoptic page, as is inlet temperature. A green inlet indicates that the system is commanded on and the temperature is high enough to provide anti-icing. This is also indicated by a white A/I icon on the EIS. The inlet changes to an amber color if the system is unable to provide anti-icing. A **L(R) ENG ANTI-ICE ON** status CAS message is posted when the system is commanded on.

Horizontal Tail Ice Protection System

HTIPS status is displayed on the ICE PROTECTION synoptic page. The leading edge is displayed in green when the system is operating and amber when failed. The leading edge is white when commanded off.

Windshield Vision Protection System

Each windshield zone is displayed in green on the ICE PROTECTION synoptic page when the heater is active. If the temperature is too low or the windshield overheats, the color changes to amber. The windshield is white when the heater is commanded off.

Air Data Probes Heat System

Each of the probes are displayed in green on the ICE PROTECTION synoptic page when heating is commanded on. The color changes to amber if the probe heat system or the probe itself has failed. The probes are white if the heater is commanded off.

Ice Detection System

Each of the ice detector probes are displayed in green on the ICE PROTECTION synoptic page when commanded on. The detectors are white when commanded off and amber if failed. An ICE DETECTED white icon is displayed when either ice detector detects icing conditions.

Ice Inspection Lights

Commanded state of the wing inspection light(s) is shown on the STATUS page.

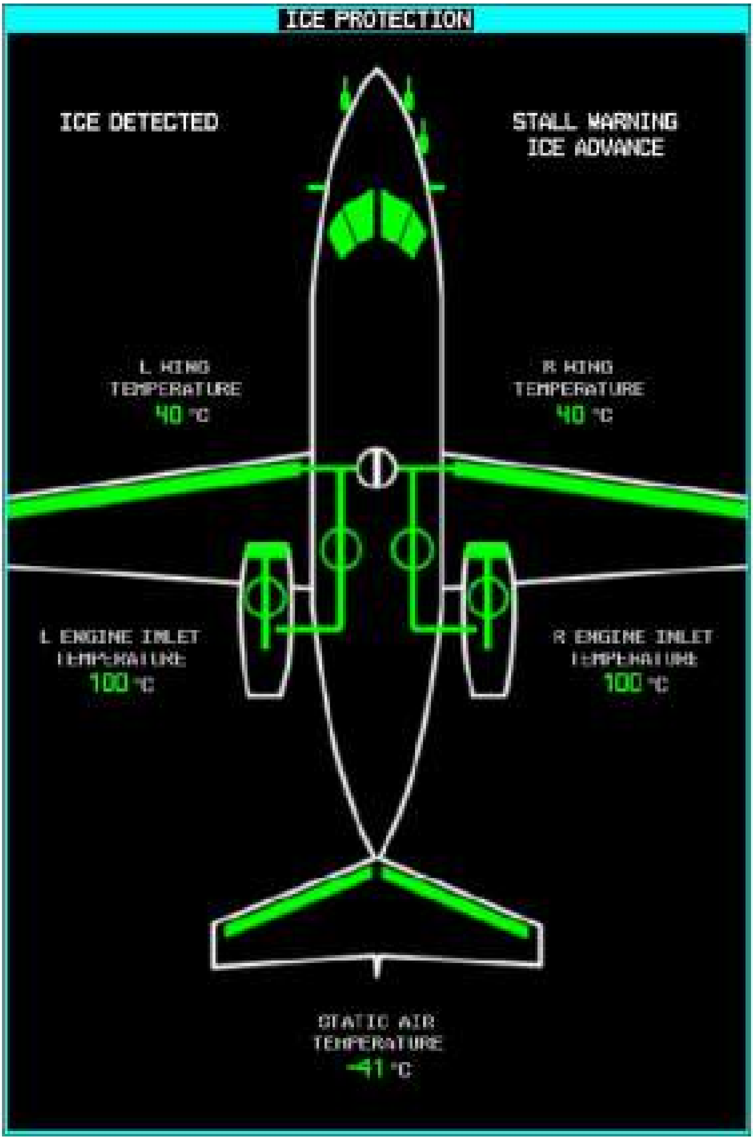

Figure 1-78. Ice Protection Synoptic Page

CAS Messages

Message	Description
L(R) ENG ANTI-ICE FAIL	The engine anti-ice system has failed
ICE DETECT FAIL	Both ice detectors have failed
ICE PROT NOT ACTIVE	Ice detected and one or more protection systems are not active
TAIL DE-ICE FAIL	The tail de-ice system has failed
L(R) PROBE HEAT FAIL	The associated air data probe heater has failed or is not powered
STBY PROBE HEAT FAIL	The standby air data probe heater has failed or is not powered
L-R WING A/I TEMP LOW	The wing anti-ice system is operating at a lower than expected temperature
WING ANTI-ICE FAIL	Wing anti-ice system pre-flight test has failed, wing anti-ice has failed, or wing bleed air leak detection has failed
WING ANTI-ICE FAIL ON	Wing anti-ice system has failed on
L(R) WING ANTI-ICE OVERHEAT	An overheat has been detected in the associated wing anti-ice system
L(R) WING ANTI-ICE TEMP LOW	The affected wing anti-ice system is operating at a lower than expected temperature

Message	Description
WING ANTI-ICE UNAVAIL	Wing Anti-Ice has been selected ON but is unavailable during single bleed operations
L(R) WSHD ZONE FAIL	There is a failure of the windshield zone heat
L(R) WSHD ZONE OVERHEAT	There is an overheat of the windshield zone
CONFIG WING ANTI-ICE	Wing Anti-Ice is active on the ground but wing temperature is less than 10°C
L(R) ENG ANTI-ICE FAULT	A fault has been detected in the affected engine anti-ice system
ICE DETECTED	Ice has been detected
ICE DETECT FAULT	One ice detector has failed
TAIL DE-ICE FAIL ON	The tail de-ice system has failed on
TAIL DE-ICE FAULT	There is a degradation in tail de-icing capability
TAIL DE-ICE OFF	The TAIL DE-ICE switch has been selected OFF
TAIL DE-ICE ON	The TAIL DE-ICE switch has been selected ON
WING ANTI-ICE FAULT	A fault has been detected in the wing anti-ice system
WING ANTI-ICE OFF	WING ANTI-ICE switch selected OFF

Message	Description
WING ANTI-ICE ON	WING ANTI-ICE switch selected ON
WING FLOW FROM L(R)	WING FLOW switch selected FROM L(R)
L(R) WSHD ZONE FAULT	Affected zone unable to select high heat mode
L(R) WSHD ZONE OFF	Applicable windshield zone not activated
L(R) ENG ANTI-ICE ON	Engine anti-ice system has been selected on

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ELECTRICAL

The electrical power system uses a split-bus architecture to power the airplane. The primary source of electrical power is a 28 VDC engine-driven starter-generator on each engine. Each starter-generator is air cooled and rated at 325 Amps. A dedicated Generator Control Unit (GCU) for each starter-generator supplies field excitation, voltage regulation, and protection. The GCUs also supply the control function for the generator line contactors, start contactors, and the bus tie contactor. The aircraft is equipped with two lead-acid batteries. The batteries are rated at 28 Amp hours each, and can start the engines and supply emergency power. An external power receptacle is located on the right side of the forward belly fairing.

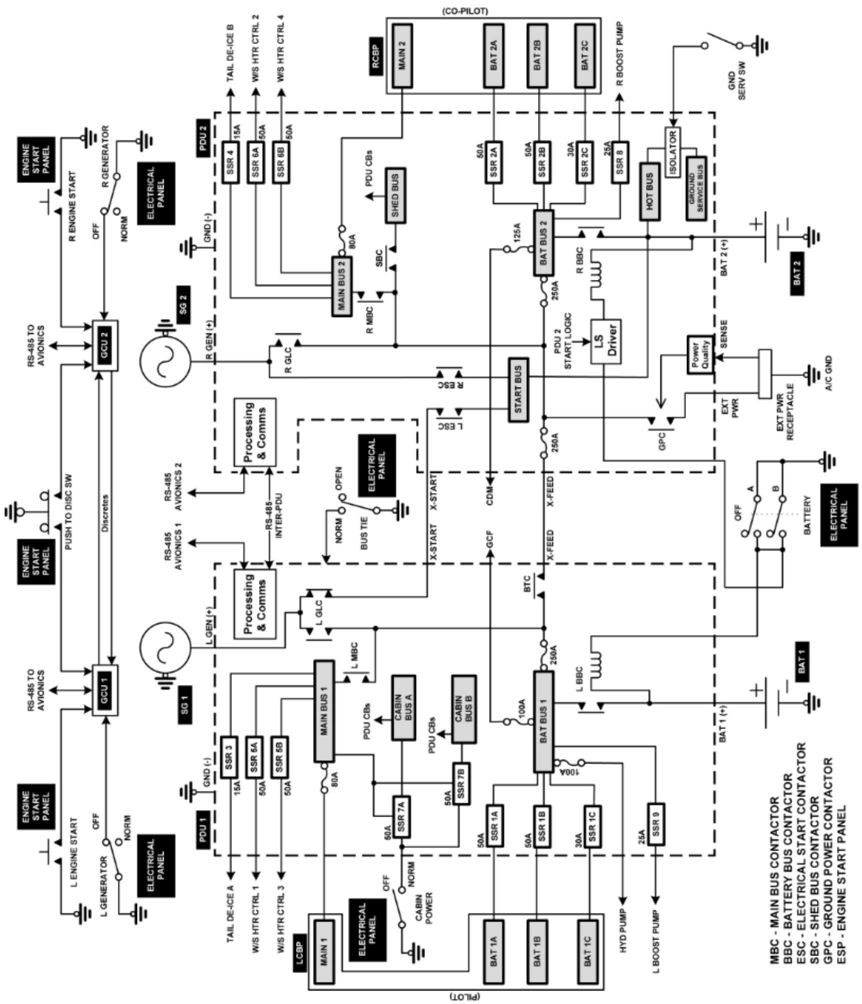

Figure 1-79. Electrical Schematic

Two power distribution units (PDU) perform primary power distribution for the airplane systems. These units contain contactors, solid state relays, and electronic and processor controls. The PDUs also contain circuit breakers that route power to non-essential systems. Essential system circuit breakers are installed on the pilot’s and co-pilot’s circuit breaker panels (CBP) outboard of each crew seat. Additional circuit breakers are mounted on the outboard surface of the PDUs for items that do not require access during flight.

POWER GENERATION AND STORAGE

Starter-Generators

When the ENGINE START button is pushed, the starter-generator engages the starter function and the engine starting sequence is initiated. During start, the bus system isolates the number 2 battery. The loads that are normally powered by the number 2 battery are powered by the number 1 battery through the bus tie contactor. At approximately 50% N_2, the starter disengages and the starter-generator begins operating as a generator. The start sequence can be aborted at any time by pushing the PUSH TO DISC switch.

Selecting the L or R GENERATOR switch to OFF opens the line contactor and isolates the generator from the electrical system. Cycling the switch OFF, then NORM acts as a reset command to the GCU. In the NORM position, the generator will automatically come online whenever it is available except when external power is powering the aircraft.

Batteries

The electrical system includes two lead-acid batteries, each with a 28 Amp-hour design capacity. Batteries are located behind the electrical service doors in the front of the wing-to-body fairing.

The BATTERY switch, when selected ON, connects the batteries to BATT BUS 1 and BATT BUS 2. Both batteries are used in parallel to provide power when both generators are not online.

External Power

The external power can supply 28 VDC to the airplane during ground operations. External power also assists Battery 2 during the first engine start. The second start is assisted by the generator on the operating engine.

LOAD DISTRIBUTION

Solid-state relays (SSR) located in each PDU provide overcurrent protection and control sequencing of loads during engine start, and perform load shed of high power loads in the event that one or both generators go off-line. Tripped SSRs can be reset from the CDU Power page which also shows a list of tripped SSRs.

Other high power loads such as the Ground Cooling Fan (GCF) and the Air Conditioner are powered directly, with discrete signals provided to their respective controllers to enable/disable the associated load depending on power source availability.

Power to cabin system loads is sourced through two Cabin Bus (A and B) SSRs. Selecting the CABIN POWER switch to OFF commands both SSRs open.

Fuses installed in the PDUs are used to protect individual buses and wiring to high power loads.

If a generator is lost the bus tie automatically closes, allowing the remaining generator to power both sides of the electrical system. Cabin A and B and the Shed buses are automatically shed in this case as is the Air Conditioner. Selecting the BUS TIE switch to OPEN forces the bus tie open.

If both generators are lost in flight the Main 1 and 2, Battery 1C and 2C, Cabin A and B and the Shed Bus are automatically load shed.

On battery power only on the ground, the Main 1 and 2, Cabin A and B, and the Shed Bus are not powered.

Main 1 and 2 buses are shed when operating in the Ground Cooling mode.

Cabin Power

The CABIN POWER switch controls power to CABIN BUS A and CABIN BUS B. Cabin lighting, entertainment systems and optional 110 VAC cabin outlets are all controlled by this switch. The outlets are powered by inverters. The single inverter configuration provides three cabin outlets and the dual configuration six cabin outlets. The first inverter is powered by CABIN BUS A and the second inverter is powered by CABIN BUS B. Cabin power outlets can be controlled manually or automatically. In the automatic mode, the outlets are automatically depowered during takeoff and approach and landing.

Indications

Battery bus voltage and generator current are displayed full-time on the ASI. Values are normally displayed in green but change to amber if a limit is exceeded.

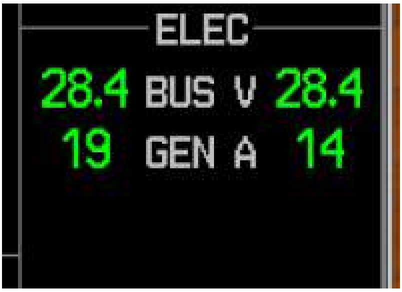

Figure 1-80. Electrical System ASI

A white EXT PWR ON or EXT PWR AVAIL icon is displayed when external power is powering the aircraft or is available to do so.

A white STARTER icon is displayed on the EIS when the starter-generator is operating in starter mode as is a green halo around the START button. The PUSH TO DISC switch illuminates during this condition too.

Status of each individual bus is displayed on the ELECTRICAL synoptic page as is battery bus and generator voltage and generator current. Battery, generator, bus tie and Cabin Bus A contactor status is also displayed. Powered buses are displayed in green color and failed buses in amber.

An external power icon and voltage is displayed whenever the external power door is open.

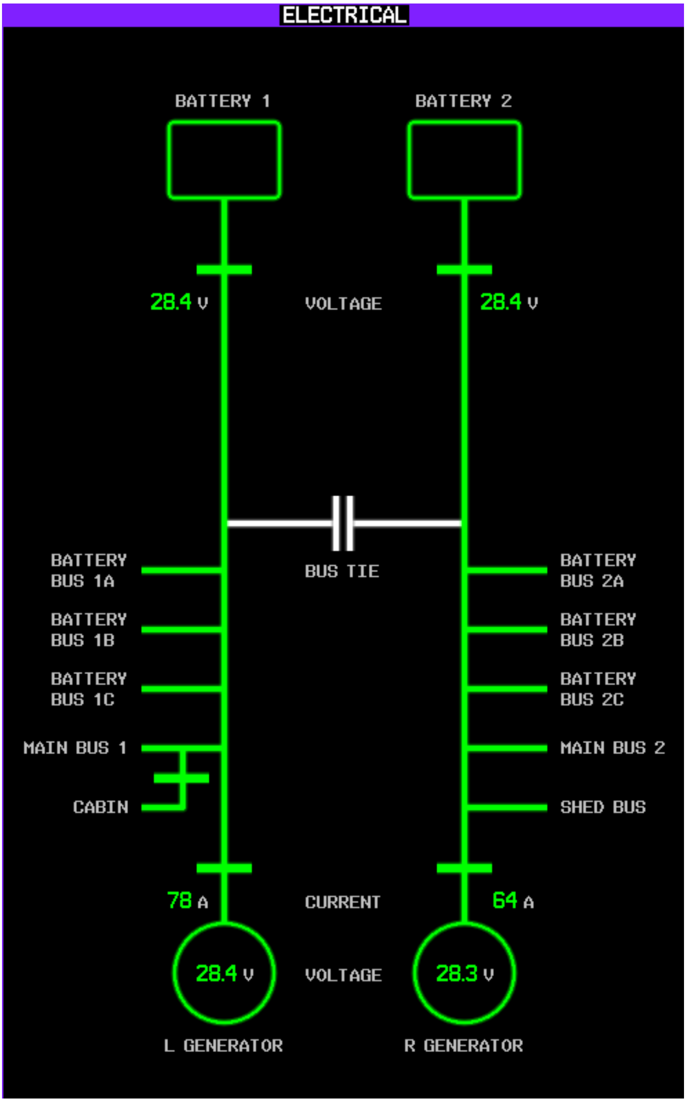

Figure 1-81. Electrical System Synoptic Page

CAS Messages

Message	Description
ELEC EMER POWER	Both generators are off-line in the air, or on the ground with both engines running
BATTERY BUS 1 FAIL	Battery bus 1 is isolated from the aircraft electrical system
BATTERY BUS 1A FAIL	Battery bus 1A has failed or is isolated from the aircraft electrical system
BATTERY BUS 1B FAIL	Battery bus 1B has failed or is isolated from the aircraft electrical system
BATTERY BUS 1C FAIL	Battery bus 1C has failed or is isolated from the aircraft electrical system
BATTERY BUS 2 FAIL	Battery bus 2 is isolated from the aircraft electrical system
BATTERY BUS 2A FAIL	Battery bus 2A has failed or is isolated from the aircraft electrical system
BATTERY BUS 2B FAIL	Battery bus 2B has failed or is isolated from the aircraft electrical system
BATTERY BUS 2C FAIL	Battery bus 2C has failed or is isolated from the aircraft electrical system
BUS TIE FAIL	Bus Tie has failed to achieve required state

Message	Description
L(R) GENERATOR FAIL	The generator has failed
L(R) GENERATOR OVERLOAD	Generator load is above allowable limits
MAIN BUS 1 FAIL	Main Bus 1 has failed or is isolated from the airplane electrical system
MAIN BUS 2 FAIL	Main Bus 2 has failed or is isolated from the airplane electrical system
BATTERY OFF	Battery selected off
BATTERY 1(2) FAIL	The associated battery has failed
BATTERY 1(2) FAULT	A fault has been detected in the battery or charging system, or the battery temperature is too low for charging
BUS TIE OPEN	BUS TIE switch is selected to OPEN
CABIN BUS FAIL	The Cabin bus has failed
CABIN POWER OFF	The Cabin bus has been turned off
L(R) GENERATOR FAULT	Minor generator fault detected
L(R) GENERATOR OFF	The affected GEN switch is selected OFF
POWER OUTLETS MAN ON	Power outlets have been commanded on when auto mode would have commanded them off

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LIGHTING

EXTERIOR LIGHTING

The following external lights are installed:

- Landing lights
- Taxi lights
- Strobe / Anti-collision lights
- Beacon
- Navigation lights
- Ice inspection lights
- Recognition lights
- Logo lights

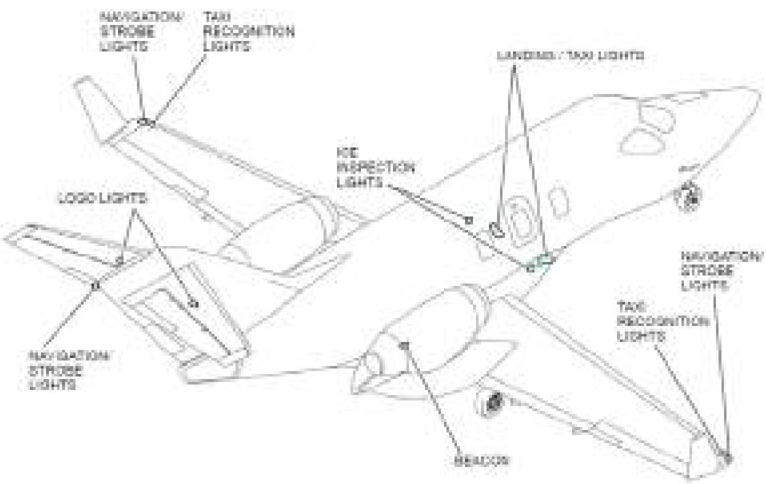

Figure 1-82. Exterior Light Locations

All exterior lights use light-emitting diode (LED) technology. The external lights can be operated in Normal mode or in Manual mode.

In Normal mode, lights are commanded on/off automatically at certain flight phases/time of day by two Aircraft Component Control Units (ACCUs). The normal mode is the default mode and becomes active anytime aircraft power is cycled. Manual mode can be selected for each individual light and on/off status controlled from the CDU External Lights page.

Figure 1-83. External Lights CDU Page

Table 1-2. NORMAL (Automatic) Lighting Conditions

Light	"ON" Condition
Landing	Take-off run and landing roll or in-flight with gear down.
Recognition - Pulsed	In flight and airplane below transition altitude* during dawn to dusk.
Recognition - Steady	In flight and airplane below transition altitude* during dusk to dawn.
Taxi	Parking brake not set, on ground at low speed.
Strobe	Take-off run or in-flight.
Navigation	Dusk to dawn.
Ice Inspection	In flight below transition altitude or when ice is detected during dusk to dawn.
Beacon	At least one engine running.
Logo	On ground or in-flight below transition altitude during dusk to dawn.

***If transition altitude alert is active, or below 18,000 feet.

Landing Lights
The landing lights are two-function lights which are installed behind a lens in the forward belly fairing under the fuselage.

Recognition Lights
The Recognition lights are located in the outboard leading edge of each wing. The airborne recognition lights can be operated in steady or pulse mode.

Taxi Lights
The taxi lights are located in the outboard leading edge of each wing. One-third of the landing light also illuminates when taxi lights are on.

Strobe / Navigation Lights
Strobe and Navigation light assemblies are located on the outboard leading edge of each wing. A Tail Strobe and Navigation light assembly is located on the aft top portion of the vertical stabilizer.

Ice Inspection Lights
A Wing Ice Inspection light is located on the left upper mid-belly fairing. An optional right side light is also available.

Beacon Light
A ground recognition Beacon light is located on the mid-aft belly.

Logo Lights
The optional Logo lights are located in each of the lower surfaces of the left-hand and right-hand horizontal stabilizer and provide illumination of the vertical stabilizer.

Indications

Commanded state of each light is displayed on the STATUS synoptic page. Indications are magenta if in the Normal mode and cyan if in the Manual mode.

Figure 1-84. STATUS Page Exterior Lights Section

CAS Messages

Message	Description
EXT LIGHTS MAN OFF	Some external lights have manually been selected OFF when automatic logic had determined they should be on
LIGHTING CONTROL 1(2) FAIL	The associated lighting controller has failed

INTERIOR LIGHTING

The following interior lights are installed:

- Pilot and co-pilot map light
- Cockpit overhead light
- Cockpit footwell lights
- Instrument panel lights
- Entry / overhead lights
- Sconce lights
- Wash lights
- Table and Reading lights
- Lavatory Overhead / Lavatory Task* / Cabinet lights
- Aft / Forward Baggage lights
- Cabin logo lights*

** Indicates lights that may be optional or are part of an optional package*

All interior lights use light-emitting diode (LED) technology.

Cockpit Lighting System

Instrument panel lights and display brightness controls are part of the integrated cockpit interior lighting system. Panel backlighting and display brightness are automatically adjusted based on ambient light using built-in light sensors. Brightness can also be adjusted using the Master brightness control on the CDU Lighting Configuration page. In addition, controls to adjust the brightness bias of each display as well as for two control panel backlighting zones are available by selecting the Backlight calibration button. The Light Mode button allows for toggling the switch-lights between a day and a night mode.

Switch-lights can be tested using the Switch Illum. button on the System Tests page.

Figure 1-85. CDU Lighting Configuration Page

A Cockpit Overhead light is positioned in the ceiling and provides general illumination for the cockpit. The light can be switched on or off and brightness can be adjusted through the CDU Interior Lights page. This page also allows for toggling the Pilot and Co-Pilot Footwell lights on or off.

420POM01_3134A

Figure 1-86. CDU Interior Lights Page

Cockpit Pilot and Co-Pilot Map lights are positioned over their respective seat. Each light is equipped with an on/off switch and a brightness slider control.

Cabin Lighting System

The Cabin Lighting Switch Panel provides centralized control for most cabin lights. Reading lights and Table lights are controlled by switches located with the lights.

Four lighting schemes can be selected by dedicated switches on the Cabin Lighting Switch Panel: Entry, Cabin, Accent, and Night.

Figure 1-87. Cabin Lighting Switch Panel

A 'blue halo' effect illuminates around the selected icon while a user input is detected.

Entry – switches the Entry Overhead light on/off.

Cabin – controls the cabin Wash lights. Additional presses of the Cabin switch will cycle the brightness of the Wash lights between 100%, 66%, 33% and OFF.

Accent – switches the Right-Hand Cabinet light, the Sconce lights, the Cabin Logo lights (if installed), and the Lavatory Task lights (if installed) on or off.

Night – switches the Entry Overhead Halo light, the Sconce Halo lights, and the Table Halo lights on/off. When the Night lighting scheme is activated, it extinguishes the lights controlled by the other three switches.

A cabin entry light is positioned in the ceiling centered above the Main Entry Door area of the aircraft. The Cabin Entry Overhead Light will be on for 10 minutes when the Main Entry Door is opened. The timer can be reset for 10 minutes by activating the switch located on the entry area sidewall. The light will be off when the door is closed unless commanded on by the lighting control panel in the forward RH cabinet.

Backlit, illuminated ‘No Smoking’ and ‘Fasten Seat Belts’ and Lavatory ‘Return to Seat’ signs are provided. These are selected on/off from the CDU Interior Lights page

AVIONICS AND AFCS

AVIONICS

The avionics system is built around a three-display Garmin® G3000® system. The system includes three, 14-inch landscape GDU 1400 screens configured as two Primary Flight Displays and one Multi-Function Display.

A detailed description of the avionics system can be found in the Garmin® G3000® Integrated Avionics System Pilot’s Guide for the HondaJet HA-420.

Figure 1-88. Cockpit Layout

The functions of communication and navigation are integrated into two Integrated Avionics Computers 1 and 2 (IAC) with data presented on the PFDs and MFD, and control through two Control Display Units (CDUs).

Dual VHF Com radios, dual VHF Navigation radios (VOR, ILS, and Marker Beacon), and dual WAAS GPS receivers are included.

Each PFD consists of a Primary Flight Display and a Display Pane. The MFD has two individual Display Panes or one full screen Display Pane, an Engine Indication System (EIS)/Aircraft System Indications (ASI) display area and a Status Bar which presents eight pilot-selectable navigation information parameters.

The PFDs display data for the capabilities that follow:

- Critical Flight parameters (Altitude, Airspeed, Attitude, and Heading)
- Crew Alerting System (CAS) messages
- Automatic Flight Control System (AFCS) Modes and Annunciations
- Navigation Data
- Optional Synthetic Vision

The Display Pane displays data for the capabilities that follow:

- Moving Map
- Aircraft System Synoptic pages
- Weather Radar
- TCAS
- TAWS
- Weather Data Link
- Electronic Checklist
- Charts
- Documents

The CDUs are used for systems navigation, data entry, and data retrieval tasks. The CDU incorporates a color display, hard controls, and an infrared touchscreen as the primary means for system control and data entry.

The CDUs provide integrated control of functions, including:

- Radio Tuning
- Audio System Control
- Display Pane Control
- FMS Function Control
- Transponder Control
- Weather Radar Control
- System Control
- Navigation Control
- Avionics Settings
- Planning Tools
- TAWS Control
- TCAS Control
- Weather Data Link Control (Optional)
- Charts Control
- Checklist Control
- Controller Pilot Data Link Communication (CPDLC) (Optional)

The raised bezel outboard, below, and between the CDUs provide hand rest locations for use by pilots for hand stabilization while making inputs via the touchscreen.

A number of the avionics settings can be saved as a pilot profile that can be activated at any time.

Initialization

When the system powers up, the MFD will present a splash screen with status of all databases that will have to be acknowledged before the display can be used. After the acknowledgement, the MFD will display the STATUS synoptic page and a Map in the Display Pane. The PFD Display Panes will display the checklist and both CDUs will display the Initialization page. The Initialization page will guide the pilot through setting up the avionics for flight and includes the following items:

- System Tests
- Weight and Fuel
- Flight Plan
- V-speeds
- Pilot Profile

Aircraft System Data

Essential information related to the Engines, Fuel, Cabin Pressure, Electrical Power, Landing Gear, Speedbrake, Flaps, and Trim Positions are displayed on the ESI / ASI area of the MFD.

Measured values are normally displayed in green but change color to amber or red as appropriate if there is an exceedance. Text and graphical icons are displayed in white with the exception of the engine rating icons that are cyan in color. Loss of data is indicated by amber dashes (values) or amber X (graphical elements). See each system description section for more detail.

Certain items automatically de-clutter based on system state or phase of flight.

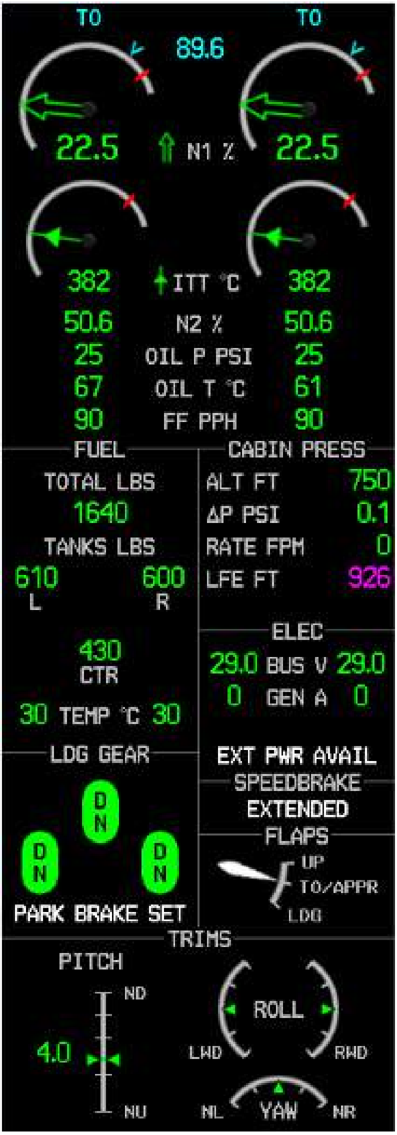

Figure 1-89. EIS / ASI Data Layout

Reversionary Mode

A reversionary display mode is activated automatically if a display failure is detected. The Reversionary display mode presents a PFD next to a condensed version of the EIS/ASI over the top of a condensed Display Pane.

	PFD1 State	MFD State	PFD2 State
PFD1 Offline	--	Reversionary	Normal
MFD Offline	Reversionary	--	Normal
PFD2 Offline	Normal	Normal	--

Figure 1-90. Automatic Display Reversion Logic

Reversionary mode can also be manually activated by pushing the DISPLAY REVERSION switch on the Pilot or Co-Pilot Annunciator Panel. Pushing the Pilot's switch forces PFD 1 and the MFD into reversionary mode; pushing the Copilot's switch forces the PFD 2 into Reversionary mode.

Figure 1-91. PFD Reversionary Mode

Crew Alerting System

The crew alerting system presents visual, aural and tactile alerts triggered by signals or groups of signals sent by the monitored systems. Alerts are indicated by use of PFD flags or CAS messages presented in a dedicated window on the lower right of each PFD.

CAS Messages

CAS messages are divided into warning messages (red), caution messages (amber), advisory messages (cyan), and system status (white) messages based on urgency. Warning and caution messages also trigger the Master Caution/Warning light. These messages flash between normal and reverse video until acknowledged by pressing the Master Caution/Warning switch. Advisory and status messages also flash when first presented but self-acknowledge after five seconds. CAS messages remain posted as long as the condition is true.

CAS Acknowledgement

Certain warning level alerts are accompanied by an aural alert. In some cases these can be silenced, or the repeat rate be reduced, by pressing the master caution/warning switch. Aural alerts can also be annunciated for certain conditions that are associated with an exceedance or PFD flags rather than a CAS message.

Phase Inhibits

Certain caution and advisory CAS messages are suppressed during critical phases of flight (takeoff and landing). If the condition is still true when exiting the phase of flight, the message will post at that time.

Takeoff Configuration Warning

Under the following conditions, a “TAKEOFF CONFIG” warning will alert when thrust levers are advanced for takeoff while on the ground:

- If the aircraft flaps, speedbrake, parking brake, or trims are not configured in an approved takeoff position, or
- If the wing anti-ice temperature is below the normal operating temperature with the system selected ON.

An advisory message will post when the parking brake is released and the aircraft is on the ground. The message will not post until deceleration is below 40 knots during the landing rollout.

CDU Messages

Certain operational and minor avionics system alerts are displayed as CDU messages. When a message is posted, an “M” is displayed on the PFD and at the bottom of each CDU. Selecting the CDU button displays a page where the message can be viewed. A similar scheme is used for data link communication, such as CPDLC.

Primary Air Data and Temperature

In addition to the basic air data parameters, two Multi-function Air Data Probes also provide angle of attack (AoA) data for the Stall Warning/Protection System (SWPS). On-side air data and attitude/heading data are normally displayed on each PFD. If one air data source is lost, data from the other is automatically displayed. Cross-side data can also be selected manually using the PFD soft keys.

When both PFDs are displaying data from the same source, or if cross-side data is used, an annunciation is provided on the PFDs. A flag is also posted if there a miscompare between the two air data systems.

Barometric pressure setting is adjusted using the BARO SET knob and is displayed below the altimeter tape. Barometric pressure units are selectable, through the CDU, in inches of mercury (in Hg) or hectoPascals (hPa).

Airspeed/Mach and altitude bugs can be set using the SPD and ALT knobs on the Mode Control panel.

Temperature data is provided by two Total Air Temperature sensors in each engine. Static Air Temperature and deviation from ISA temperature are displayed in the lower left of each PFD.

Primary Attitude and Heading Data

Two primary GRS 77 AHRS units slaved to dual GMU 44 magnetometers provide aircraft attitude and stabilized magnetic heading data. Each AHRS uses inputs from one Magnetometer, one air data input, and both GPS data inputs. On-side AHRS data is normally displayed on each PFD. If one AHRS source is lost, data from the other is automatically displayed. Cross-side data can also be selected manually using the PFD soft keys.

When both PFDs are displaying data from the same source, or if cross-side data is used, an annunciation is provided on the PFDs. A flag is also posted if there a miscompare between the two AHRS systems.

A heading bug can be set using the HDG knob on the Mode Control panel.

Standby Instrument

The standby instrument is an integrated solid state system displaying altitude, airspeed/Mach, attitude and heading information. Data from a dedicated standby air data probe, built in AHRS sensors and magnetometer is used. ILS/BC navigation data from VHF NAV 1 can also be displayed.

Figure 1-92. Standby Display

Barometric correction can be set using a bezel mounted rotary knob. Pushing the knob selects standard baro. Barometric units (inches of Mercury or hectoPascals) can be selected via a HP/IN bezel button.

The V_{MO}/M_{MO} limits are indicated by a red thermometer-type overspeed strip on the airspeed tape.

ILS or BC navigation data from VHF NAV 1 can be selected for display using the NAV button.

In the event of a dual failure of both primary AHRS and/or ADC systems, the Standby system can provide attitude/heading or air data information for display on the PFDs.

System Synoptic Pages

Six system synoptic pages can be selected for display on any Display Pane using the Aircraft Systems button. Flow lines are displayed in white when not powered, green when powered and amber or red when a limit is exceeded. Controls (for example, valves and pumps) are displayed in white when closed/passive and green when open/active. The color changes to amber if the control has failed. Similarly measured values are normally displayed in green but change color to amber or red as appropriate if there is an exceedance. Loss of data is indicated by amber dashes (values) or amber X (graphical elements).

The available pages are:

STATUS – displays pre-flight data including fluid/fuel quantity as well as door status and commanded state of exterior lights.

ENVIRONMENTAL – displays status of the bleed air and environmental systems including valve states, pressure / temperature readings and air conditioner/ground cooling fan running status. Oxygen quantity is also displayed.

ELECTRICAL – displays status of electrical buses, contactors, batteries, generators as well as voltage/current readings.

FUEL – displays status of fuel flow, tank quantities, and valve/pump state and temperature/pressure readings.

HYDRAULICS – displays status of the hydraulic system including quantity, pressure and pump running status.

ICE PROTECTION – displays status of the ice protection systems including valve status, temperature readings and heater status as well as ice detected status.

Figure 1-93. Systems Synoptic Pages

System Control Pages

A Systems Control page is available on the Aircraft Systems page or by pressing the SYSTEM CONTROL button mounted on each yoke. Pressing the SYSTEM CONTROL button a second time returns the CDU to the previously displayed page.

The available system control pages are:

Power Control – allows display and reset of tripped Solid State Relays (SSR). Manual or automatic operation mode for the optional cabin power outlets can also be selected.

Engine – allows for de-selection of the automatic engine synchronization mode.

Landing Field Elev. – allows for selection of automatic selection of landing field elevation (LFE) from the FMS destination or manual entry of the LFE.

Exterior Lights – allows for selection of automatic mode or manual control of the exterior lights.

Interior Lights – allows for switching of cockpit lights and ordinance signs.

Lighting Config. – allows for dimming of overall display/panel brightness and toggling of day/night mode for switch-lights. A sub-page can also be selected where brightness bias for each display and two panel backlighting zones can be set.

CVR Erase – allows for the optional CVFDR to be erased if the parking brake is set.

Thermostat – allows for selection of cockpit and cabin temperature set point. Also allows for selection of manual fan control and ECS modes. Additional controls are presented when these manual modes are active. Control of cabin temperature/fan speed can be enabled as can the ground cooling mode.

Stall Warn Ice Advance Reset – resets the approach reference speed (green donut) and the stall protection system angles to baseline values. The button is greyed out in icing conditions.

Figure 1-94. Systems Controls Page

Figure 1-95. Individual Systems Control Pages

System Tests Pages

A System Tests page is available on the Aircraft Systems page or through the Initialization page. This page allows activation of several pilot initiated tests.

A Preflight Test button commands the system to run all the tests in a sequential manner. During test execution, status is shown as In Progress on the respective button as well as in the Test Status box at the top right corner of the page.

At completion, the button for each test indicates result of the test. Tests that require a pilot evaluated condition (Fire Detection Illumination, Stall Protection, and Switch Illumination) indicate "Done" when the test sequence has run to completion and all associated automated steps passed.

If any automated steps fail, "Fail" will be indicated. If the test does not require any pilot evaluation (Optional CVFDR Test), "Pass" or "Fail" will be indicated at the completion of the test.

NOTE The Test Status box will also indicate execution of automatic system initiated tests. Pilot initiated tests cannot be executed when a system initiated test is already running.

The available tests are:

- Fire Detection
- Stall Protection
- Switch Illumination
- CVFDR (optional, if CVFDR is installed). This test is not included in the automated Preflight sequence.

Figure 1-96. System Tests Page

Communication Systems

VHF Communication

Dual digital-tuning VHF Com radios are provided. Tuning, selection of active radio and volume/squelch control is made using the CDU touch-screen or control knobs. If availability of both CDUs should be lost, both radios are automatically tuned to 121.500 MHz.

Two push-to-talk (PTT) switches are provided for each crew member, one on the yoke and one on the glareshield.

In addition to the headset and oxygen mask microphones, an always active, hand-held microphone is mounted on each control column. The hand-held microphone input is separate from the headset/oxygen mask input.

If a microphone is activated for more than 35 seconds, that input will be disabled and a “stuck mic” alert posted.

Intercom

A Pilot/Copilot intercom enables the crew to communicate with each other. The intercom function can be selected off through the CDU Intercom page where individual volume and squelch adjustments are also available.

Cockpit Speakers

The cockpit speakers can be selected on/off and volume adjusted using the on-side CDU Audio & Radios page.

Controller Pilot Data Link Communication

Controller Pilot Data Link Communication (CPDLC) using a third digital VHF radio is available as an option. Logon and communication is through the CPDLC CDU page. A PFD and CPDLC CDU message icon is posted whenever a message is received.

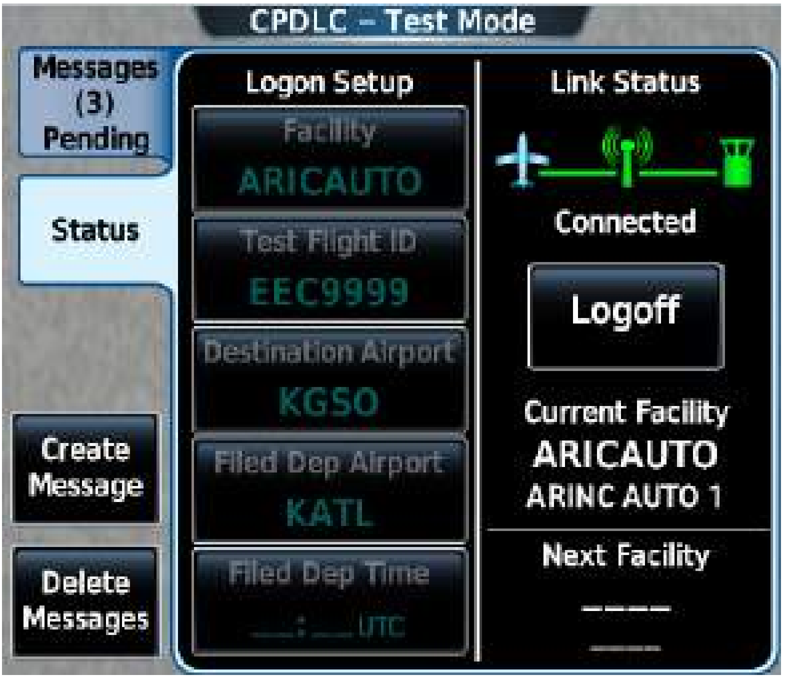

Figure 1-97. CPDLC CDU Page

SatCom (Iridium) Telephone (Optional)

The optional SatCom telephone provides for air-ground, world-wide communications through the Iridium satellite constellation. The pilot speaks and listens through the headset, and initiates and terminates calls through the CDU. The Iridium system is also used to provide weather data for the optional Garmin Connext™ weather data link.

Navigation Systems

Display of primary navigation data is through a CDI on each PFD. Navigation source can be selected using PFD soft keys. A Navigation Status Box located next to the CDI displays current data.

Two bearing pointers can be selected to FMS, either VHF NAV or the optional ADF and overlaid on the CDI. When selected, the associated data is displayed below the CDI.

VOR, ILS/Marker Beacon

Dual VOR, ILS/Marker Beacon receivers are installed. Tuning and control is done through the CDU Audio & Radios page. Automatic tuning can also be accomplished by the FMS. Course can be selected using the CRS knobs on the Mode Control panel.

In addition to aural tones, marker beacon activation is visually indicated on the PFD and on each CDU in the upper left corner. Pushing the CDU indication removes the indication and silences the tone.

GPS-based Navigation

Dual WAAS GPS receivers are installed. GPS data is also used by the FMS and several other aircraft systems. A GPS status page can be displayed, using the CDU, on any Display Pane.

The Flight Management and Planning functionality provide guidance information for departure, enroute, and arrival/approach flight operations. Area navigation is GPS-based. Flight plans can be created, edited and stored using the CDUs. The navigation database contains departure, arrival and approach procedures that can be loaded into the flight plan.

The system also allows the pilot to view trip planning information, fuel information, and other information for a specified flight plan or flight plan leg based on current measured data, or based on manually entered data.

Flight plan data is overlaid on the navigation map.

Automatic Direction Finder

The optional Automatic Direction Finder (ADF) provides the capability to determine direction to non-directional beacons or AM broadcast stations operating in the 190 to 1799, 2088 to 2094, 2179 to 2185 kHz frequency ranges and is offered as optional equipment. Data can be displayed as a bearing pointer on the CDI. Tuning and control is via the CDUs.

Distance Measuring Equipment

The optional single DME can display DME distance for either VHF Navigation unit or for a different frequency using a “hold” function. DME information is displayed in the PFD Navigation block and selection and tuning is done through the CDU.

Radio Altimeter

Data from the optional single Radio Altimeter is displayed on the PFD, when the height is between 0 and 2,500 ft. Minimums alert may be selected based on radio altimeter height in which case the selected height is displayed on the PFD as is rising terrain symbology on the altitude tape.

Radio Altimeter data is also used by the optional TAWS A and TCAS II systems.

Surveillance Systems

Diversity Capable Mode S Transponder

The GTX 33D ES Mode S Diversity Transponder provides Mode A, C, and S capabilities for ATC and TCAS I surveillance requirements as well as Extended Squitter for ADS-B Out functionality.

Mode selection, code and flight ID entry is performed through the CDU. IDENT function can be activated through the CDU or via the IDENT switch on each yoke. The transponder powers up in an automatic mode that will automatically select ground mode on the ground and the highest available mode when in flight.

If the optional second transponder is installed, selection of the active transponder is done through the CDU. If the active transponder fails the other unit is automatically activated.

A GTX-3000 single or dual transponder is installed if the optional TCAS II system is installed. The alternate unit is controlled in the same manner and supports the same modes as the baseline unit.

Traffic Collision Avoidance System I (TCAS I)

The TCAS I system provides collision avoidance information from other suitably-equipped aircraft within the reception range.

Traffic information can be displayed on a dedicated Display Pane or as an overlay on the Map page. If the optional Synthetic Vision PFD feature is installed, traffic will also be displayed on the PFD using similar symbology. TCAS control is through the CDUs.

Traffic Collision Avoidance System II

The optional TCAS II system provides Resolution Advisories (RA) in addition to the information provided by the baseline TCAS I system. When a RA is encountered, fly-to and avoid instruction are provided visually on the PFD as well as aurally.

Emergency Locator Transmitter

The Emergency Locator Transmitter is an Automatic Fixed COSPAS-SARSAT ELT two-frequency transmitter. The ELT can be activated either automatically when the LRU detects a high-G impulse (via an internal shock sensor), or manually (via either a switch mounted on the transmitter housing, or via a Remote Control Panel).

The ELT receives GPS position data, which (along with aircraft identification data) is transmitted when the unit is activated, from the Integrated Avionics units.

Selecting the ELT switch to the ‘ON’ position begins ELT transmissions. In the ‘NORM’ position ELT will begin transmitting upon detection of an activating impact by the G sensor. The ‘RESET/TEST’ position is used to reset the unit, and to stop transmission, in case of unintentional activation; or to initiate unit self-test.

The red light provides an indication of the working mode for the ELT. After the self-test: a series of short flashes indicates that the self-test failed, and one long flash indicates that the self-test passed. In operating mode: periodic flashes occur during emergency frequency (121.5 MHz) transmission, and a long flash occurs during satellite (406 MHz) transmission.

Cockpit Voice and Flight Data Recorder

An optional Cockpit Voice and Flight Data Recorder (CVFDR) digital recorder records cockpit area microphone, pilot and copilot microphone as well as selected aircraft data. There are 120 minutes of cockpit voice recording and 25 hours of flight data recording provided. A bulk erase feature is available through the CDU when the parking brake is set.

An internal Recorder Independent Power Supply (RIPS) provides ten minutes of backup power when all primary power is lost.

Weather and Terrain Awareness Systems

Weather Radar

A Garmin GWX-70 digital color Weather Radar provides real-time weather imagery. Weather data can be displayed on a dedicated weather radar page or as an overlay on the Map page. Control is provided via the CDUs. The weather radar incorporates a 12-inch phased array antenna.

The system provides selectable scan (up to 120 degrees). Pitch-and-roll stabilization is provided. A side-view vertical scanning function enables profiling of storm tops, gradients, and cell buildup activity at various altitudes. The weather radar is automatically set to Standby upon landing.

Ground clutter suppression and turbulence detection modes are offered as options.

SiriusXM® Weather Data Link

An optional SiriusXM® Weather Data Link provides weather and Temporary Flight Restrictions (TFR) information as well as digital audio entertainment in the United States. Weather/TFR information can be displayed on a dedicated page or as an overlay on the Map page. Control is through the CDUs.

Audio entertainment is available at each crew station when on the ground with engines not running or in flight above 20,000 feet. Channel selection and volume control is via the CDUs.

A subscription to the SiriusXM® Satellite Radio service is required to enable SiriusXM® capability.

Connext™ Weather Data Link

The optional Connext™ weather data-link uses the Iridium based Data Link system to provide weather and Temporary Flight Restrictions (TFR) information throughout most of the world. Weather information can be displayed on a dedicated page or as an overlay on the Map page. Control is provided via the CDUs.

A subscription to the Connext™ service is required to enable the data link capability.

Terrain Awareness and Warning System B

A standard Terrain Awareness and Warning System (TAWS) B provides terrain awareness and alerting based on a terrain database. Terrain information can be displayed on a dedicated page or as an overlay on the Map page. Terrain information is also displayed on the PFD when the optional synthetic vision system is installed. Control is provided via the CDUs.

The optional TAWS A system provides additional alerting based on onboard sensors. Display and control is the same as the baseline TAWS B system.

Windshear
An automatic reactive windshear detection system provides aural alerts and PFD flags when a windshear is detected.

Synthetic Vision
The optional Synthetic Vision Technology (SVT) system provides additional awareness of the aircraft position with respect to terrain. The Synthetic Vision Technology system consists of depictions of terrain, traffic, obstacles, and a Flight Path Marker on the PFD.

Electronic Flight Bag Functions

FliteCharts
Garmin FliteCharts® provides high resolution equivalents to paper charts. It has full color capability and shows current aircraft position on charts that are to scale. The database requires an active subscription and includes published arrivals, departure procedures, airport diagrams, and approaches.

Jeppesen Chartview
The optional Jeppesen Chartview offers the same functionality as FliteCharts but with Jeppesen charts.

Electronic Checklists
Checklists can be displayed on any Display Pane and checklist items or sections can be selected and de-selected. Selection of checklist items or checklist sections can be accomplished using the CDU controls or by a scroll wheel control on each yoke. Pushing the wheel displays the checklist on the on-side PFD Display Pane. Rotating the scroll wheel

moves a selection box up/down on the display. Pushing the scroll wheel with the checklist displayed selects/de-selects the highlighted checklist item.

Pushing the scroll wheel for more than 2 seconds removes the checklist and restores the previously displayed page on the PFD Display Pane.

SafeTaxi

The optional SafeTaxi provides additional airport detail including designated Hot Spots when the Map is zoomed in. The function requires an active database subscription.

SurfaceWatch™

The optional Garmin SurfaceWatch™ feature provides crew alerts during takeoff and landing to notify the flight crew of critical situations, such as runway incursions and overruns. An information window in the PFD contains runway and taxiway information that dynamically updates as the aircraft moves through the airport environment.

Document Viewer

The Document Viewer function allows viewing of company and operator provided documents on a Display Pane.

Maintenance and Diagnostics

The Integrated Avionics System provides a Central Maintenance function that collects aircraft system data related to predefined operational events, failures and CAS messages; as well as data required for routine aircraft maintenance and troubleshooting from the set of data present in the Integrated Avionics System.

CAS Messages

Message	Description
AHRS 1(2) FAIL	The associated AHRS unit has failed
AIR DATA 1(2) FAIL	The associated air data computer is not providing proper data
L(R) AUDIO FAIL	The intercom and associated speaker, handmic, and oxygen mask mic have failed
AVIONICS COMPUTER 1 FAIL	Avionics computer 1 has failed
AVIONICS COMPUTER 2 FAIL	Avionics computer 2 has failed
CPDLC FAIL	The CPDLC has failed
DATA ACQUISITION 1 FAIL	Data Acquisition Unit 1 has failed
DATA ACQUISITION 2 FAIL	Data Acquisition Unit 2 has failed
DATA ACQUISITION 3 FAIL	Data Acquisition Unit 3 has failed
DATA CONCENTRATOR 1 FAIL	Data Concentrator 1 has failed
DATA CONCENTRATOR 2 FAIL	Data Concentrator 2 has failed
TRANSPONDER MODE	The transponder is not in ALT mode while airborne
ADF FAIL	The Automatic Direction Finding system has failed
ADS B OUT 1(2) FAIL	The ADS-B Out function has failed

Message	Description
AIR DATA 1(2) FAULT	The affected air data probe is operating in a degraded mode Some minor degradation in air data may be experienced under certain flight conditions
AVIONICS CONFIG	The avionics software/hardware configuration is not correct for the aircraft
AVIONICS FAULT	One or more avionics components are reporting a need for maintenance One or more displays may be dimmer than usual
COM 1(2) TEMP HIGH	Affected radio reporting a high internal temperature – effective range may be reduced
CONFIG BRAKE	Parking brake pressure is greater than 175 psi with the parking brake not set
CONFIG FLAP	Flaps not set to the correct takeoff position
CONFIG PITCH TRIM	Pitch trim not set in the takeoff band
CONFIG SPEEDBRAKE	Speedbrake not in the takeoff position
CPDLC TEMP HIGH	The CPDLC radio is reporting a high internal temperature – effective range may be reduced
CVR FAIL	The Cockpit Voice Recorder has failed
DME FAIL	Distance measuring equipment has failed

Message	Description
FDR FAIL	The Flight Data Recorder has failed
GLIDE-SLOPE 1(2) FAIL	Affected glide slope has failed
L(R) MIC STUCK ON	Associated handmic or PTT switch is stuck on
MAINTENANCE MODE	The avionics system is in maintenance mode
SATCOM FAIL	Satellite Communication system has failed including Connext™ Weather, or there has been a failure to receive data correctly during an update
STBY AIR DATA FAIL	Standby instrument air data computer is not providing proper data
STBY AHRS FAIL	The standby AHRS has failed
SURFACEWATCH FAIL	SurfaceWatch™ has failed
TRANSPONDER 1(2) FAIL	The associated transponder has failed
WEATHER RADAR FAIL	The weather radar has failed
WINDSHEAR FAIL	The windshear function has failed
XM DATALINK FAIL	SiriusXM® Datalink Weather and Music is failed or data is missing
SURFACEWATCH INHIBIT	SurfaceWatch™ is inhibited

AUTOMATIC FLIGHT CONTROL

A digital Automatic Flight Control System (AFCS) is integrated within the System avionics architecture.

The AFCS includes the following:

- Flight director
- Two-axis digital flight control autopilot
- Manual Electric Trim (MET) for all three axes
- Auto-trim for pitch axis
- Stall Warning/Protection
- Yaw Damper/Turn Coordinator
- Rudder Bias
- Cruise Speed Control (CSC).

A dedicated Flight Mode Annunciator (FMA), area on the top of each PFD, shows both active and armed flight director modes as well as engage status of autopilot, yaw damper, rudder bias and CSC functions.

Figure 1-98. Flight Mode Annunciator (FMA)

All AFCS functions can be temporarily disabled / disconnected by depressing the AFCS/TRIM MASTER switch mounted on each control yoke. Each servo can be de-powered using the SERVO POWER panel switches.

Flight Director

The flight director function displays pitch and roll targets, based on the selected mode and sensor data, on the Primary Flight Display. The AFCS Mode Controller panel is used to select flight director modes. Active modes are displayed in green with the lateral mode to the left and the vertical mode to the right. Armed modes are displayed in white below the active mode. Dual-Cue and Single-Cue flight director presentation may be selected via the CDUs.

Flight Director (FD) Buttons on the Mode Controller activate/deactivate the selected onside flight director. The flight director button turns on the flight director in the default pitch and roll modes if no modes were previously selected. If the autopilot is engaged, the flight director button function is inhibited. If the autopilot is not engaged, removing the command bars on both sides will also remove all flight director modes.

A low bank mode is automatically selected at high altitude or can be activated manually using the BANK button. Low bank mode is indicated by a green band on the top of the attitude indicator.

PFD1 or PFD2 data can be used by the FD and is selected using the CPL button. Active PFD is indicated by a green arrow in the FMA.

The following FD modes are available:

Navigation

The navigation mode is selected using the NAV button and couples the lateral axis to the selected navigation source.

Heading

The heading mode is selected using the HDG button. When engaged the flight director will acquire and hold the selected heading.

Altitude

The altitude mode is selected using the ALT button and will cause the FD to hold the altitude at the time of activation.

The ALT mode is also automatically armed when another vertical mode is active. When approaching the selected or VNAV altitude the altitude will automatically be captured and the ALT mode activated.

Vertical Navigation

The vertical navigation mode is armed using the VNV button. When the desired path is reached, the mode will activate and FD will produce commands to follow the path.

NOTE When using altitude constraints at along-track-offset waypoints, the VNAV *Direct-To* button on the VNAV Altitude page could be misleading. The button has the same label as the next waypoint in the flight plan that is not an along-track-offset waypoint. When selected, VNAV will achieve the commanded altitude at the selected along-track-offset waypoint, not the waypoint indicated on the *Direct-To* button.

Vertical Speed

The vertical speed mode is activated by pushing the VS button and then selecting target vertical speed using the PITCH wheel. When active, a target value and bug is displayed on the vertical speed indicator.

Flight Level Change

The flight level change mode is selected using the FLC button and will acquire and hold the target speed while climbing or descending to the selected altitude. The target speed is synced to actual speed at time of engagement.

Approach

The approach mode is armed using the APR button. When capture criteria is met, the mode will activate and track the active navigation source.

Takeoff and Go-around

The Takeoff or Go-around modes are activated by pushing either TO/GA switch. Pressing it also disengages the autopilot and sequences the FMS to the missed approach.

If on the ground, the takeoff mode is activated and in flight, the go-around mode is activated. The takeoff and go-around modes command wings level and a fixed pitch attitude based on the number of operating engines and flap setting.

Autopilot

The autopilot system follows attitude command inputs from the flight director. The autopilot system controls the pitch servo, which moves the elevator and the roll servo which moves both ailerons. The autopilot also controls the pitch trim tabs (pitch auto-trim) when it is engaged. A green AP is displayed on the FMA when engaged.

When disconnected, the AP symbol flashes in amber or red color based on whether disconnect was commanded or not. The amber normal disengagement indication will self-acknowledge in 5 seconds, but the red abnormal disconnect annunciation requires the yoke mounted AP ACK/DISC or the AFCS/TRIM MASTER button to be pushed to clear the red indication and silence the aural alert. This AP ACK/DISC button can also be used to disengage the autopilot in addition to the AP engage/disengage button on the AFCS Mode Control panel.

The CWS button can be used to disengage the pitch and roll servos from the flight control surfaces and allows the crew to fly the airplane manually without disengaging the autopilot. When the CWS button is released appropriate flight director references are synchronized to the current aircraft state.

An overspeed protection mode automatically activates when the speed exceeds V_{MO}+6 / M_{MO}+0.01 if the flight director is engaged in a vertical mode other than ALT. The overspeed protection mode will command up to 1.5g pull-up to minimize the speed excursion until the condition is corrected.

Yaw Damper and Turn Coordination

A yaw damper system uses a yaw servo to input rudder commands to reduce Dutch Roll oscillations and to provide turn coordination. The yaw damper will automatically engage after takeoff or can be manually selected on/off using the AFCS mode control panel. The yaw damper automatically disengages at touchdown if engaged. When engaged a green YD symbol is displayed in the FMA.

Rudder Bias

The rudder bias system continuously monitors and calculates the difference in thrust levels of the engines. If the thrust difference exceeds a pre-determined level, the Yaw servo is used to input a force proportional to the thrust difference, to alleviate the required pedal force. When active, the YD icon is replaced by a green RB symbol. When differential thrust is reduced, RB will automatically disengage and YD will become active, if YD was engaged prior to the RB engagement. If the YD was not engaged prior to the RB engaged, YD will not auto-engage. A disconnect of the RB is indicated by an amber flashing RB, that self clears after 5 seconds.

NOTE During a single engine descent, the RB and YD will alternate depending on the thrust setting on the operating engine. The pilot has to disengage the YD prior to landing, if the YD was engaged before the RB engagement, to prevent it from auto-engaging during the flare following the thrust reduction.

Cruise Speed Control

Cruise Speed Control (CSC) is an AFCS and FADEC function that modulates engine N_1 output within a limited authority band to maintain the aircraft's airspeed or Mach number at the time of engagement. Once engaged, the CSC target cannot be changed without disengaging the mode.

The function is engaged by pressing the CSC button on the AFCS Mode Control Panel when Altitude Hold (ALT) is the active vertical Flight Director mode, airspeed rate is stable (less than 0.85 kt/sec), speed is between LSA + 10 kts and V_{MO}/M_{MO}, and SYNC is the active engine control mode.

During normal operation of the CSC function, the following indications are present:

- A green CSC annunciation in the general AFCS Flight Mode Annunciation (FMA) display area on the Primary Flight Displays (PFDs).
- A regular speed bug to the right of the airspeed tape on the PFDs is replaced by a magenta bug at the target airspeed or airspeed corresponding to the target Mach number.
- A regular speed bug value displayed at the top of the airspeed tape on the PFDs is replaced by the target airspeed or Mach number displayed in magenta.

- A white CSC annunciation in the Engine Indication System (EIS) display.

To maintain the CSC target speed, the FADEC will modulate engine thrust in either direction up to 5% N_1 or 5 degrees of equivalent thrust lever angle change, whichever is more constraining.

CAUTION *Due to CSC's limited control authority, target speed may not be maintained during all operational scenarios, such as configuration changes (flaps, speed brake, or landing gear) or when the flight director is not being followed.*

Any of the following methods can be used to disengage the CSC function:

- Press the CSC button on the AFCS Mode Control Panel.
- Move either thrust lever by more than 1 degree.
- Press the AFCS/Trim Master button on either control yoke.
- Select a vertical AFCS mode other than Altitude Hold (ALT).

When the CSC function is disengaged, the CSC annunciation on the FMA flashes amber. All other PFD and EIS CSC indications are removed upon disengagement. The flashing CSC annunciation is self-clearing after 5 seconds.

If an attempt to engage CSC is made while the function is not available, a flashing amber CSC annunciation appears on the FMA. This indication is also self-clearing after 5 seconds.

If the CSC function detects a failure situation such as invalid sensor data or FADEC communication, a CRUISE SPD CTRL FAIL advisory message is displayed.

Stall Warning and Protection

The Stall Warning and Protection System (SWPS) include a stick shaker and a stick pusher, as well as visual indications and aural alerts. The stall warning and protection system is primarily driven from the air data probe angle of attack (AoA) data.

The stall protection function of the system incorporates a tactile (shaker) alert and a stick pusher actuated by the pitch servo. The pusher moves the elevator in the nose down direction to immediately decrease the AoA. An aural "*STALL, STALL*" alert and a red **STALL** PFD flag will annunciate in the stalled condition if recovery has not occurred within expected time.

In addition to the stall warning and protection, the airspeed indicator incorporates a complementary function in the Low Speed Awareness (LSA) cue. The LSA appears as a colored bar at the bottom of the airspeed tape. The top of the red and white "barber pole" indicates stall warning (stick shaker). Below this, the top of the solid red bar represents stall protection (stick pusher).

When ice is detected or the wing anti-ice is operated manually, the stall warning and protection system automatically compensates after a delay of sixty (60) seconds. This compensation has two schedules, one for normal operation of the icing protection systems and one for failure modes. When the system is operating in either schedule, the **STALL WARN ICE ADVANCE** advisory message is displayed, as is a STALL WARN ICE ADVANCE message on the ICE PROTECTION synoptic page.

When no longer in icing conditions and the aircraft is confirmed free of ice, the angles and speeds can be reset to the baseline settings by pushing the Stall Warn Ice Advance Reset button on the Systems Controls CDU page.

Trim Control

Autopilot automatically commands pitch trim to resolve persistent forces when engaged. Manual trim is described in the Flight Controls section.

CAS Messages

Message	Description
TAKEOFF CONFIG	One or more configuration items are not properly set for takeoff
AFCS MISTRIM	Autopilot is holding constant force
FLT DIR MODE CHANGE	The flight director function has automatically reverted to a non-armed mode
RUDDER BIAS FAIL	Rudder Bias system has failed
STALL PUSHER FAIL	The stall pusher has failed
STALL WARN MISCOMP	AOA 1 and AOA 2 do not agree within allowable limits
YAW DAMPER FAIL	The Yaw Damper system has failed
YAW DAMPER OFF	The Yaw Damper is operational but not selected during enroute flight operations
AFCS FAULT	A fault has been detected by the AFCS system
AFCS PITCH SERVO OFF	Pitch Servo is selected off

Message	Description
AFCS ROLL SERVO OFF	Roll Servo is selected off
AFCS YAW SERVO OFF	Yaw Servo is selected off
AUTOPILOT FAIL	The autopilot function has failed
AUTOPILOT FAULT	An automatic pitch trim fault has been detected by the autopilot. If autopilot is disengaged, it may not be able to be reengaged
CRUISE SPD CTRL FAIL	Cruise speed control has failed
RUDDER BIAS FAULT	Rudder Bias system has detected a fault but can still activate Message may post when aircraft on battery power only
STALL SHAKER FAIL	The stick shaker is unable to actuate a stall warning command
STALL WARN ICE ADVANCE	Stall Shaker and Pusher trigger thresholds and the approach reference speed (green circle) have been compensated due to ice detection or manual operation of wing anti-ice.
YAW DAMPER FAULT	A fault has been detected in the yaw damper

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SECTION 2

FLIGHT PLANNING

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FLIGHT PLANNING

INTRODUCTION

Performance data for cruise, climb, descent and holding are presented in the charts and tables on the following pages. Performance data for takeoff and landing are presented in the Airplane Flight Manual. Fuel consumption information is derived from flight test data and average engine performance.

NOTE When necessary, interpolation may be used between table values to determine performance for the current ambient conditions and aircraft weight. If interpolation is not used, the next higher ambient temperature and weight should be used for the determination of aircraft performance.

NOTE When operating with engine and wing anti-ice ON, there will be an increase in fuel flow of approximately 3% for a given flight condition. Above 20,000 feet, MCT will be reduced by up to 10%, resulting in a reduction in climb and maximum speed cruise performance.

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Time, Distance, and Fuel to Climb*							
ISA		210 KCAS / Mach 0.57 No Wind, Ice Protection Off					
Altitude [ft]		Takeoff Weight [lb]					
		8000	8500	9000	9500	10000	10600
43000	Time [min]	13.4	14.6	15.9	17.4	19.0	21.2
	Dist [nm]	66	72	79	86	94	106
	Fuel[lb]	274	297	321	348	378	415
41000	Time [min]	12.0	13.0	14.0	15.2	16.4	18.0
	Dist [nm]	58	63	69	74	80	88
	Fuel[lb]	258	278	300	322	347	378
39000	Time [min]	10.8	11.7	12.6	13.6	14.6	16.9
	Dist [nm]	52	56	61	65	70	77
	Fuel[lb]	243	262	282	302	324	351
37000	Time [min]	9.9	10.7	11.5	12.3	13.2	14.3
	Dist [nm]	47	51	54	59	63	68
	Fuel[lb]	230	247	265	284	304	329
35000	Time [min]	9.1	9.8	10.5	11.3	12.0	13.0
	Dist [nm]	43	46	49	53	57	61
	Fuel[lb]	218	234	251	268	287	309
33000	Time [min]	8.4	9.1	9.7	10.4	11.1	12.0
	Dist [nm]	39	42	45	48	51	56
	Fuel[lb]	206	221	237	254	271	292
31000	Time [min]	7.8	8.4	9.0	9.6	10.3	11.1
	Dist [nm]	36	38	41	44	47	51
	Fuel[lb]	195	209	224	239	255	275
29000	Time [min]	7.2	7.7	8.3	8.8	9.4	10.1
	Dist [nm]	32	34	37	39	42	45
	Fuel[lb]	182	195	209	223	238	256
25000	Time [min]	6.0	6.4	6.9	7.3	7.8	8.4
	Dist [nm]	26	28	29	31	34	36
	Fuel[lb]	157	168	180	192	204	220
20000	Time [min]	4.6	5.0	5.3	5.7	6.0	6.5
	Dist [nm]	19	20	22	23	25	27
	Fuel[lb]	126	135	145	154	164	176
15000	Time [min]	3.3	3.6	3.8	4.1	4.3	4.6
	Dist [nm]	13	14	15	16	17	18
	Fuel[lb]	95	102	109	116	123	132
10000	Time [min]	2.1	2.2	2.4	2.5	2.7	2.9
	Dist [nm]	8	8	9	10	10	11
	Fuel[lb]	64	68	73	77	82	88

* Based on Climb Starting from Sea Level

TDF_CLB_ISA_0_02

Time, Distance, and Fuel to Climb*

ISA+5		210 KCAS / Mach 0.57 No Wind, Ice Protection Off					
		Takeoff Weight [lb]					
Altitude [ft]		8000	8500	9000	9500	10000	10600
43000	Time [min]	14.4	15.8	17.3	19.0	21.0	24.0
	Dist [nm]	72	79	87	96	107	122
	Fuel[lb]	283	308	335	364	396	443
41000	Time [min]	12.7	13.8	14.9	16.2	17.6	19.4
	Dist [nm]	63	68	74	81	88	97
	Fuel[lb]	265	286	309	333	360	394
39000	Time [min]	11.4	12.3	13.3	14.3	15.4	16.9
	Dist [nm]	56	60	65	70	76	83
	Fuel[lb]	249	269	289	311	334	363
37000	Time [min]	10.3	11.2	12.0	12.9	13.8	15.0
	Dist [nm]	50	54	58	62	67	73
	Fuel[lb]	235	253	272	292	312	338
35000	Time [min]	9.5	10.2	11.0	11.7	12.6	13.6
	Dist [nm]	45	49	52	56	60	65
	Fuel[lb]	222	239	256	275	293	317
33000	Time [min]	8.7	9.4	10.1	10.8	11.6	12.6
	Dist [nm]	41	44	47	51	54	59
	Fuel[lb]	210	226	242	259	277	299
31000	Time [min]	8.1	8.7	9.3	10.0	10.6	11.6
	Dist [nm]	37	40	43	46	49	53
	Fuel[lb]	198	213	228	244	261	281
29000	Time [min]	7.4	7.9	8.5	9.1	9.7	10.4
	Dist [nm]	33	36	38	41	44	47
	Fuel[lb]	185	199	213	227	242	261
25000	Time [min]	6.1	6.5	7.0	7.4	7.9	8.5
	Dist [nm]	26	28	30	32	34	37
	Fuel[lb]	159	170	182	194	207	223
20000	Time [min]	4.5	4.9	5.3	5.6	6.0	6.4
	Dist [nm]	19	20	22	23	25	27
	Fuel[lb]	127	136	145	155	165	177
15000	Time [min]	3.3	3.5	3.8	4.0	4.3	4.6
	Dist [nm]	13	14	15	16	17	18
	Fuel[lb]	96	102	109	117	124	133
10000	Time [min]	2.1	2.2	2.4	2.5	2.7	2.9
	Dist [nm]	8	8	9	10	10	11
	Fuel[lb]	64	68	73	78	82	88

* Based on Climb Starting from Sea Level.

TDF_CLB_ISA+5_0_02

Time, Distance, and Fuel to Climb*

ISA+10		210 KCAS / Mach 0.57 No Wind, Ice Protection Off					
Altitude [ft]		Takeoff Weight [lb]					
		8000	8500	9000	9500	10000	10600
43000	Time [min]	16.2	17.9	19.9	22.2	25.2	
	Dist [nm]	83	92	102	115	131	
	Fuel[lb]	300	328	359	395	438	
41000	Time [min]	13.9	15.2	16.6	18.1	19.9	22.3
	Dist [nm]	70	77	84	92	101	114
	Fuel[lb]	278	301	327	354	384	425
39000	Time [min]	12.4	13.4	14.5	15.7	17.0	18.8
	Dist [nm]	62	67	73	79	85	94
	Fuel[lb]	260	281	303	327	352	385
37000	Time [min]	11.1	12.0	13.0	14.0	15.1	16.4
	Dist [nm]	55	59	64	69	74	81
	Fuel[lb]	244	263	283	304	327	355
35000	Time [min]	10.1	10.9	11.8	12.6	13.6	14.7
	Dist [nm]	49	53	57	62	66	72
	Fuel[lb]	230	248	266	286	306	332
33000	Time [min]	9.3	10.0	10.8	11.6	12.4	13.4
	Dist [nm]	45	48	52	55	59	65
	Fuel[lb]	217	234	251	269	288	311
31000	Time [min]	8.6	9.2	9.9	10.6	11.3	12.3
	Dist [nm]	40	43	47	50	54	58
	Fuel[lb]	205	220	236	253	270	292
29000	Time [min]	7.7	8.3	8.9	9.6	10.2	11.0
	Dist [nm]	36	38	41	44	47	51
	Fuel[lb]	190	204	219	234	250	270
25000	Time [min]	6.2	6.7	7.2	7.7	8.2	8.8
	Dist [nm]	28	30	32	34	36	39
	Fuel[lb]	162	174	186	198	211	228
20000	Time [min]	4.5	4.9	5.2	5.6	6.0	6.4
	Dist [nm]	19	21	22	23	25	27
	Fuel[lb]	128	137	146	156	166	178
15000	Time [min]	3.3	3.5	3.7	4.0	4.2	4.5
	Dist [nm]	13	14	15	16	17	18
	Fuel[lb]	96	103	110	117	124	134
10000	Time [min]	2.1	2.2	2.3	2.5	2.7	2.8
	Dist [nm]	8	8	9	10	10	11
	Fuel[lb]	64	69	73	78	83	89

* Based on Climb Starting from Sea Level

TDF_CLB_ISA+10_0_02

Time, Distance, and Fuel to Climb*

ISA+15 — 210 KCAS / Mach 0.57, No Wind, Ice Protection Off

Altitude [ft]		Takeoff Weight [lb] 8000	8500	9000	9500	10000	10600
43000	Time [min]	19.3	21.7	24.7			
	Dist [nm]	101	113	130			
	Fuel[lb]	332	367	408			
41000	Time [min]	16.2	17.8	19.6	21.6	24.1	27.7
	Dist [nm]	83	91	101	112	125	145
	Fuel[lb]	302	330	359	393	430	485
39000	Time [min]	14.2	15.5	16.9	18.4	20.1	22.4
	Dist [nm]	72	79	86	94	102	114
	Fuel[lb]	281	305	330	358	388	427
37000	Time [min]	12.7	13.8	15.0	16.2	17.5	19.3
	Dist [nm]	64	69	75	81	88	97
	Fuel[lb]	263	285	307	331	357	390
35000	Time [min]	11.5	12.5	13.5	14.5	15.6	17.1
	Dist [nm]	57	61	66	72	77	85
	Fuel[lb]	247	267	288	309	332	362
33000	Time [min]	10.6	11.4	12.3	13.2	14.2	15.5
	Dist [nm]	51	55	60	64	69	75
	Fuel[lb]	233	251	270	290	311	338
31000	Time [min]	9.7	10.4	11.2	12.0	12.9	14.0
	Dist [nm]	46	50	54	58	62	67
	Fuel[lb]	219	236	254	272	291	316
29000	Time [min]	8.7	9.4	10.1	10.8	11.6	12.5
	Dist [nm]	41	44	47	50	54	59
	Fuel[lb]	203	218	235	251	269	291
25000	Time [min]	7.0	7.5	8.0	8.6	9.2	9.9
	Dist [nm]	31	33	36	38	41	44
	Fuel[lb]	172	185	198	212	226	244
20000	Time [min]	5.1	5.4	5.8	6.2	6.6	7.1
	Dist [nm]	21	23	25	26	28	30
	Fuel[lb]	135	144	155	165	176	189
15000	Time [min]	3.6	3.8	4.1	4.4	4.7	5.0
	Dist [nm]	14	16	17	18	19	20
	Fuel[lb]	101	108	116	123	131	141
10000	Time [min]	2.2	2.4	2.6	2.7	2.9	3.1
	Dist [nm]	9	9	10	11	11	12
	Fuel[lb]	67	72	77	82	87	94

* Based on Climb Starting from Sea Level

TDF_CLB_ISA+15_0_02

Time, Distance, and Fuel to Climb*

ISA+20 — 210 KCAS / Mach 0.57, No Wind, Ice Protection Off

Altitude [ft]		Takeoff Weight [lb] 8000	8500	9000	9500	10000	10500
43000	Time [min]	25.3					
	Dist [nm]	135					
	Fuel [lb]	390					
41000	Time [min]	19.6	21.8	24.4	27.7		
	Dist [nm]	102	114	128	146		
	Fuel [lb]	339	373	412	459		
39000	Time [min]	16.8	18.4	20.2	22.3	24.6	28.0
	Dist [nm]	86	95	105	115	128	146
	Fuel [lb]	311	339	370	403	442	496
37000	Time [min]	14.9	16.2	17.6	19.2	21.0	23.3
	Dist [nm]	75	82	90	98	107	119
	Fuel [lb]	289	314	340	369	400	441
35000	Time [min]	13.4	14.5	15.8	17.1	18.5	20.3
	Dist [nm]	67	73	79	86	93	103
	Fuel [lb]	270	293	317	342	369	404
33000	Time [min]	12.2	13.2	14.3	15.5	16.7	18.3
	Dist [nm]	60	65	71	76	83	91
	Fuel [lb]	254	275	297	320	344	376
31000	Time [min]	11.1	12.0	13.0	14.0	15.1	16.5
	Dist [nm]	54	58	63	68	73	80
	Fuel [lb]	238	257	277	298	321	349
29000	Time [min]	9.9	10.7	11.6	12.5	13.4	14.6
	Dist [nm]	47	51	55	59	64	69
	Fuel [lb]	220	237	255	274	294	319
25000	Time [min]	7.9	8.5	9.1	9.8	10.5	11.4
	Dist [nm]	35	38	41	44	47	51
	Fuel [lb]	184	198	213	228	244	265
20000	Time [min]	5.6	6.1	6.5	7.0	7.4	8.0
	Dist [nm]	24	26	28	30	32	34
	Fuel [lb]	143	154	165	176	188	203
15000	Time [min]	4.0	4.3	4.6	4.9	5.2	5.6
	Dist [nm]	16	17	19	20	21	23
	Fuel [lb]	107	114	122	131	139	150
10000	Time [min]	2.5	2.7	2.8	3.0	3.2	3.5
	Dist [nm]	10	10	11	12	13	14
	Fuel [lb]	71	76	81	86	92	99

* Based on Climb Starting from Sea Level — TDF_CLB_ISA+20_0_02

Time, Distance, and Fuel to Climb*

ISA		160 KCAS, Flaps TO/APPR, Icing No Wind, Ice Protection Off				
		Takeoff Weight [lb]				
Altitude [ft]		8000	8500	9000	9500	9860
18000	Time [min]	6.3	6.9	7.4	8.0	8.4
	Dist [nm]	20	21	23	25	26
	Fuel[lb]	167	181	195	210	222
15000	Time [min]	5.0	5.4	5.8	6.3	6.6
	Dist [nm]	15	16	18	19	20
	Fuel[lb]	137	148	160	172	181
10000	Time [min]	3.1	3.3	3.6	3.9	4.1
	Dist [nm]	9	10	10	11	12
	Fuel[lb]	90	97	105	112	118
5000	Time [min]	1.5	1.6	1.7	1.8	1.9
	Dist [nm]	4	4	5	5	5
	Fuel[lb]	45	48	52	55	58

* Based on Climb Starting from Sea Level

TDF_CLB_TO_ISA_0_01

Long Range Cruise

ISA — Flaps UP, No Wind, Ice Protection Off

Altitude [ft]		Cruise Weight [lb] 8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	350	352	356	358	358	366
	Mach [---]	0.611	0.614	0.621	0.624	0.624	0.638
	Fuel Flow [lb/hr]	498	516	538	558	577	613
41000	KTAS [kts]	344	348	352	354	357	361
	Mach [---]	0.601	0.607	0.614	0.617	0.623	0.630
	Fuel Flow [lb/hr]	501	523	545	563	586	609
39000	KTAS [kts]	337	342	346	349	351	354
	Mach [---]	0.587	0.596	0.603	0.608	0.612	0.618
	Fuel Flow [lb/hr]	511	534	554	576	594	617
37000	KTAS [kts]	334	334	337	344	346	349
	Mach [---]	0.582	0.582	0.588	0.600	0.603	0.609
	Fuel Flow [lb/hr]	533	544	563	590	607	629
35000	KTAS [kts]	316	326	331	336	341	346
	Mach [---]	0.549	0.566	0.574	0.583	0.591	0.600
	Fuel Flow [lb/hr]	527	557	578	601	624	647
33000	KTAS [kts]	302	312	321	328	332	336
	Mach [---]	0.519	0.536	0.552	0.563	0.572	0.577
	Fuel Flow [lb/hr]	519	549	580	604	627	646
31000	KTAS [kts]	289	298	307	317	326	331
	Mach [---]	0.492	0.508	0.524	0.540	0.556	0.563
	Fuel Flow [lb/hr]	519	550	581	612	644	667
29000	KTAS [kts]	280	286	294	303	312	321
	Mach [---]	0.474	0.484	0.497	0.512	0.527	0.542
	Fuel Flow [lb/hr]	529	553	581	613	645	676
25000	KTAS [kts]	263	269	276	282	288	293
	Mach [---]	0.438	0.447	0.459	0.469	0.478	0.487
	Fuel Flow [lb/hr]	545	569	598	624	650	676
20000	KTAS [kts]	249	255	260	265	267	269
	Mach [---]	0.406	0.415	0.423	0.432	0.434	0.438
	Fuel Flow [lb/hr]	579	604	628	654	668	688
15000	KTAS [kts]	229	238	243	248	254	257
	Mach [---]	0.366	0.379	0.387	0.395	0.406	0.411
	Fuel Flow [lb/hr]	597	633	658	683	713	736
10000	KTAS [kts]	207	213	222	224	227	228
	Mach [---]	0.325	0.334	0.348	0.350	0.356	0.357
	Fuel Flow [lb/hr]	604	634	675	690	715	730

LRC_ISA_0_08

Long Range Cruise							
ISA+5		Flaps UP No Wind, Ice Protection Off					
Altitude [ft]		Cruise Weight [lb]					
		8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	354	356	358	362	370	
	Mach [---]	0.611	0.614	0.618	0.624	0.638	
	Fuel Flow [lb/hr]	506	524	544	569	602	
41000	KTAS [kts]	348	352	356	358	360	360
	Mach [---]	0.601	0.607	0.614	0.617	0.620	0.620
	Fuel Flow [lb/hr]	509	531	553	572	591	609
39000	KTAS [kts]	341	346	350	353	355	359
	Mach [---]	0.587	0.596	0.603	0.609	0.612	0.618
	Fuel Flow [lb/hr]	519	542	562	584	603	626
37000	KTAS [kts]	334	336	341	348	350	353
	Mach [---]	0.576	0.579	0.588	0.600	0.603	0.609
	Fuel Flow [lb/hr]	534	549	572	599	616	639
35000	KTAS [kts]	333	335	335	338	345	350
	Mach [---]	0.571	0.574	0.574	0.580	0.591	0.600
	Fuel Flow [lb/hr]	562	576	588	606	633	657
33000	KTAS [kts]	320	328	333	335	336	339
	Mach [---]	0.544	0.558	0.566	0.569	0.572	0.577
	Fuel Flow [lb/hr]	561	587	606	621	636	656
31000	KTAS [kts]	292	301	311	320	328	333
	Mach [---]	0.492	0.508	0.524	0.540	0.553	0.561
	Fuel Flow [lb/hr]	527	558	589	621	650	673
29000	KTAS [kts]	282	290	297	306	315	325
	Mach [---]	0.471	0.484	0.497	0.512	0.527	0.542
	Fuel Flow [lb/hr]	533	561	590	622	655	688
25000	KTAS [kts]	266	272	278	284	289	296
	Mach [---]	0.438	0.447	0.457	0.466	0.476	0.487
	Fuel Flow [lb/hr]	552	577	602	628	655	686
20000	KTAS [kts]	252	257	263	267	269	272
	Mach [---]	0.406	0.415	0.423	0.430	0.434	0.438
	Fuel Flow [lb/hr]	587	611	636	658	677	697
15000	KTAS [kts]	233	239	245	250	255	260
	Mach [---]	0.368	0.377	0.387	0.395	0.403	0.411
	Fuel Flow [lb/hr]	609	638	667	693	719	746
10000	KTAS [kts]	209	215	224	227	228	229
	Mach [---]	0.325	0.334	0.348	0.352	0.354	0.356
	Fuel Flow [lb/hr]	612	643	685	705	720	736

LRC_ISA+5_0_05

Long Range Cruise							
ISA+10		Flaps UP No Wind, Ice Protection Off					
		Cruise Weight [lb]					
Altitude [ft]		8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	358	362	364	370		
	Mach [---]	0.611	0.618	0.621	0.631		
	Fuel Flow [lb/hr]	513	536	555	583		
41000	KTAS [kts]	352	356	360	362	364	369
	Mach [---]	0.601	0.607	0.614	0.617	0.620	0.630
	Fuel Flow [lb/hr]	517	539	562	581	601	630
39000	KTAS [kts]	344	352	354	357	359	361
	Mach [---]	0.587	0.599	0.603	0.608	0.612	0.615
	Fuel Flow [lb/hr]	527	553	571	593	612	632
37000	KTAS [kts]	336	338	345	350	354	356
	Mach [---]	0.570	0.576	0.588	0.597	0.603	0.606
	Fuel Flow [lb/hr]	536	554	580	604	626	644
35000	KTAS [kts]	332	333	337	342	349	354
	Mach [---]	0.563	0.566	0.571	0.580	0.591	0.600
	Fuel Flow [lb/hr]	560	574	593	616	643	667
33000	KTAS [kts]	324	332	333	335	338	345
	Mach [---]	0.544	0.558	0.561	0.563	0.569	0.580
	Fuel Flow [lb/hr]	566	594	608	623	642	669
31000	KTAS [kts]	298	320	328	331	333	336
	Mach [---]	0.497	0.534	0.548	0.553	0.556	0.561
	Fuel Flow [lb/hr]	547	604	631	649	663	682
29000	KTAS [kts]	277	297	317	325	328	329
	Mach [---]	0.458	0.492	0.525	0.537	0.542	0.545
	Fuel Flow [lb/hr]	531	586	641	669	688	702
25000	KTAS [kts]	269	275	281	285	291	295
	Mach [---]	0.438	0.447	0.457	0.464	0.473	0.480
	Fuel Flow [lb/hr]	559	584	610	633	660	685
20000	KTAS [kts]	248	254	260	266	273	280
	Mach [---]	0.396	0.406	0.415	0.425	0.436	0.447
	Fuel Flow [lb/hr]	580	610	636	667	698	729
15000	KTAS [kts]	235	242	247	252	257	262
	Mach [---]	0.368	0.379	0.387	0.395	0.403	0.411
	Fuel Flow [lb/hr]	617	650	676	702	728	756
10000	KTAS [kts]	212	221	229	232	232	234
	Mach [---]	0.327	0.339	0.352	0.357	0.357	0.359
	Fuel Flow [lb/hr]	624	662	701	725	735	752

LRC_ISA+10_0_05

Long Range Cruise							
ISA+15		Flaps UP No Wind, Ice Protection Off					
		Cruise Weight [lb]					
Altitude [ft]		8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	362	364				
	Mach [---]	0.611	0.614				
	Fuel Flow [lb/hr]	521	540				
41000	KTAS [kts]	356	360	364	366	370	
	Mach [---]	0.601	0.607	0.614	0.617	0.623	
	Fuel Flow [lb/hr]	525	547	570	589	613	
39000	KTAS [kts]	350	352	357	361	363	367
	Mach [---]	0.590	0.593	0.603	0.609	0.612	0.618
	Fuel Flow [lb/hr]	538	554	579	602	621	645
37000	KTAS [kts]	338	345	349	352	356	360
	Mach [---]	0.570	0.582	0.588	0.594	0.600	0.606
	Fuel Flow [lb/hr]	543	569	588	609	630	654
35000	KTAS [kts]	330	334	342	347	351	354
	Mach [---]	0.554	0.560	0.574	0.583	0.589	0.594
	Fuel Flow [lb/hr]	567	575	605	627	648	669
33000	KTAS [kts]	325	329	332	339	345	350
	Mach [---]	0.541	0.547	0.552	0.563	0.574	0.583
	Fuel Flow [lb/hr]	570	588	606	632	656	682
31000	KTAS [kts]	313	322	327	330	335	341
	Mach [---]	0.516	0.532	0.540	0.545	0.553	0.563
	Fuel Flow [lb/hr]	576	607	628	647	669	696
29000	KTAS [kts]	285	308	317	322	327	330
	Mach [---]	0.466	0.504	0.520	0.527	0.535	0.540
	Fuel Flow [lb/hr]	548	610	641	663	686	704
25000	KTAS [kts]	264	272	285	298	306	310
	Mach [---]	0.426	0.438	0.459	0.480	0.492	0.499
	Fuel Flow [lb/hr]	554	585	629	674	704	726
20000	KTAS [kts]	251	257	265	272	277	283
	Mach [---]	0.397	0.408	0.419	0.430	0.438	0.447
	Fuel Flow [lb/hr]	591	617	651	682	709	737
15000	KTAS [kts]	232	238	245	250	256	262
	Mach [---]	0.360	0.370	0.379	0.387	0.397	0.407
	Fuel Flow [lb/hr]	612	642	673	701	733	765
10000	KTAS [kts]	214	219	224	230	234	240
	Mach [---]	0.327	0.334	0.341	0.350	0.357	0.366
	Fuel Flow [lb/hr]	632	659	687	720	749	783

LRC_ISA+15_0_03

Long Range Cruise							
ISA+20		Flaps UP No Wind, Ice Protection Off					
		Cruise Weight [lb]					
Altitude [ft]		8000	8500	9000	9500	10000	10500
43000	KTAS [kts]						
	Mach [---]						
	Fuel Flow [lb/hr]						
41000	KTAS [kts]	360	364				
	Mach [---]	0.601	0.607				
	Fuel Flow [lb/hr]	532	555				
39000	KTAS [kts]	352	359	361	365	367	
	Mach [---]	0.587	0.599	0.603	0.609	0.612	
	Fuel Flow [lb/hr]	542	570	587	611	630	
37000	KTAS [kts]	344	349	353	358	362	363
	Mach [---]	0.573	0.582	0.588	0.597	0.603	0.606
	Fuel Flow [lb/hr]	554	577	597	621	644	663
35000	KTAS [kts]	330	339	346	351	354	361
	Mach [---]	0.549	0.563	0.574	0.583	0.589	0.600
	Fuel Flow [lb/hr]	558	587	613	637	657	687
33000	KTAS [kts]	324	327	334	342	349	352
	Mach [---]	0.533	0.539	0.550	0.563	0.574	0.580
	Fuel Flow [lb/hr]	567	585	611	641	668	688
31000	KTAS [kts]	311	319	325	332	338	346
	Mach [---]	0.508	0.521	0.532	0.542	0.553	0.566
	Fuel Flow [lb/hr]	572	601	626	652	679	710
29000	KTAS [kts]	295	308	314	321	327	335
	Mach [---]	0.479	0.499	0.510	0.520	0.530	0.542
	Fuel Flow [lb/hr]	570	609	635	661	687	718
25000	KTAS [kts]	268	280	292	298	304	308
	Mach [---]	0.428	0.447	0.466	0.476	0.485	0.492
	Fuel Flow [lb/hr]	565	605	647	673	700	724
20000	KTAS [kts]	254	262	270	276	280	285
	Mach [---]	0.397	0.410	0.423	0.432	0.438	0.447
	Fuel Flow [lb/hr]	599	632	666	693	716	745
15000	KTAS [kts]	234	239	245	254	262	268
	Mach [---]	0.360	0.368	0.377	0.391	0.403	0.413
	Fuel Flow [lb/hr]	619	646	678	717	753	786
10000	KTAS [kts]	215	221	226	232	238	247
	Mach [---]	0.325	0.334	0.341	0.350	0.357	0.374
	Fuel Flow [lb/hr]	636	668	697	730	759	809

LRC_ISA+20_0_03

Long Range Cruise

ISA		Flaps TO/APPR, Icing No Wind					
		Cruise Weight [lb]					
Altitude [ft]		8000	8500	9000	9500	10000	10500
18000	KTAS [kts]	183	184	186	188	194	197
	Mach [---]	0.296	0.298	0.300	0.304	0.313	0.319
	Fuel Flow [lb/hr]	792	817	842	875	924	966
15000	KTAS [kts]	168	173	178	181	184	188
	Mach [---]	0.256	0.262	0.269	0.274	0.276	0.278
	Fuel Flow [lb/hr]	765	810	856	889	930	972
10000	KTAS [kts]	163	167	172	175	176	178
	Mach [---]	0.251	0.269	0.269	0.274	0.276	0.278
	Fuel Flow [lb/hr]	834	877	922	959	984	1010

LRC_TO_ISA_0_01

Long Range Cruise

ISA+5		Flaps TO/APPR, Icing No Wind					
		Cruise Weight [lb]					
Altitude [ft]		8000	8500	9000	9500	10000	10500
18000	KTAS [kts]	185	186	188	190	195	199
	Mach [---]	0.296	0.298	0.300	0.304	0.313	0.319
	Fuel Flow [lb/hr]	802	827	853	887	936	979
15000	KTAS [kts]	170	175	180	184	186	190
	Mach [---]	0.255	0.262	0.269	0.274	0.276	0.278
	Fuel Flow [lb/hr]	775	820	866	908	942	985
10000	KTAS [kts]	164	169	173	177	178	179
	Mach [---]	0.251	0.269	0.269	0.274	0.276	0.278
	Fuel Flow [lb/hr]	844	888	933	971	996	1023

LRC_TO_ISA+5_0_01

Long Range Cruise							
ISA+10		Flaps TO/APPR, Icing No Wind					
Altitude [ft]		Cruise Weight [lb]					
		8000	8500	9000	9500	10000	10500
18000	KTAS [kts]	187	188	189	192	197	201
	Mach [---]	0.296	0.298	0.300	0.304	0.313	0.319
	Fuel Flow [lb/hr]	813	838	864	898	948	991
15000	KTAS [kts]	171	177	182	185	188	192
	Mach [---]	0.263	0.264	0.269	0.274	0.276	0.278
	Fuel Flow [lb/hr]	784	830	877	919	954	987
10000	KTAS [kts]	164	171	175	178	180	181
	Mach [---]	0.226	0.264	0.269	0.274	0.276	0.278
	Fuel Flow [lb/hr]	848	907	945	983	1009	1035

LRC_TO_ISA+10_0_01

Long Range Cruise							
ISA+15		Flaps TO/APPR, Icing No Wind					
Altitude [ft]		Cruise Weight [lb]					
		8000	8500	9000	9500	10000	10500
18000	KTAS [kts]	186	187	190	195	199	203
	Mach [---]	0.292	0.294	0.298	0.306	0.313	0.319
	Fuel Flow [lb/hr]	808	834	868	917	960	1004
15000	KTAS [kts]	181	183	185	186	190	195
	Mach [---]	0.256	0.264	0.267	0.271	0.273	0.276
	Fuel Flow [lb/hr]	839	871	897	923	968	1017
10000	KTAS [kts]	168	173	175	178	179	181
	Mach [---]	0.256	0.264	0.267	0.271	0.273	0.276
	Fuel Flow [lb/hr]	869	914	944	978	1005	1040

LRC_TO_ISA+15_0_01

Long Range Cruise

ISA+20 — Flaps TO/APPR, Icing, No Wind

Altitude [ft]		Cruise Weight [lb]					
		8000	8500	9000	9500	10000	10500
18000	KTAS [kts]	185	188	193	197	201	205
	Mach [---]	0.287	0.292	0.300	0.306	0.313	0.319
	Fuel Flow [lb/hr]	804	837	885	928	972	1017
15000	KTAS [kts]	180	181	184	189	193	197
	Mach [---]	0.258	0.262	0.264	0.265	0.273	0.278
	Fuel Flow [lb/hr]	833	859	892	942	985	1030
10000	KTAS [kts]	171	173	174	176	180	184
	Mach [---]	0.258	0.262	0.264	0.265	0.273	0.278
	Fuel Flow [lb/hr]	883	915	940	966	1017	1060

LRC_TO_ISA+20_0_01

High Speed Cruise							
ISA		Flaps UP No Wind, Ice Protection Off					
		Cruise Weight [lb]					
Altitude [ft]		8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	408	406	403	400	397	391
	Mach [---]	0.712	0.708	0.703	0.698	0.692	0.682
	Fuel Flow [lb/hr]	678	677	676	675	674	672
41000	KTAS [kts]	413	413	411	409	407	404
	Mach [---]	0.720	0.720	0.717	0.713	0.710	0.705
	Fuel Flow [lb/hr]	742	759	761	760	760	759
39000	KTAS [kts]	413	413	413	413	412	410
	Mach [---]	0.720	0.720	0.720	0.720	0.719	0.715
	Fuel Flow [lb/hr]	786	801	818	835	847	846
37000	KTAS [kts]	413	413	413	413	413	413
	Mach [---]	0.720	0.720	0.720	0.720	0.720	0.720
	Fuel Flow [lb/hr]	837	850	865	881	897	916
35000	KTAS [kts]	415	415	415	415	415	415
	Mach [---]	0.720	0.720	0.720	0.720	0.720	0.720
	Fuel Flow [lb/hr]	902	914	926	939	955	971
33000	KTAS [kts]	419	419	419	419	419	419
	Mach [---]	0.720	0.720	0.720	0.720	0.720	0.720
	Fuel Flow [lb/hr]	971	981	992	1004	1017	1030
31000	KTAS [kts]	422	422	422	422	422	422
	Mach [---]	0.720	0.720	0.720	0.720	0.720	0.720
	Fuel Flow [lb/hr]	1059	1069	1078	1089	1100	1112
29000	KTAS [kts]	416	416	416	416	416	416
	Mach [---]	0.703	0.703	0.703	0.703	0.703	0.703
	Fuel Flow [lb/hr]	1069	1076	1083	1090	1098	1107
25000	KTAS [kts]	391	391	391	391	391	391
	Mach [---]	0.649	0.649	0.649	0.649	0.649	0.649
	Fuel Flow [lb/hr]	1041	1047	1053	1059	1066	1073
20000	KTAS [kts]	362	362	362	362	362	362
	Mach [---]	0.589	0.589	0.589	0.589	0.589	0.589
	Fuel Flow [lb/hr]	1037	1042	1048	1054	1060	1067
15000	KTAS [kts]	335	335	335	335	335	335
	Mach [---]	0.536	0.535	0.535	0.535	0.536	0.536
	Fuel Flow [lb/hr]	1078	1083	1088	1094	1100	1106
10000	KTAS [kts]	311	311	311	311	311	311
	Mach [---]	0.488	0.488	0.488	0.488	0.488	0.488
	Fuel Flow [lb/hr]	1112	1118	1123	1129	1135	1141

HSC_ISA_0_02

High Speed Cruise

ISA+5 — Flaps UP, No Wind, Ice Protection Off

Altitude [ft]		Cruise Weight [lb] 8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	404	400	395	388	381	371
	Mach [---]	0.696	0.690	0.681	0.669	0.656	0.639
	Fuel Flow [lb/hr]	634	633	631	628	625	621
41000	KTAS [kts]	413	411	409	406	403	400
	Mach [---]	0.712	0.708	0.704	0.700	0.695	0.689
	Fuel Flow [lb/hr]	714	713	713	712	712	711
39000	KTAS [kts]	418	416	414	412	410	408
	Mach [---]	0.720	0.717	0.714	0.711	0.707	0.703
	Fuel Flow [lb/hr]	794	795	795	794	794	794
37000	KTAS [kts]	418	418	418	416	415	413
	Mach [---]	0.720	0.720	0.720	0.717	0.715	0.712
	Fuel Flow [lb/hr]	848	860	874	876	876	876
35000	KTAS [kts]	420	420	420	420	419	418
	Mach [---]	0.720	0.720	0.720	0.720	0.719	0.717
	Fuel Flow [lb/hr]	914	925	937	949	960	959
33000	KTAS [kts]	423	423	423	423	423	423
	Mach [---]	0.720	0.720	0.720	0.720	0.720	0.720
	Fuel Flow [lb/hr]	985	995	1005	1017	1029	1041
31000	KTAS [kts]	427	427	427	427	427	427
	Mach [---]	0.720	0.720	0.720	0.720	0.720	0.720
	Fuel Flow [lb/hr]	1071	1080	1089	1098	1109	1119
29000	KTAS [kts]	421	421	421	421	421	421
	Mach [---]	0.703	0.703	0.703	0.703	0.703	0.703
	Fuel Flow [lb/hr]	1082	1089	1095	1103	1110	1118
25000	KTAS [kts]	395	395	395	395	395	395
	Mach [---]	0.649	0.649	0.649	0.649	0.649	0.649
	Fuel Flow [lb/hr]	1056	1061	1067	1073	1080	1087
20000	KTAS [kts]	365	365	365	365	365	365
	Mach [---]	0.589	0.589	0.589	0.589	0.589	0.589
	Fuel Flow [lb/hr]	1051	1056	1062	1068	1074	1081
15000	KTAS [kts]	339	339	339	339	339	339
	Mach [---]	0.535	0.535	0.535	0.535	0.535	0.535
	Fuel Flow [lb/hr]	1093	1098	1103	1109	1115	1121
10000	KTAS [kts]	314	314	314	314	314	314
	Mach [---]	0.488	0.488	0.488	0.488	0.488	0.488
	Fuel Flow [lb/hr]	1127	1132	1138	1144	1150	1156

HSC_ISA+5_0_02

High Speed Cruise							
ISA+10		Flaps UP No Wind, Ice Protection Off					
Altitude [ft]		Cruise Weight [lb]					
		8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	392	387	380	372	363	
	Mach [---]	0.668	0.659	0.648	0.635	0.618	
	Fuel Flow [lb/hr]	593	592	590	588	585	
41000	KTAS [kts]	408	406	402	397	391	384
	Mach [---]	0.696	0.691	0.685	0.677	0.667	0.656
	Fuel Flow [lb/hr]	673	673	671	670	668	665
39000	KTAS [kts]	415	413	411	408	405	401
	Mach [---]	0.707	0.704	0.700	0.696	0.691	0.684
	Fuel Flow [lb/hr]	751	751	750	749	747	746
37000	KTAS [kts]	419	417	415	413	411	409
	Mach [---]	0.713	0.711	0.708	0.704	0.701	0.698
	Fuel Flow [lb/hr]	827	826	826	825	825	824
35000	KTAS [kts]	422	421	420	418	416	415
	Mach [---]	0.716	0.714	0.712	0.709	0.706	0.703
	Fuel Flow [lb/hr]	906	905	905	904	904	903
33000	KTAS [kts]	428	427	425	425	424	422
	Mach [---]	0.720	0.719	0.717	0.715	0.713	0.710
	Fuel Flow [lb/hr]	993	997	996	996	995	994
31000	KTAS [kts]	429	428	427	426	425	423
	Mach [---]	0.716	0.714	0.712	0.710	0.708	0.706
	Fuel Flow [lb/hr]	1057	1057	1056	1056	1055	1056
29000	KTAS [kts]	425	425	425	425	424	423
	Mach [---]	0.703	0.703	0.703	0.703	0.701	0.699
	Fuel Flow [lb/hr]	1096	1103	1109	1115	1115	1114
25000	KTAS [kts]	399	399	399	399	399	399
	Mach [---]	0.649	0.649	0.649	0.649	0.649	0.649
	Fuel Flow [lb/hr]	1069	1074	1081	1087	1094	1102
20000	KTAS [kts]	369	369	369	369	369	369
	Mach [---]	0.589	0.589	0.589	0.589	0.589	0.589
	Fuel Flow [lb/hr]	1066	1071	1077	1083	1089	1096
15000	KTAS [kts]	342	342	342	342	342	342
	Mach [---]	0.535	0.535	0.535	0.535	0.535	0.535
	Fuel Flow [lb/hr]	1107	1112	1117	1123	1129	1135
10000	KTAS [kts]	317	317	317	317	317	317
	Mach [---]	0.488	0.488	0.488	0.488	0.488	0.488
	Fuel Flow [lb/hr]	1142	1147	1153	1159	1165	1172

HSC_ISA+10_0_02

High Speed Cruise

ISA+15 — Flaps UP, No Wind, Ice Protection Off

Altitude [ft]		Cruise Weight [lb] 8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	376	369	360			
	Mach [---]	0.634	0.622	0.607			
	Fuel Flow [lb/hr]	551	550	548			
41000	KTAS [kts]	397	392	387	381	374	366
	Mach [---]	0.669	0.661	0.652	0.643	0.631	0.618
	Fuel Flow [lb/hr]	630	629	627	625	624	621
39000	KTAS [kts]	407	404	401	397	393	388
	Mach [---]	0.687	0.682	0.676	0.669	0.662	0.654
	Fuel Flow [lb/hr]	707	706	705	704	703	701
37000	KTAS [kts]	413	411	409	406	403	399
	Mach [---]	0.696	0.693	0.689	0.684	0.679	0.673
	Fuel Flow [lb/hr]	780	780	779	778	777	776
35000	KTAS [kts]	417	415	413	412	409	407
	Mach [---]	0.700	0.697	0.694	0.691	0.687	0.683
	Fuel Flow [lb/hr]	854	853	853	852	851	851
33000	KTAS [kts]	424	423	421	420	418	416
	Mach [---]	0.706	0.703	0.701	0.699	0.696	0.693
	Fuel Flow [lb/hr]	940	939	939	939	938	936
31000	KTAS [kts]	422	421	420	418	417	415
	Mach [---]	0.697	0.695	0.693	0.691	0.688	0.686
	Fuel Flow [lb/hr]	990	990	989	989	988	986
29000	KTAS [kts]	421	420	419	417	416	414
	Mach [---]	0.689	0.687	0.685	0.683	0.681	0.678
	Fuel Flow [lb/hr]	1049	1049	1049	1048	1048	1047
25000	KTAS [kts]	403	403	403	403	403	403
	Mach [---]	0.649	0.649	0.649	0.649	0.649	0.649
	Fuel Flow [lb/hr]	1083	1089	1095	1102	1109	1116
20000	KTAS [kts]	373	373	373	373	373	373
	Mach [---]	0.589	0.589	0.589	0.589	0.589	0.589
	Fuel Flow [lb/hr]	1080	1085	1090	1096	1102	1109
15000	KTAS [kts]	345	345	345	345	345	345
	Mach [---]	0.535	0.535	0.535	0.535	0.535	0.535
	Fuel Flow [lb/hr]	1123	1128	1134	1139	1145	1152
10000	KTAS [kts]	320	320	320	320	320	320
	Mach [---]	0.488	0.488	0.488	0.488	0.488	0.488
	Fuel Flow [lb/hr]	1157	1163	1169	1175	1181	1188

HSC_ISA+15_0_02

High Speed Cruise							
ISA+20		Flaps UP No Wind, Ice Protection Off					
Altitude [ft]		Cruise Weight [lb]					
		8000	8500	9000	9500	10000	10500
43000	KTAS [kts]	356					
	Mach [---]	0.593					
	Fuel Flow [lb/hr]	509					
41000	KTAS [kts]	381	376	370	361		
	Mach [---]	0.636	0.627	0.616	0.603		
	Fuel Flow [lb/hr]	585	584	582	580		
39000	KTAS [kts]	396	392	388	383	378	371
	Mach [---]	0.661	0.654	0.647	0.639	0.630	0.619
	Fuel Flow [lb/hr]	663	662	661	659	658	656
37000	KTAS [kts]	403	401	398	394	390	386
	Mach [---]	0.673	0.668	0.663	0.657	0.651	0.644
	Fuel Flow [lb/hr]	735	734	733	732	730	729
35000	KTAS [kts]	408	406	404	401	399	395
	Mach [---]	0.678	0.675	0.671	0.667	0.662	0.657
	Fuel Flow [lb/hr]	806	805	804	803	803	802
33000	KTAS [kts]	417	415	413	411	409	407
	Mach [---]	0.686	0.683	0.680	0.677	0.674	0.670
	Fuel Flow [lb/hr]	887	887	886	885	885	884
31000	KTAS [kts]	414	413	411	409	408	406
	Mach [---]	0.677	0.674	0.672	0.669	0.666	0.663
	Fuel Flow [lb/hr]	934	934	933	933	933	932
29000	KTAS [kts]	411	410	409	407	406	404
	Mach [---]	0.667	0.665	0.662	0.660	0.657	0.654
	Fuel Flow [lb/hr]	983	982	982	981	980	980
25000	KTAS [kts]	407	406	405	404	403	401
	Mach [---]	0.649	0.648	0.646	0.644	0.642	0.640
	Fuel Flow [lb/hr]	1096	1096	1096	1095	1095	1096
20000	KTAS [kts]	376	376	376	376	376	376
	Mach [---]	0.589	0.589	0.589	0.589	0.589	0.589
	Fuel Flow [lb/hr]	1094	1099	1105	1111	1117	1124
15000	KTAS [kts]	348	348	348	348	348	348
	Mach [---]	0.535	0.535	0.535	0.535	0.535	0.535
	Fuel Flow [lb/hr]	1136	1141	1147	1153	1159	1165
10000	KTAS [kts]	323	323	323	323	323	323
	Mach [---]	0.488	0.488	0.488	0.488	0.488	0.488
	Fuel Flow [lb/hr]	1173	1179	1184	1190	1197	1203

HSC_ISA+20_0_02

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Time, Distance, and Fuel to Descend to SL							
ISA		Flaps UP, No Wind, Ice Protection Off					
		Normal-2,000 FPM Thrust: Flight Idle			High Speed-3,000 FPM 270 KCAS / Mach 0.72*		
Altitude [ft]		Descent Weight [lb]			Descent Weight [lb]		
		8000	9000	10000	8000	9000	10000
43000	Time [min]	21.6	21.6	21.6	14.3	14.3	14.3
	Dist [nm]	93	96	98	85	85	85
	Fuel[lb]	68	68	68	124	114	104
41000	Time [min]	20.6	20.6	20.6	13.7	13.7	13.7
	Dist [nm]	87	90	92	81	81	81
	Fuel[lb]	65	65	65	120	110	100
39000	Time [min]	19.6	19.6	19.6	13.0	13.0	13.0
	Dist [nm]	82	84	86	76	76	76
	Fuel[lb]	62	62	62	116	106	96
37000	Time [min]	18.6	18.6	18.6	12.3	12.3	12.3
	Dist [nm]	76	78	80	72	72	72
	Fuel[lb]	59	59	59	111	101	92
35000	Time [min]	17.5	17.6	17.6	11.7	11.7	11.7
	Dist [nm]	71	73	75	67	67	67
	Fuel[lb]	56	56	55	106	96	87
33000	Time [min]	16.5	16.6	16.5	11.0	11.0	11.0
	Dist [nm]	66	68	70	62	62	62
	Fuel[lb]	53	52	52	99	90	81
31000	Time [min]	15.5	15.5	15.5	10.3	10.3	10.3
	Dist [nm]	61	63	64	58	58	58
	Fuel[lb]	50	49	49	92	83	74
29000	Time [min]	14.5	14.5	14.5	9.7	9.7	9.7
	Dist [nm]	56	58	59	53	53	53
	Fuel[lb]	46	46	46	85	76	68
25000	Time [min]	12.5	12.5	12.5	8.3	8.3	8.3
	Dist [nm]	47	49	50	44	44	44
	Fuel[lb]	40	40	40	72	64	56
20000	Time [min]	10.0	10.0	10.0	6.7	6.7	6.7
	Dist [nm]	36	37	39	34	34	34
	Fuel[lb]	32	32	32	56	49	43
15000	Time [min]	7.5	7.5	7.5	5.0	5.0	5.0
	Dist [nm]	26	27	28	24	24	24
	Fuel[lb]	25	25	24	40	34	29
10000	Time [min]	5.0	5.0	5.0	3.3	3.3	3.3
	Dist [nm]	17	18	18	15	15	15
	Fuel[lb]	17	17	17	24	20	16

* 250 kcas at and below 10,000 feet.

TDF_DES_ISA_0_02

Time, Distance, and Fuel to Descend to SL							
ISA+5		Flaps UP, No Wind, Ice Protection Off					
		Normal-2,000 FPM Thrust: Flight Idle			High Speed-3,000 FPM 270 KCAS / Mach 0.72*		
		Descent Weight [lb]			Descent Weight [lb]		
Altitude [ft]		8000	9000	10000	8000	9000	10000
43000	Time [min]	21.6	21.6	21.6	14.3	14.3	14.3
	Dist [nm]	94	96	98	86	86	86
	Fuel[lb]	69	69	69	127	117	107
41000	Time [min]	20.6	20.6	20.6	13.7	13.7	13.7
	Dist [nm]	88	90	92	82	82	82
	Fuel[lb]	66	66	66	123	113	103
39000	Time [min]	19.6	19.6	19.6	13.0	13.0	13.0
	Dist [nm]	82	85	87	77	77	77
	Fuel[lb]	63	63	63	119	109	99
37000	Time [min]	18.6	18.6	18.6	12.3	12.3	12.3
	Dist [nm]	77	79	81	72	72	72
	Fuel[lb]	60	60	59	114	104	94
35000	Time [min]	17.6	17.6	17.6	11.7	11.7	11.7
	Dist [nm]	72	74	75	68	68	68
	Fuel[lb]	57	56	56	108	98	89
33000	Time [min]	16.6	16.6	16.6	11.0	11.0	11.0
	Dist [nm]	67	68	70	63	63	63
	Fuel[lb]	53	53	53	102	92	83
31000	Time [min]	15.6	15.6	15.6	10.3	10.3	10.3
	Dist [nm]	62	63	66	58	58	58
	Fuel[lb]	50	50	50	94	85	76
29000	Time [min]	14.6	14.6	14.6	9.7	9.7	9.7
	Dist [nm]	57	58	60	53	53	53
	Fuel[lb]	47	47	47	87	78	69
25000	Time [min]	12.6	12.5	12.5	8.3	8.3	8.3
	Dist [nm]	48	49	50	44	44	44
	Fuel[lb]	40	40	40	73	65	58
20000	Time [min]	10.0	10.0	10.0	6.7	6.7	6.7
	Dist [nm]	37	38	39	34	34	34
	Fuel[lb]	32	32	32	57	50	44
15000	Time [min]	7.5	7.5	7.5	5.0	5.0	5.0
	Dist [nm]	27	27	28	24	24	24
	Fuel[lb]	25	25	25	41	35	30
10000	Time [min]	5.0	5.0	5.0	3.3	3.3	3.3
	Dist [nm]	17	18	18	16	16	16
	Fuel[lb]	17	17	17	24	21	17

* 250 kcas at and below 10,000 feet.

TDF_DES_ISA+5_0_02

Time, Distance, and Fuel to Descend to SL							
ISA+10		Flaps UP, No Wind, Ice Protection Off					
		Normal-2,000 FPM Thrust: Flight Idle			High Speed-3,000 FPM 270 KCAS / Mach 0.72*		
Altitude [ft]		Descent Weight [lb]			Descent Weight [lb]		
		8000	9000	10000	8000	9000	10000
43000	Time [min]	21.5	21.6	21.6	14.3	14.3	14.3
	Dist [nm]	95	97	99	87	87	87
	Fuel[lb]	70	70	70	130	120	110
41000	Time [min]	20.5	20.6	20.6	13.7	13.7	13.7
	Dist [nm]	89	91	93	82	82	82
	Fuel[lb]	67	67	66	126	116	106
39000	Time [min]	19.5	19.6	19.6	13.0	13.0	13.0
	Dist [nm]	83	85	87	78	78	78
	Fuel[lb]	64	64	63	122	111	102
37000	Time [min]	18.5	18.6	18.6	12.3	12.3	12.3
	Dist [nm]	78	80	81	73	73	73
	Fuel[lb]	60	60	60	117	107	97
35000	Time [min]	17.5	17.6	17.6	11.7	11.7	11.7
	Dist [nm]	72	74	76	68	68	68
	Fuel[lb]	57	57	57	111	101	91
33000	Time [min]	16.5	16.6	16.5	11.0	11.0	11.0
	Dist [nm]	67	69	70	64	64	64
	Fuel[lb]	54	54	54	104	94	85
31000	Time [min]	15.5	15.6	15.5	10.3	10.3	10.3
	Dist [nm]	62	64	66	59	59	59
	Fuel[lb]	51	51	50	96	87	78
29000	Time [min]	14.5	14.5	14.5	9.7	9.7	9.7
	Dist [nm]	57	59	60	54	54	54
	Fuel[lb]	47	47	47	89	80	71
25000	Time [min]	12.5	12.5	12.5	8.3	8.3	8.3
	Dist [nm]	48	49	50	45	45	45
	Fuel[lb]	41	41	41	75	67	59
20000	Time [min]	10.0	10.0	10.0	6.7	6.7	6.7
	Dist [nm]	37	38	39	34	34	34
	Fuel[lb]	33	33	32	58	52	46
15000	Time [min]	7.5	7.5	7.5	5.0	5.0	5.0
	Dist [nm]	27	28	28	24	24	24
	Fuel[lb]	25	25	25	42	36	31
10000	Time [min]	5.0	5.0	5.0	3.3	3.3	3.3
	Dist [nm]	17	18	18	15	16	16
	Fuel[lb]	17	17	17	25	21	18

* 250 kcas at and below 10,000 feet.

TDF_DES_ISA+10_0_02

Time, Distance, and Fuel to Descend to SL

ISA+15		Flaps UP, No Wind, Ice Protection Off					
		Normal-2,000 FPM Thrust: Flight Idle			High Speed-3,000 FPM 270 KCAS / Mach 0.72*		
Altitude [ft]		Descent Weight [lb]			Descent Weight [lb]		
		8000	9000	10000	8000	9000	10000
43000	Time [min]	21.6	21.6	21.6	14.3	14.3	14.3
	Dist [nm]	95	98	100	88	88	88
	Fuel[lb]	71	71	71	133	123	112
41000	Time [min]	20.6	20.6	20.6	13.7	13.7	13.7
	Dist [nm]	89	92	94	83	83	83
	Fuel[lb]	68	68	67	129	119	108
39000	Time [min]	19.6	19.6	19.6	13.0	13.0	13.0
	Dist [nm]	84	86	88	78	78	78
	Fuel[lb]	65	64	64	124	114	104
37000	Time [min]	18.6	18.6	18.6	12.3	12.3	12.3
	Dist [nm]	78	80	82	74	74	74
	Fuel[lb]	61	61	61	119	109	99
35000	Time [min]	17.6	17.5	17.6	11.7	11.7	11.7
	Dist [nm]	73	75	76	69	69	69
	Fuel[lb]	58	58	58	113	103	94
33000	Time [min]	16.6	16.5	16.6	11.0	11.0	11.0
	Dist [nm]	68	69	71	64	64	64
	Fuel[lb]	55	54	54	106	97	87
31000	Time [min]	15.6	15.5	15.6	10.3	10.3	10.3
	Dist [nm]	62	64	66	59	59	59
	Fuel[lb]	51	51	51	99	89	80
29000	Time [min]	14.6	14.5	14.5	9.7	9.7	9.7
	Dist [nm]	58	59	61	54	54	54
	Fuel[lb]	48	49	48	91	82	73
25000	Time [min]	12.5	12.5	12.5	8.3	8.3	8.3
	Dist [nm]	48	49	51	45	45	45
	Fuel[lb]	41	41	41	77	69	61
20000	Time [min]	10.0	10.0	10.0	6.7	6.7	6.7
	Dist [nm]	37	38	39	34	34	34
	Fuel[lb]	33	33	33	60	53	46
15000	Time [min]	7.5	7.5	7.5	5.0	5.0	5.0
	Dist [nm]	27	28	29	24	24	24
	Fuel[lb]	25	25	25	43	37	32
10000	Time [min]	5.0	5.0	5.0	3.3	3.3	3.3
	Dist [nm]	17	18	19	16	16	16
	Fuel[lb]	17	17	17	26	22	18

* 250 kcas at and below 10,000 feet. TDF_DES_ISA+15_0_02

Time, Distance, and Fuel to Descend to SL							
ISA+20		Flaps UP, No Wind, Ice Protection Off					
		Normal-2,000 FPM Thrust: Flight Idle			High Speed-3,000 FPM 270 KCAS / Mach 0.72*		
Altitude [ft]		Descent Weight [lb]			Descent Weight [lb]		
		8000	9000	10000	8000	9000	10000
43000	Time [min]	21.5	21.6	21.6	14.3	14.3	14.3
	Dist [nm]	96	98	100	89	89	89
	Fuel[lb]	72	72	71	136	125	115
41000	Time [min]	20.5	20.6	20.6	13.7	13.7	13.7
	Dist [nm]	90	92	94	84	84	84
	Fuel[lb]	69	69	68	132	121	111
39000	Time [min]	19.5	19.6	19.6	13.0	13.0	13.0
	Dist [nm]	84	86	88	79	79	79
	Fuel[lb]	65	65	65	127	117	107
37000	Time [min]	18.5	18.6	18.5	12.3	12.3	12.3
	Dist [nm]	79	81	82	74	74	74
	Fuel[lb]	62	62	62	122	112	102
35000	Time [min]	17.5	17.6	17.5	11.7	11.7	11.7
	Dist [nm]	73	75	77	70	70	70
	Fuel[lb]	59	59	58	116	106	96
33000	Time [min]	16.5	16.6	16.5	11.0	11.0	11.0
	Dist [nm]	68	70	71	65	65	65
	Fuel[lb]	55	55	55	109	99	90
31000	Time [min]	15.5	15.6	15.5	10.3	10.3	10.3
	Dist [nm]	63	65	66	60	60	60
	Fuel[lb]	52	52	52	101	91	82
29000	Time [min]	14.5	14.6	14.5	9.7	9.7	9.7
	Dist [nm]	58	60	61	55	55	55
	Fuel[lb]	49	49	48	93	84	75
25000	Time [min]	12.5	12.5	12.5	8.3	8.3	8.3
	Dist [nm]	48	50	51	46	46	46
	Fuel[lb]	42	42	42	79	71	63
20000	Time [min]	10.0	10.0	10.0	6.7	6.7	6.7
	Dist [nm]	37	38	39	35	35	35
	Fuel[lb]	33	33	33	61	54	48
15000	Time [min]	7.5	7.5	7.5	5.0	5.0	5.0
	Dist [nm]	27	28	29	25	25	25
	Fuel[lb]	26	26	25	44	38	33
10000	Time [min]	5.0	5.0	5.0	3.3	3.3	3.3
	Dist [nm]	17	18	19	16	16	16
	Fuel[lb]	18	18	18	26	23	19

* 250 kcas at and below 10,000 feet.

TDF_DES_ISA+20_0_02

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Holding Fuel Burn, Fuel Flow [lbs/hr]

ISA	140 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	437	453	470	488	506	529
20000	452	468	485	503	520	542
15000	467	483	500	518	537	560
10000	483	499	516	534	553	577
5000	502	518	535	553	572	597
1500	518	534	551	569	588	612

HLD_140_ISA_0_03

Holding Fuel Burn, Fuel Flow [lbs/hr]

ISA+10	140 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	449	466	482	500	518	542
20000	464	481	498	517	536	561
15000	480	497	514	532	552	575
10000	496	513	530	549	568	593
5000	515	531	549	567	587	612
1500	531	548	565	583	603	627

HLD_140_ISA+10_0_03

Holding Fuel Burn, Fuel Flow [lbs/hr]

ISA+20	140 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	462	479	497	517	537	563
20000	477	494	511	530	550	576
15000	492	509	527	546	566	591
10000	509	526	544	563	583	608
5000	527	544	562	581	601	626
1500	544	561	578	597	617	642

HLD_140_ISA+20_0_03

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA	180 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	548	558	569	580	592	608
20000	565	574	585	595	607	621
15000	586	596	606	616	628	642
10000	608	618	628	639	650	665
5000	630	641	651	663	675	690
1500	648	658	669	680	692	707

HLD_180_ISA_0_02

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+10	180 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	563	573	584	596	608	624
20000	584	594	606	617	630	645
15000	602	612	622	633	645	669
10000	624	635	646	657	670	685
5000	646	657	668	680	692	707
1500	664	674	685	697	709	725

HLD_180_ISA+10_0_02

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+20	180 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	584	594	605	617	629	645
20000	599	609	620	632	644	659
15000	619	630	641	653	666	682
10000	640	651	663	675	688	704
5000	662	673	685	697	710	726
1500	680	690	702	714	727	743

HLD_180_ISA+20_0_02

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA	200 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	628	637	646	656	666	678
20000	644	652	661	671	681	694
15000	666	674	683	692	701	713
10000	696	704	713	722	732	745
5000	721	730	739	748	758	771
1500	740	748	757	767	777	790

HLD_200_ISA_0_03

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+10	200 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	652	661	669	679	688	701
20000	669	677	686	696	706	719
15000	684	693	701	710	720	732
10000	715	723	732	742	752	765
5000	740	748	758	767	778	791
1500	758	767	776	786	797	810

HLD_200_ISA+10_0_03

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+20	200 KCAS, Flaps UP No Wind, Ice Protection Off					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
25000	666	675	684	694	704	718
20000	683	692	701	710	721	734
15000	708	716	725	735	745	757
10000	734	743	752	763	772	785
5000	759	769	778	788	799	813
1500	778	787	797	807	818	832

HLD_200_ISA+20_0_03

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA	140 KCAS, Flaps TO/APPR, Icing No Wind					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
18000	800	817	835	854	874	899
15000	808	824	841	859	879	905
10000	834	849	865	882	900	922
5000	861	877	893	909	927	950
1500	880	896	914	932	950	972

HLD_140_TO_ISA_0_01

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+10	140 KCAS, Flaps TO/APPR, Icing No Wind					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
18000	821	838	856	876	896	923
15000	829	845	863	881	902	928
10000	855	870	887	904	922	945
5000	882	898	914	931	949	972
1500	901	918	936	954	973	996

HLD_140_TO_ISA+10_0_01

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+20	140 KCAS, Flaps TO/APPR, Icing No Wind					
	Weight [lbs]					
Altitude [ft]	8000	8500	9000	9500	10000	10600
18000	842	860	878	898	919	946
15000	849	866	885	904	925	951
10000	869	884	901	920	940	965
5000	904	921	939	958	977	1003
1500	923	940	958	977	997	1022

HLD_140_TO_ISA+20_0_01

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA	180 KCAS, Flaps TO/APPR, Icing No Wind					
Altitude [ft]	Weight [lbs]					
	8000	8500	9000	9500	10000	10600
18000	1187	1198	1210	1222	1235	1251
15000	1199	1210	1221	1234	1246	1262
10000	1216	1227	1238	1251	1263	1280
5000	1237	1247	1258	1270	1282	1298
1500	1256	1267	1277	1289	1301	1316

HLD_180_TO_ISA_0_01

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+10	180 KCAS, Flaps TO/APPR, Icing No Wind					
Altitude [ft]	Weight [lbs]					
	8000	8500	9000	9500	10000	10600
18000	1217	1228	1240	1253	1266	1283
15000	1229	1240	1251	1264	1277	1293
10000	1245	1256	1268	1280	1293	1310
5000	1266	1277	1288	1300	1312	1328
1500	1286	1296	1307	1319	1332	1347

HLD_180_TO_ISA+10_0_01

Holding Fuel Burn, Fuel Flow [lbs/hr]						
ISA+20	180 KCAS, Flaps TO/APPR, Icing No Wind					
Altitude [ft]	Weight [lbs]					
	8000	8500	9000	9500	10000	10600
18000	1212	1212	1211	1210	1210	1209
15000	1258	1269	1281	1294	1304	1303
10000	1274	1285	1297	1310	1323	1340
5000	1295	1306	1318	1330	1343	1359
1500	1315	1325	1337	1349	1362	1378

Dark grey shading indicates MCT thrust and <180 kcas

HLD_180_TO_ISA+20_0_01

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Altitude Capability, Altitude [ft] AEO No Wind, Ice Protection Off						
dISA [°C]	Weight [lbs]					
	8000	8500	9000	9500	10000	10500
0	43000	43000	43000	43000	43000	43000
5	43000	43000	43000	43000	43000	43000
10	43000	43000	43000	43000	42500	41800
15	43000	43000	42600	41900	41300	40700
20	42400	41700	41200	40600	39900	39200

ALTCAP_AEO_0_02

Altitude Capability, Altitude [ft] OEI No Wind, Ice Protection Off						
dISA [°C]	Weight [lbs]					
	8000	8500	9000	9500	10000	10500
0	33200	32000	30900	29800	28600	27500
5	32500	31400	30300	29100	27900	26600
10	31300	30200	29100	27800	26300	24700
15	29600	28300	27000	25600	24100	20200
20	27700	26200	24800	20700	19600	18800

ALTCAP_OEI_0_02

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SECTION 3

OPERATING PROCEDURES AND TECHNIQUES

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OPERATING PROCEDURES AND TECHNIQUES

GENERAL

The purpose of this section is to provide crew with common techniques to reference for operation of the HondaJet HA-420. Use of these procedures enhances crew performance and effectiveness. The techniques in this manual are not mandatory, nor are they intended to supersede airmanship and good judgment or guidance of a regulatory nature. This section shall be used in conjunction with the FAA approved Airplane Flight Manual (AFM) and the Garmin® G3000® Integrated Avionics System Pilot's Guide, which provides detailed guidance on avionics functions, customization, and settings. If there is a conflict, the AFM shall take precedence.

This manual contains techniques for using standard and optional equipment. The reader may omit steps referring to any optional equipment that is not installed.

RESPONSIBILITIES

The techniques in this manual refer to single pilot operations and, where applicable, provide suggestions for effective crew resource management when additional crew members are available.

In cases with more than one crew member, certain conventions appear throughout the manual to designate the crew members and their responsibilities. The Pilot in Command (PIC) is the ultimate authority and responsible for safe conduct of the flight. When required, the Second in Command (SIC) assists the PIC with assigned duties as directed by regulatory guidance and suggested by this manual. The pilot flying (PF) refers to the crew member who has the primary responsibility for control and navigation of the aircraft and accomplishes or calls for checklists, as required. The pilot monitoring (PM) assists the PF by monitoring the flight path of the aircraft and is responsible for radio communications and reading or performing normal, abnormal, and emergency checklists as directed by the PF.

COCKPIT/CREW RESOURCE MANAGEMENT

Aircrew should not allow the avionics to detract from flying the aircraft, but effective use of the displays and avionics functions will contribute to decreased workload and increased situational awareness. This manual provides techniques to reduce workload and make effective use of cockpit resources, automation, and design features that will enhance single pilot operations. Where possible, it also provides suggestions for effective crew resource management when additional crew members are available.

CHECKLIST

Checklist discipline is essential to safe operation. The design of the checklist procedures together with the layout of controls and displays in the cockpit of the HA-420 creates a natural flow that maximizes efficiency in normal operations. Do not allow checklist operations to distract from aircraft control or navigation. The pilot should reference checklists when stopped on the ground or with the autopilot engaged during flight whenever possible.

Several conventions appear in the AFM and Quick Reference Handbook (QRH) procedural guidance. Responses to checklist items printed in capital letters coincide with switch or control labels in the cockpit. This correlation may not be verbatim but should be obvious. For example, RET, the abbreviation for *retract*, appears in the checklist as seen below and corresponds to the appropriate label on the center console next to the speedbrake control lever.

SPEEDBRAKE (if installed)………RET

Some checklist items refer to multiple user interfaces (panels and switches) or specific areas on the displays and these appear in checklists with initial capitalization convention as seen here.

Flight Guidance……………………As required

Finally, the response to some checklist items requires several sub-steps. These expanded sub-steps are listed in the AFM, but they may not appear in the QRH or electronic checklist. In these cases, the response step immediately follows the checklist item with no ellipses (…). The response appears in parentheses as seen here.

Avionics / Flight Data (Set/Entered)

The AFM normal checklist procedures will specify “Normal” when a switchlight is dark (nothing illuminated) in normal operations. Otherwise, the AFM will show the required position in capital letters, for example “OFF” or “NORM” for switchlights.

Abnormal indications appear as amber in switchlights, for example, amber “OFF.” Rotary switches are referenced by the label of the desired position in capital letters. In most cases, selection of a switch or actuation of a control provides tactile feedback and visual indication on the corresponding display, and proper checklist discipline should include verification of both. For example, set the parking brake handle and verify the parking brake indication appears on the Aircraft Systems and Information (ASI) display.

CREW ALERTING

The alerting system of the HA-420 airplane follows certain conventions in accordance with the AFM. These alerts consist of visual, aural, and tactile means of notifying the pilot of advisory, abnormal, and emergency operating conditions.

CAS messages are text alerts that appear in one of four colors corresponding to their classification in the lower right corner of the PFDs or, in case of pilot PFD failure, on the MFD in reversionary display mode.

CAS messages include three levels of alerts—warning, caution, and advisory—as well as status information messages. Certain CAS messages will also have aural alerts associated with them. Aural alerts include tones and spoken alert messages. Tactile alerts are used for the stall warning function via a single shaker motor.

Pressing the pilot or copilot's MASTER WARNING/CAUTION button acknowledges warning and caution CAS messages.

In general, red alerts and CAS messages refer to situations requiring immediate response to protect the occupants and the aircraft from harm during a critical situation.

Amber alerts and CAS messages usually indicate failure conditions that require timely pilot action to maintain an acceptable level of airworthiness or reduce operational risk resulting from the failure.

Cyan advisory CAS messages only require routine pilot reaction. There are two types of advisory messages. One type posts when a control is placed in a non-normal position; the other posts due to a fault or loss of redundancy that requires simple or no crew action. For example, selection of the fuel pump to ON or OFF will result in a cyan CAS message. In all cases, the pilot should acknowledge all alerts and CAS messages and reference the AFM for required actions.

AFM advisory procedures for cyan CAS messages note whether or not that failure is included in the manufacturer-provided master minimum equipment list (MMEL). All failures must be addressed prior to flight unless dispatch is allowed by an approved minimum equipment list (MEL) or otherwise authorized by the appropriate aviation authority.

The following sections provide amplified techniques for completion of normal procedures found in the AFM. Some checklist steps do not require amplification, and in those cases, they do not appear below. Do not substitute these techniques for the AFM or approved abbreviated checklist, but use them to enhance pilot knowledge and improve efficiency.

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PREFLIGHT INSPECTION

PRELIMINARY EXTERIOR INSPECTION

Accomplish the Preliminary Exterior Inspection in accordance with the AFM. See Section 4 for the number and location of covers, tie-downs, and the rudder gust lock.

COCKPIT/CABIN INSPECTION

Accomplish the Cockpit/Cabin Inspection in accordance with the AFM.

After power on, many systems automatically perform initiated built in tests (IBIT), as indicated by “Test In Progress” and graying out the pilot initiated test on the Test Status field, on the Systems Test page. During this time, abnormal indications may occur on synoptic pages. Pilot initiated tests can be started after the IBIT has finished and the pilot initiated tests are no longer grayed out.

The MFD shows a splash screen with software version and database expiration dates. The pilot should verify the status of each database and then press the right-most softkey to continue.

Check fuel quantity and balance on the ASI. Set the parking brake and verify PARKING BRAKE SET indication in the Landing Gear section of the ASI or on the Status synoptic. Use the STATUS synoptic to verify that engine oil quantity is NORM, solid state relays and PDU circuit breakers are NORMAL, both fire bottles are NORMAL, and hydraulic reservoir quantity is nominal. Refer to AFM Section 4, Oxygen Consumption, to confirm indicated oxygen quantity, as displayed on Status synoptic, is sufficient for the planned flight.

NOTE On battery power, CDU 2 is unpowered. The copilot can still transmit and tune radios through CDU 1.

EXTERIOR INSPECTION

Accomplish the exterior inspection in accordance with the AFM.

GROUND OPERATIONS

BEFORE STARTING ENGINES

Accomplish the Before Starting Engines checklist in accordance with the AFM.

Oxygen

Check the oxygen mask and panel in accordance with the AFM.

Each pilot should confirm on-side speaker operation by listening for oxygen flow while simultaneously depressing the oxygen box TEST/RESET and the oxygen mask PRESS TO TEST after selecting the OXY MASK AUDIO switch to EMER. Do not allow the headset to cover the ear during this check, as interphone audio may prevent the pilot from hearing speaker audio. After the oxygen check is complete, the speakers will remain on, and the pilot should adjust volume or may deselect left and right speakers on the respective CDU audio page if headsets are worn.

Trim Panel
Check the trim panel in accordance with the AFM.

Refer to AFM Section 5, Takeoff Pitch Trim Settings, and set the pitch trim for takeoff.

NOTE The pitch trim green band varies based on flap setting. If planning to conduct the takeoff with flaps UP, the pitch trim will be in the green band at this time. If planning to conduct the takeoff with flaps TO/APPR, set the trim using the digital display of trim setting. Verify the trim is set in the green band during the Before Taxi checklist.

Standby Instrument
Verify the standby instrument has powered on, completed its alignment, and displays valid data. Use the baro knob to set the current altimeter setting.

Exterior Lights
When left in the default (NORM) position, exterior lights illuminate automatically based on time of day and phase of flight. When the exterior lights are in NORM, lighting items contained in the checklist may be checked as complete without any other pilot action. If desired, manual operation of the lights is possible through the CDU. In this case, the **EXT LIGHTS MAN OFF** advisory CAS will post if one or more lights are commanded off when the automation would have switched it on.

NOTE If powering up on battery power, most exterior lights will not be functional until a generator comes online.

Avionics Initialization

Accomplish the avionics initialization in accordance with the AFM. When all data has been entered correctly, select Accept to confirm.

NOTE If powering up on battery, the SERVO POWER and ENGINE START panels and the throttle quadrant will not be powered and therefore those switchlights cannot be checked during the Switchlights test. If desired, re-run this test following engine start.

NOTE The optional CVFDR is not powered on battery power and can therefore only be tested when the aircraft is powered by generator(s) or external power.

NOTE When shutting down without external power connected, a momentary **R AUDIO FAIL** caution message may post.

Set transition altitude alert as appropriate for the departure.

STARTING ENGINES

Accomplish the Starting Engines checklist in accordance with the AFM.

Passenger Briefing

The passenger briefing should include consideration of the following items as well as other regulatory guidance and industry recommended practices.

- Emergency equipment
- Operation of the main entry and emergency exit doors
- Seats and seat belts
- Use of electronic devices
- Securing carry-on items
- Flight duration

Rudder Pedals

After adjustment, confirm both pedals are in the selected detent and that full deflection can be achieved.

Seats, Safety Belts

Adjust seat height so that the top of the glareshield can just be seen. Adjust fore/aft and recline so that full control column deflection can be achieved and all controls can be reached.

Doors

Verify that all “door” CAS messages have extinguished. The external power door (if used) is the only door that should be open during engine start. The right engine may be operated for heating/cooling while the main entry and baggage doors are open.

CAS Messages

The pilot should understand each CAS message displayed before engine start and correct those CAS messages not present in normal operations.

NOTE The following CAS messages appear during normal operations **L (R) ENG SHUTDOWN** and **EXT PWR DOOR OPEN** (if using external power). Other messages may appear momentarily after power up but should clear after the aircraft has fully initialized.

NOTE The Status Synoptic L(R) OIL QUANTITY indication may toggle between NORMAL and LOW following engine start on battery power until synoptic declutters following engine start.

Single Engine Cooling / Heating

To heat or cool the aircraft prior to taxi, start an engine, and select Ground Cooling mode. External power can also be used for cooling.

Engine Anti-Ice

Select ENG ANTI-ICE to ON after engine start, if operating in ground icing conditions.

External Power

After confirming both generators are online, signal to the ground crew to remove external power and verify the **EXT PWR DOOR OPEN** message extinguishes. Verify the power cart is clear of the aircraft prior to taxi.

BEFORE TAXI

Wing Anti-Ice
If ground icing conditions exist or if icing is expected during takeoff, select wing anti-ice ON to allow the system to warm up.

NOTE Monitor ITT during operation of wing anti-ice.

Accomplish the Before Taxi checklist in accordance with the AFM.

NOTE An amber **HDG** miscompare flag may post on the PFDs while parked or taxiing in the vicinity of a GPU or other metal structures. This flag should clear when the aircraft is clear of these obstacles.

Avionics / Flight Data
Display the navigation map and airport diagram chart. Decrease (zoom in) the range of the navigation map to display SafeTaxi™ airport information to aid in taxi.

NOTE Verify displayed SafeTaxi™ information with airport signs and current NOTAMs to prevent unauthorized movement on the airport surface.

Runway

Designate takeoff runway and enter required distance using the Flight Plan and the Takeoff Data menu.

WARNING **Failure to verify performance data may adversely affect SurfaceWatch™ function and prevent annunciation of warnings and cautions.**

Flaps

Set the flap handle to the desired position for takeoff and verify the correct ASI indication. Taxi with flaps retracted if taxiways are contaminated or operating in ground icing conditions.

Parking Brake

Signal to line personnel to verify removal of wheel chocks before releasing the parking brakes.

TAXI

Accomplish the Taxi checklist in accordance with the AFM.

Check the brake operation as soon as the airplane begins to move. Clear aggressively for obstacles, aircraft and personnel in the parking area, and wait until clear of congested areas before performing other items on the taxi checklist. During normal taxi turns, check nosewheel steering, and verify the slip/skid trapezoid displaces opposite the turn direction and that heading indicators rotate correctly. During straight taxi, verify heading and attitude indicators match with no flags displayed.

NOTE The recognition and landing lights may be used to supplement the taxi lights as needed in poorly lit and/or wet taxiway conditions.

BEFORE TAKEOFF

Accomplish the Before Takeoff checklist in accordance with the AFM.

Verify that flaps are in the desired position for takeoff (UP or TO/APPR) and the posted speeds and entered required runway distance are appropriate for the selected flap position. Confirm the pitch trim setting in the green band. Roll and yaw trim shall be centered (green) for takeoff.

CAS Messages

During normal operations there will be no CAS alerts present. Nominal system operations such as use of engine anti-ice may result in white status CAS messages. The pilot should review each CAS message.

Navigation

Select the appropriate navigation source for departure. If necessary, set the course deviation indicator (CDI) to the course desired for takeoff and departure. Verify the CDI course and distance based on departure instructions. Display SID chart if appropriate and increase map range to show initial departure route.

Flight Guidance

Select the TOGA switch. It is recommended that TO mode is used in the lateral axis, and HDG or NAV is selected after takeoff as appropriate, to ensure proper FD commands in case of an engine failure during takeoff. Set the altitude and heading targets according to ATC clearance.

TOLD Data

Reference the AFM to confirm performance data. If using performance data from preflight planning, confirm that conditions have not changed to invalidate charted performance.

NOTE Crew must confirm that appropriate V-speeds are still posted. V-speeds may become deselected and revert back to default values after performing engine starts on battery power.

NOTE The takeoff field length provided in the performance section of the flight manual is based on a dry runway. If departing from a wet runway, it is recommended to increase the predicted takeoff field length by 30%.

Takeoff Briefing

The takeoff briefing should include consideration of the following items as well as industry recommended practices:

- Type of takeoff
- Weather conditions (winds, runway, surface condition, anti-ice, etc.)
- Takeoff abort intentions
- Review of takeoff speeds (bugs), takeoff performance data and runway available
- ATC clearance or VFR departure plan
- Emergency return intentions
- Questions or input from additional crew members

Radar
The Weather Radar may be operated on the ground. Ensure that the caution zone is kept clear of ground personnel.

NOTE When using Weather Radar map overlay, the Tilt/Bearing icon can be displayed when Tilt/Bearing control is not active. Pushing the joystick and cycling through its available functions should restore normal operation.

NOTE If the cross-side CDU takes control of the MFD when Weather Radar is displayed, selecting the WXR control page by pushing the joystick may result in the inability to select active tile. Selecting the Home or Back button should restore normal functionality.

Ice Protection
If takeoff will be accomplished into icing conditions, select wing anti-ice ON. Ensure **CONFIG WING ANTI-ICE** is extinguished before takeoff.

TAKEOFF

Accomplish the Takeoff procedure in accordance with the AFM.

NOTE Accomplish the steps in the Takeoff procedure from memory.

When cleared for takeoff, visually confirm that the final approach course and runway are clear and review CAS messages prior to taking the runway. The pilot may perform a performance or rolling takeoff according to the procedures that follow.

ROLLING TAKEOFF

When cleared for takeoff, advance thrust levers enough to begin taxi onto the runway. Steadily advance the thrust levers after aligning aircraft with the runway. After observing normal engine response and alignment with runway centerline, continue to advance thrust levers to TO.

CAUTION *Runway remaining at the time takeoff thrust is achieved must meet the runway performance requirements from the AFM. There is no runway required performance data in the AFM for a rolling takeoff.*

Crosscheck engine instruments. Verify that N_1 matches the N_1 target settings within 1% and “TO” is displayed in large font in the EIS. Verify that airspeed is increasing at expected rate and readings are matched. Prior to 80 knots, confirm responsiveness of aircraft to crosswind control inputs, if required, and verify pitch forces are increasing with airspeed.

At V_1, remove the hand from thrust levers and place it on the yoke. At V_R, rotate the aircraft with a steady, smooth motion to achieve the FD target takeoff pitch attitude in 3-4 seconds.

CAUTION *If a crosswind exists, strictly adhere to the recommended procedure in the AFM.*

PERFORMANCE TAKEOFF

See the AFM for static takeoff procedures. Strict adherence to these procedures is required to achieve the published performance.

CAUTION *Performance numbers from Section 5 of the AFM are unfactored numbers. If factored distances are required the factor must be added to the takeoff distance obtained from Section 5.*

AFTER TAKEOFF

Retract the gear after achieving a positive rate of climb. When clear of obstacles and at no less than 130 KIAS, retract the flaps. Confirm the gear and flaps are retracted on the ASI, and then reduce the thrust levers to MCT. The pilot should consider all factors when deciding when to retract flaps, including industry best practices, noise abatement, obstacle clearance, etc.

Select FD vertical mode to FLC and speed bug to V_{CLB} (or other speed if required by ATC) and select lateral mode to HDG or NAV.

Ice Protection
Select the Wing Anti-Ice switch to NORM if it was ON during takeoff.

Accomplish the After Takeoff checklist in accordance with the AFM. See the figure that follows.

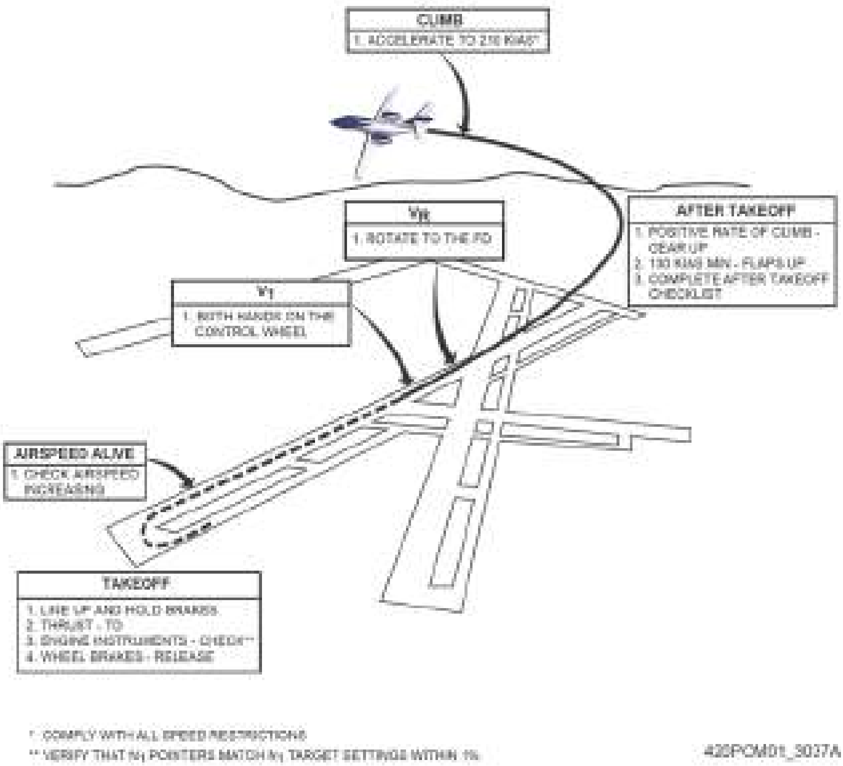

Figure 3-1. Normal Takeoff Profile

ENROUTE OPERATIONS

CLIMB

Accomplish the Climb checklist in accordance with the AFM.

CRUISE

Accomplish the Cruise checklist in accordance with the AFM.

Perform routine systems monitoring throughout the duration of cruise operations.

DESCENT

Accomplish the Descent checklist in accordance with the AFM.

Confirm Transition Altitude alert is set correctly for the arrival.

TERMINAL AREA OPERATIONS

APPROACH

Accomplish the Approach checklist in accordance with the AFM.

Passenger Briefing

The passenger briefing should include consideration of the following items, as well as other regulatory guidance and industry recommended practices.

- Seats and seat belts
- Use of electronic devices
- Securing carry-on items
- Arrival information

Avionics

When loading an instrument approach procedure, the pilot should thoroughly review each field on the CDU Procedures page to ensure accuracy. Additionally, the pilot should preview the instrument approach procedure chart and use it to input the approach minimums. After loading, view the flight plan to verify that it loaded correctly. Verify the frequency, visual or aural ident, and course information for all required radio navaids.

CAUTION *Compare the flight plan carefully to the chart. Errors in the database may result in omissions of segments, altitude constraints, or waypoints.*

Landing Data

Reference the AFM for landing distance and speeds. Load V-speeds and select landing runway and required distance.

If ice has accumulated on the aircraft, plan to use flaps set to TO/APPR for landing. Additionally, if icing conditions are expected at the destination airport, if may not be possible to safely retract flaps to UP in case of a missed approach. The reduced climb capability must be considered, as does the increased fuel burn to the alternate destination in this configuration.

When performing a circling approach or sidestep procedure, the crew should update the Landing Data page *after* loading the arrival or instrument approach. The pilot should also repeat this step if there are any subsequent changes to an arrival, instrument approach, or manual selection of a runway in the flight plan, as this will reset the Landing Data page.

WARNING **Failure to verify performance data may adversely affect SurfaceWatch™ function and prevent annunciation of warnings and cautions.**

NOTE The landing distance provided in the performance section of the flight manual is based on a dry runway. If landing on a wet runway, it is recommended to increase the predicted landing distance by 30%.

CAS Messages
During normal operations there will be no CAS alerts present. Nominal system operations, such as use of engine anti-ice, may result in status CAS messages. The pilot should review each CAS message.

Approach Briefing
The approach briefing should include consideration of the following items and industry recommended practices:

- Weather conditions (winds, runway, surface condition, anti-ice, etc.)
- Stable approach criteria
- Review of landing speeds (bugs), landing performance data and runway available
- Approach minimums and airfield environment
- Continue/Land/Balked Landing decision
- Landing emergencies
- Questions or input from additional crew members

INSTRUMENT APPROACH

If timing is required or desired, select the Timer on the CDU prior to commencing the approach.

NOTE In VNV mode, the FMS may not command a descent to the FAF altitude when it appears in the flight plan as an "at or above" altitude constraint. Instead, it will allow for intercept of the GS or GP above this altitude.

NOTE For FMS approaches with no vertical guidance, the APR button still arms the GP flight guidance mode. It will remain armed throughout the approach but will not interfere with selected pitch guidance mode.

Approach mode will not capture a back-course. Back course mode (BC) is armed by pressing the NAV key. When making a back-course approach, set the Selected Course to the localizer front course.

Initial Approach – Procedure Turn/Course Reversal
Accomplish the Approach checklist prior to beginning the instrument approach. Using the CDU, the pilot may activate the Procedure or select "direct to" the IF/IAF. Slow to 160 KIAS before reaching the fix. Arm approach mode (APR) when ATC approach clearance is received.

Initial Approach – No Procedure Turn
Accomplish the Approach checklist prior to beginning the instrument approach. Using the CDU, the pilot may activate the Procedure or select "direct to" the IF/IAF. Arm approach mode (APR) when ATC approach clearance is received. Slow to 160 KIAS no later than intercepting the final approach course.

Vectors to Final

Accomplish the Approach checklist no later than the base leg prior to beginning the instrument approach. Use the CDU to activate "vectors to final" after selecting HDG for flight guidance. Slow to 160 KIAS no later than intercepting the final approach course. Arm approach mode (APR) when ATC approach clearance is received.

NOTE In those cases where ATC instructs "intercept and track the localizer inbound", NAV mode should be used to prevent inadvertent descent on GS or GP. This technique applies to both RNAV and VHF NAV approaches (VOR or LOC).

Final Approach

Accomplish the Before Landing checklist prior to starting final descent.

The pilot should establish stable approach criteria. If exceeding these criteria, execute a missed approach or balked landing without delay. Except for momentary deviations, do not exceed:

- Airspeed: V_{REF} -5 / +10 knots

NOTE Verify V_{REF} speed against the green circle; they should normally be within +/- 2 knots.

- Navigation: +/- 1 dot deviation laterally and vertically
- When visual, within lateral confines of the runway.

With the runway in sight, maintain a composite crosscheck of navigation instruments and flight guidance on the PFD, as well as outside visual references. Make full use of visual glideslope guidance, such as VASI or PAPI, to prevent duck-under or visual illusions.

Wait until landing is assured, but no later than 50 ft AGL, to disconnect the yaw damper.

Just prior to landing, confirm proper landing configuration.

Approach with Vertical Guidance

Establish the final configuration prior to the final approach fix or glideslope/glidepath intercept. If flying with two crew members, verbally announce "1000 ft above" and "100 ft above" the DA/MDA. Declare intention to "Land," "Go-around" or "Continue" no later than the DA/MDA. Disconnect autopilot no later than 200 ft AGL for a non-precision approach and 100 ft AGL for a precision approach.

CAUTION *If using the GP mode to fly the vertical path with a non-precision approach, the aircraft will not level off at the selected altitude.*

Non-precision Approach (without vertical guidance)

Establish the final configuration prior to the final approach fix. If flying with two crew members, verbally announce "1000 ft above" and "100 ft above" the MDA. Declare intention to "Land" or "Go-around" no later than the visual descent point. Disconnect autopilot no later than 200 ft AGL for a non-precision approach.

Circling

This section refers to that visual portion of an instrument approach flown in VMC after the final approach segment when the aircraft is within the appropriate circling distance.

Circling approaches are flown with the flaps at LDG and the landing gear down at V_{REF} +10 from the final approach fix until established on final. When established on final, slow to V_{REF}.

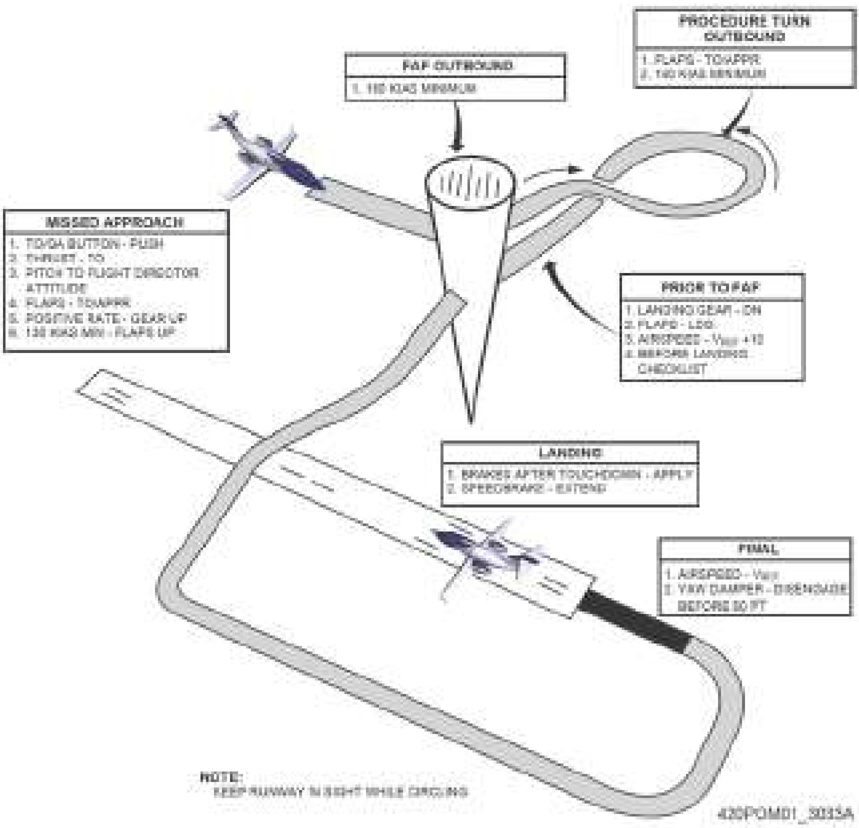

Figure 3-2. Circling Approach

Set the map zoom at useful range (2-5 nm) while approaching the airfield. Use the navigation map and the runway extension line, together with predicted flight path, to evaluate rollout onto final. Use the flight path marker and Synthetic Vision (SV) runway symbol to verify the aircraft is on a 3° flight path. Use SurfaceWatch™ to assist in confirmation of landing runway.

Instrument Approach Profiles

Suggested profiles for precision and non-precision approaches followed by a missed approach are shown in the figures that follow.

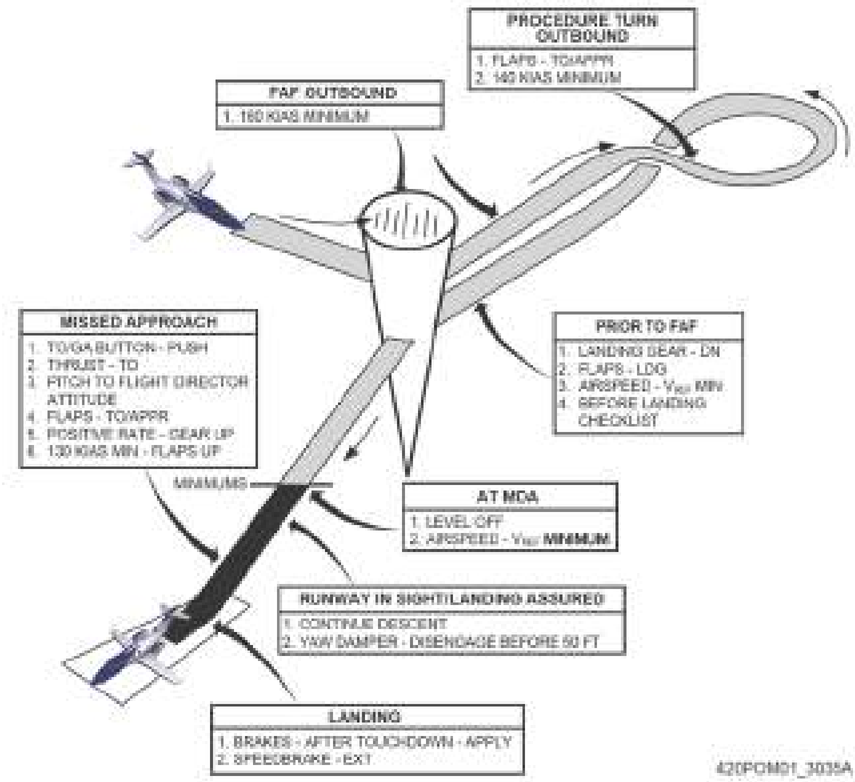

Figure 3-3. Non-Precision Approach

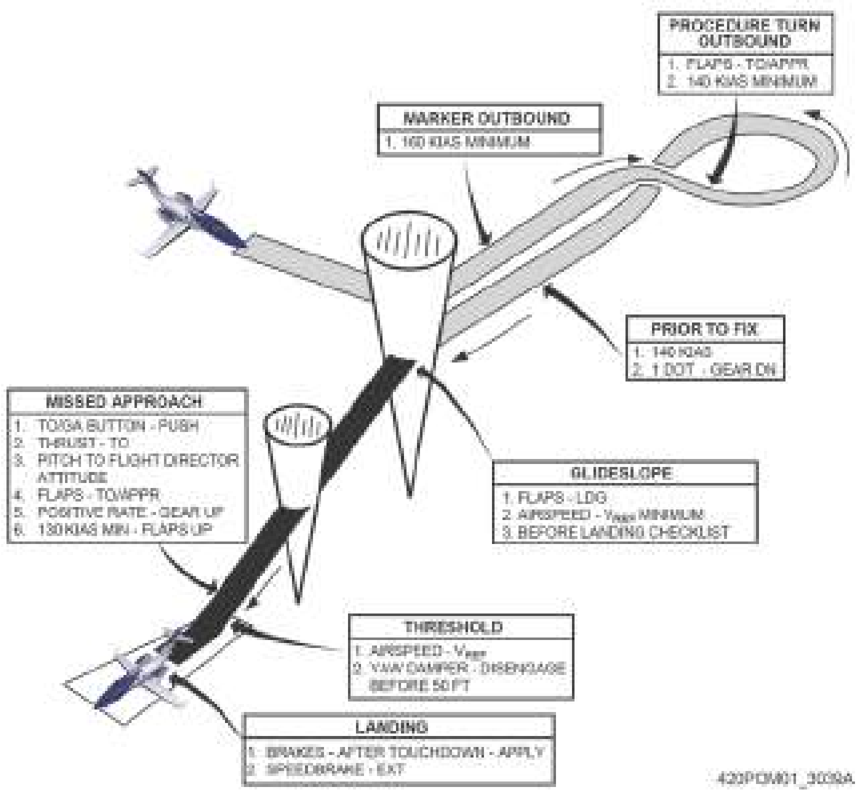

Figure 3-4. Precision Approach

VFR PATTERN

Accomplish the Approach checklist before entering the VFR pattern. Slow to 160 KIAS no later than intercepting downwind. For closed patterns, maintain 160 knots during the turn to downwind.

NOTE The closed pattern refers to those VFR pattern operations during which a continuous turn from upwind to downwind is made without rolling out on crosswind.

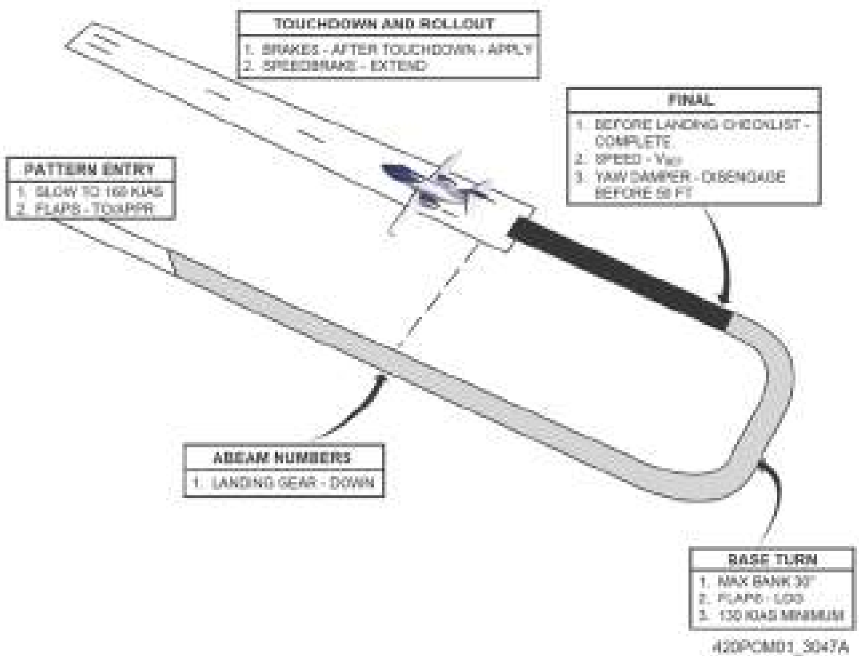

Figure 3-5. VFR Traffic Pattern

Extend landing gear no later than abeam the point of intended landing. Extend flaps to landing during the final turn, and maintain minimum 130 knots until established on final.

Complete the Before Landing checklist.

Use the flight path marker and SV runway symbol to verify the aircraft is on a 3° flight path.

LANDING

See the AFM for performance landing procedures. Crew must use AFM procedures to meet charted performance. Excess airspeed, tailwind, and runway downslope will increase the runway required to land.

NOTE Establish directional control using rudder, and then apply brakes symmetrically during the initial part of the landing rollout.

NORMAL LANDING

At 50 ft, rapidly reduce thrust to IDLE and touchdown with minimal flare. Lower the nose to the runway and apply maximum braking. Deploy the speedbrake (if installed) and maintain maximum braking until the aircraft has stopped. If minimum stopping distance is not required, a normal flare can be performed and braking applied as required by runway available and conditions.

CROSSWIND LANDING

See the AFM for further guidance.

BALKED LANDING

Initiate the balked landing by pressing the TOGA button, advance the thrust levers to TO, and pitch to maintain V_{REF}. Follow the flight director initially, then adjust the pitch attitude as required to maintain V_{REF}.

NOTE Accomplish the above steps without reference to the Balked Landing checklist.

Once clear of obstacles, set the flaps to TO/APPR, retract the landing gear when a positive rate of climb is confirmed and maintain V_{AC}. When clear of obstacles accelerate to 130 KIAS minimum and retract flaps UP.

It may not be possible to safely retract flaps to UP in case of a balked landing, if icing conditions were encountered with the flaps extended. Climb performance capability and increased fuel burn during cruise to the alternate destination must be considered in this configuration.

CAUTION *Retracting the flaps to UP following an icing encounter with the flaps extended may result in damage to the flaps or airframe.*

NOTE See performance tables in the Airplane Flight Manual (Section 5 – Performance) and either the Quick Reference Handbook (Volume 1, Performance Section) or the Pilot's Operating Manual (Section 2 – Flight Planning).

Accomplish the Balked Landing checklist in accordance with the AFM.

MISSED APPROACH

For a go around or missed approach, simultaneously press the TOGA button, advance the thrust levers to TO, and adjust initial pitch attitude to follow the flight director. Retract the flaps to TO/APPR and maintain V_{AC}. Retract the landing gear when a positive rate of climb is established. When clear of obstacles, accelerate to 130 KIAS minimum and retract the flaps to UP.

It may not be possible to safely retract flaps to UP in case of a missed approach, if icing conditions were encountered with the flaps extended. Climb performance capability and increased fuel burn during cruise to the alternate destination must be considered in this configuration.

CAUTION *Retracting the flaps to UP following an icing encounter with the flaps extended may result in damage to the flaps or airframe.*

Accomplish the Balked Landing checklist in accordance with the AFM.

NOTE With an instrument approach procedure loaded and activated, selecting TOGA will also activate the missed approach segment of the flight plan and select FMS as the navigation source.

AFTER LANDING

Accomplish the After Landing checklist in accordance with the AFM.

Although the After Landing checklist should be accomplished as soon as possible after exiting the runway, none of the items on the checklist must be accomplished immediately. Display the navigation map and an airport diagram. Decrease (zoom in) the range of the navigation map to display SafeTaxi™ airport information including taxiway names, hold short lines, hot spots, etc., to aid in taxi.

If icing was encountered with the flaps extended or after landing on a snow or slush covered runway, do not retract flaps to UP until they can be verified to be free from ice and snow accumulation.

CAUTION *Retracting the flaps to UP following an icing encounter with the flaps extended may result in damage to the flaps or aircraft. The flaps must be inspected, and any residual ice must be removed before retracting the flaps to UP.*

NOTE Verify displayed SafeTaxi™ and SurfaceWatch™ information with airport signs and current NOTAMs to prevent unauthorized movement on the airport surface.

NOTE Accomplish the above steps without reference to the checklist. When time and conditions permit, reference the After Landing checklist to confirm steps completed from memory.

SHUTDOWN

Upon arrival at the parking spot, set the parking brake and signal to the ground crew to install wheel chocks. Verify parking brake indication on the ASI.

EXTERNAL POWER

External power is not a requirement, but air conditioning and many systems on the right hand side of the aircraft, including right PFD and CDU, are not available without external power after the engines are shut down. If desired and external power is available, connect external power prior to shutting down both engines. EXT PWR AVAIL will display on the ASI when suitable electrical power is connected to the airplane and available for use.

THRUST LEVERS

Confirm engine indications decrease normally when the thrust levers are placed to CUT OFF. Verify the **L ENG SHUTDOWN** and **R ENG SHUTDOWN** CAS messages post.

SECURING THE AIRCRAFT

Confirm that wheel chocks are in place and both engines are shut down prior to releasing the parking brake. Install the gust locks, pitot covers, and engine covers as required before departing the aircraft (see Section 4 for details). If desired, install the locking device in the emergency exit door handle and lock the main entry door.

EMERGENCY AND ABNORMAL PROCEDURES

The purpose of this section is to provide crew with common techniques to reference for emergency/abnormal operations. The techniques in this manual are not mandatory, nor are they intended to supersede airmanship and good judgment or guidance of a regulatory nature. If there is a conflict, the AFM shall take precedence.

Explanation that amplifies abnormal and emergency procedures follows this section. Techniques described previously that apply to normal phases of flight do not repeat but may be applicable. For example, amplification about EXTERIOR LIGHTS, as described above, does not appear below but still applies whenever it appears in an abnormal or emergency checklist.

ENGINE FAILURE DURING TAKEOFF

When cleared for takeoff, advance thrust levers enough to begin taxi onto the runway. If conducting a static takeoff, refer to the AFM; otherwise steadily advance the thrust levers after aligning aircraft with the runway. After observing normal engine response and alignment with runway centerline, continue to advance thrust levers to TO.

CAUTION *Runway remaining at the time takeoff thrust is achieved must meet the runway performance requirements from the AFM. There is no runway required performance data in the AFM for a rolling takeoff.*

Crosscheck engine instruments. Verify that N_1 matches the N_1 target settings within 1% and “TO” is displayed in large font in the EIS. Verify that airspeed is increasing at expected rate and readings are matched. Verify that control yoke is responsive just prior to 80 KIAS.

If an engine fails or another situation occurs that requires the flight crew to abort the takeoff prior to reaching V_1, reduce the thrust levers to idle, apply the brakes and extend the speedbrake. See the figure that follows.

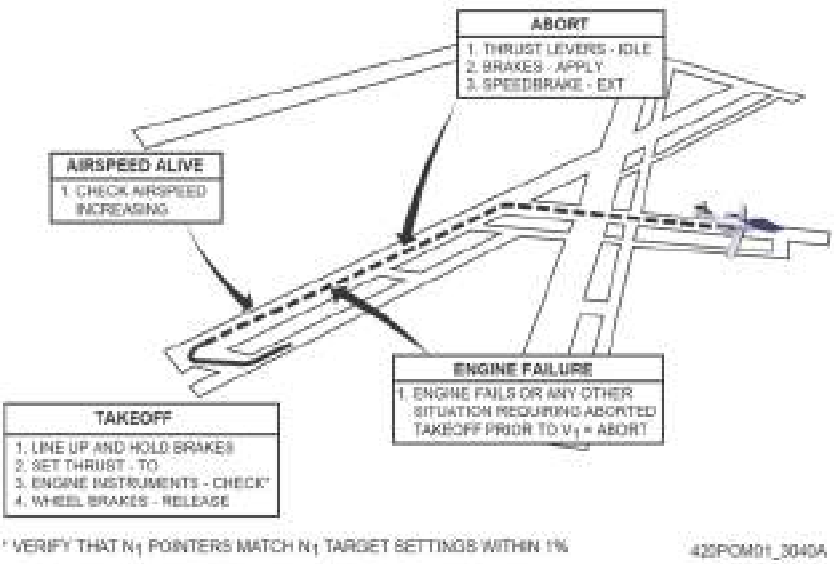

Figure 3-6. Rejected Takeoff

If an engine failure occurs after V_1 but before V_R, at V_1, remove the hand from thrust levers and place it on the yoke. At V_R, rotate the aircraft with a steady, smooth motion to achieve the FD target takeoff pitch attitude in 3-4 seconds.

NOTE Accomplish initial steps of this procedure from memory. When time and conditions permit, accomplish the **L(R) ENGINE FLAMEOUT** procedure in accordance with the AFM, and confirm those steps completed from memory.

Retract the landing gear after achieving a positive rate of climb. Adjust pitch to maintain V_2 during the initial climb. Use yaw and roll trim to reduce control forces, and engage the autopilot as desired. Further yaw trim adjustments may be required to maintain coordinated flight.

Pitch target can be adjusted using the control wheel steering (CWS) button momentarily to set the FD in pitch mode at a pitch attitude that yields the desired airspeed or by adjusting the pitch wheel. Alternatively, FLC mode can be selected and speed target set to V_2. Carefully monitor airspeed and climb rate.

When clear of obstacles or at 1,500 ft AGL, accelerate to V_2 + 10 KIAS, and retract the flaps. Accelerate to and climb at 140 KIAS. Reduce the thrust levers to MCT, and continue enroute climb. See the figure that follows.

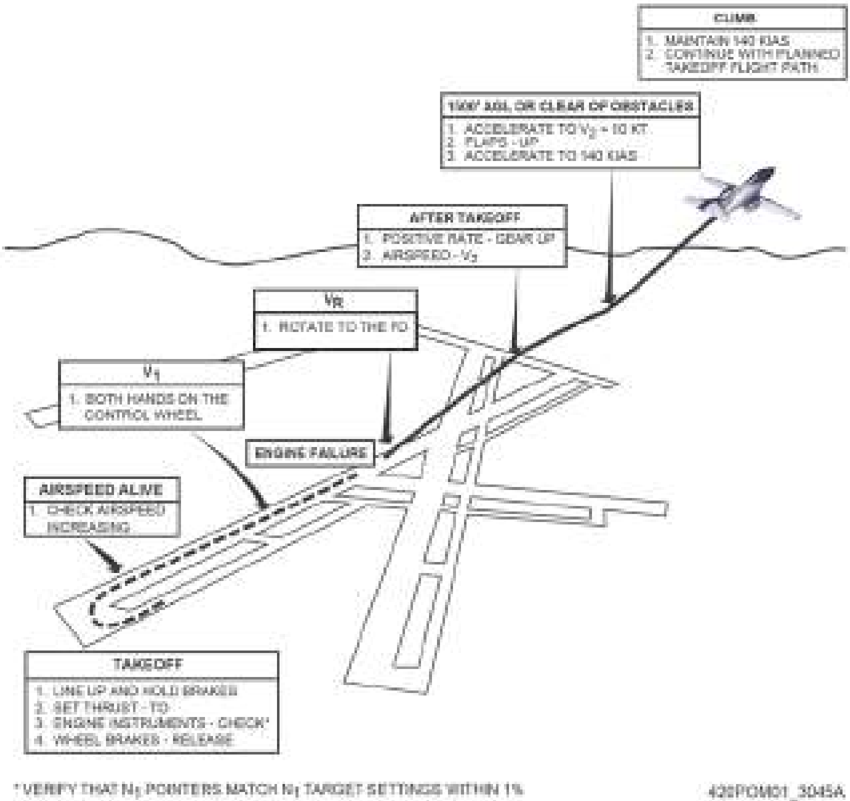

Figure 3-7. Engine Failure at or Above V_1

SINGLE-ENGINE APPROACH AND LANDING

Use the AFM Single-Engine Approach and Landing checklist instead of the normal Descent, Approach, and Before Landing checklists. Fly the final approach at V_{REF} + 5 with flaps TO/APPR. When landing is assured, select flaps to LDG and slow to V_{REF}. A smooth power reduction on the operating engine should minimize yaw transients during the flare and landing.

NOTE If the YD was engaged before the rudder bias engagement, the pilot has to disengage the YD prior to landing to prevent it from auto-engaging during the flare following the thrust reduction.

Approach Briefing (Before Landing)

In addition to normal approach briefing items, address non-standard landing speeds and distance, and give special emphasis to single-engine missed approach considerations.

TAWS Warning

Flap Override (if TAWS-A equipped) should be selected to avoid a nuisance alert.

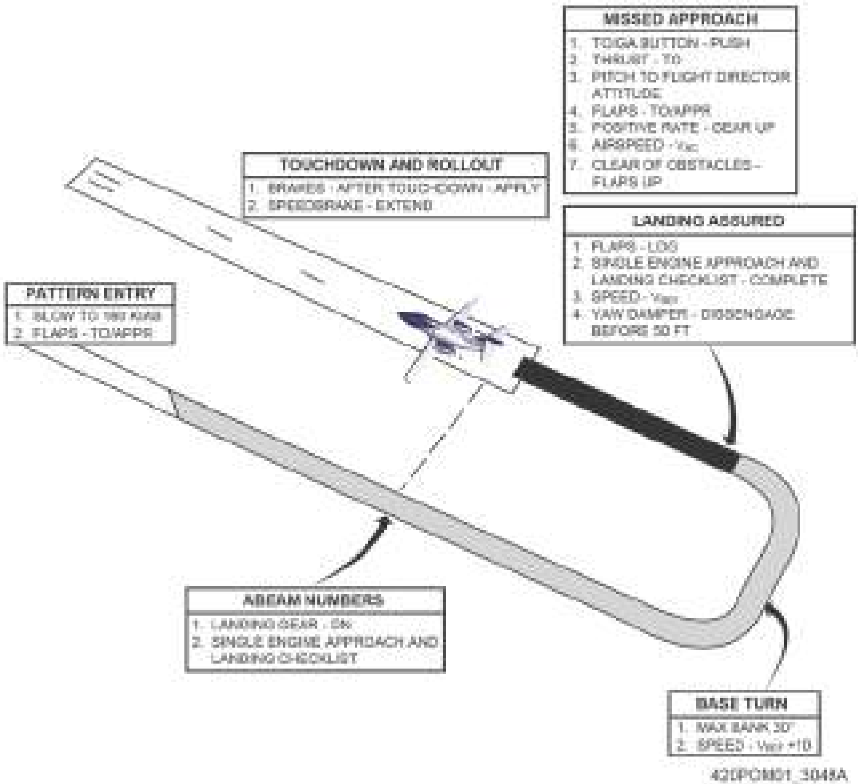

Figure 3-8. Visual Approach Single Engine

SINGLE ENGINE INSTRUMENT APPROACH PROFILES

Suggested profiles for single engine precision and single engine non-precision approaches followed by a missed approach are shown in the figures that follow.

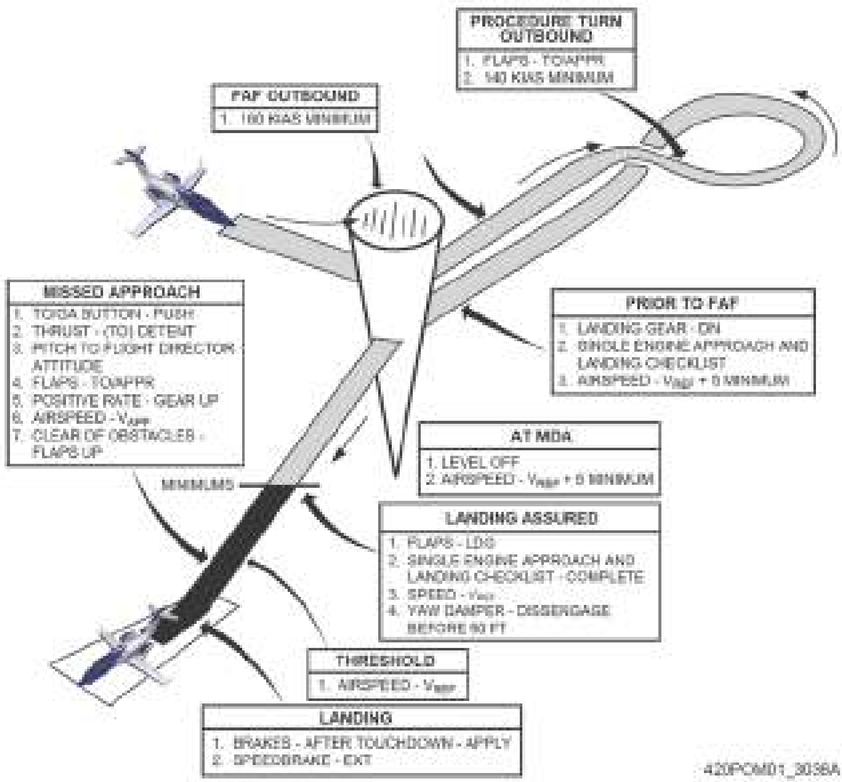

Figure 3-9. Non-Precision Approach – Missed Approach, Single Engine

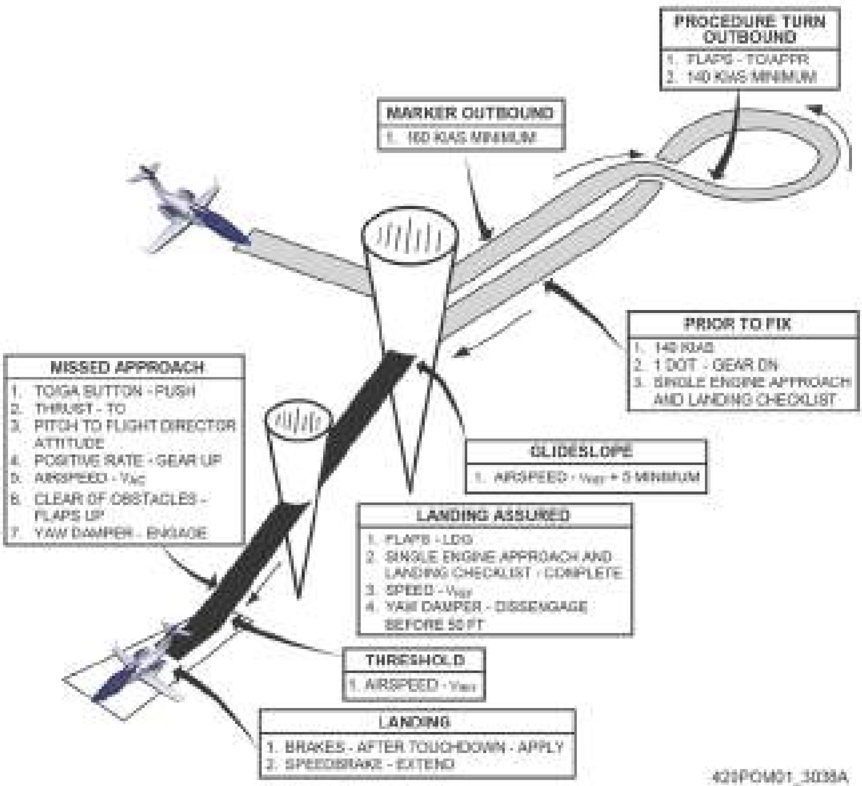

Figure 3-10. Precision Approach – Missed Approach, Single Engine

APPROACHES IN ICING

Slow to 180 KIAS no later than intercepting the final approach course or reaching the initial approach fix. Arm approach mode (or NAV) when ATC approach clearance is received. Maintain 180 KIAS as long as possible.

Extend the landing gear and slow to 140 KIAS prior to the final approach fix. Select the flaps to TO/APPR just prior to starting final descent. Accomplish the Before Landing checklist. Wait until landing is assured to disconnect the yaw damper, but no later than 50 ft AGL.

Just prior to landing, confirm proper landing configuration. Do not retract the flaps after landing until it can be confirmed that the flaps are free of ice contamination.

If a missed approach is required, do not retract the flaps to the UP position. See performance tables in the Airplane Flight Manual (Section 5 – Performance) and either the Quick Reference Handbook (Volume 1, Performance Section) or the Pilot’s Operating Manual (Section 2 – Flight Planning).

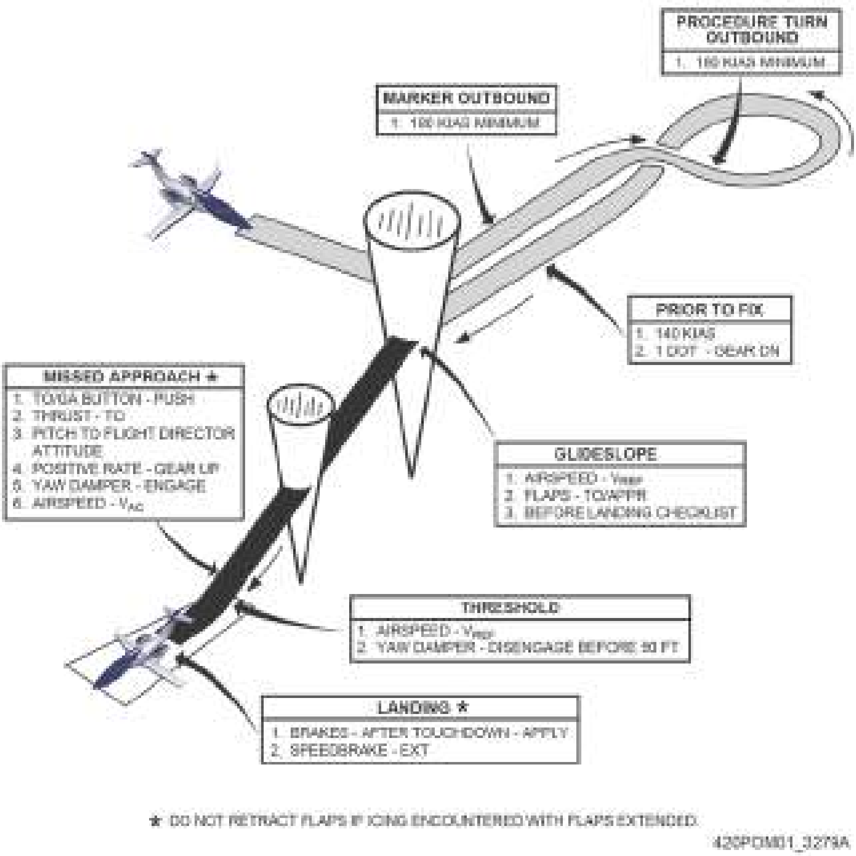

Figure 3-11. Approach in Icing Conditions

REDUCED FLAP LANDING

A reduced flap landing is any landing with other than LDG flaps. Use the AFM Reduced Flap Landing checklist instead of the normal Descent, Approach, and Before Landing checklists. Land on the longest suitable runway.

A landing with flaps at TO/APPR is very similar to a landing with flaps LDG.

For flaps UP landing, apply the following considerations. Airspeed control is critical. If possible, slow to the corrected landing speed during level flight, prior to the FAF. With lower than normal drag, precise flight path control will be required to avoid the possibility of being high and fast on final without the capability to slow down or to re-capture the intended glide slope. Use momentary extension of the speedbrake (if installed) to correct airspeed and glideslope, but then retract the speedbrake as soon as possible.

CAUTION *Failure to retract the speedbrake may result in the inability to land in the touchdown zone.*

Reduce power to IDLE at 50 ft AGL and use minimal flare. Do not allow the aircraft to float excessively. The pitch attitude is slightly higher than normal and may affect normal visual references.

Approach Briefing

In addition to normal approach briefing items, address non-standard landing speeds and distance.

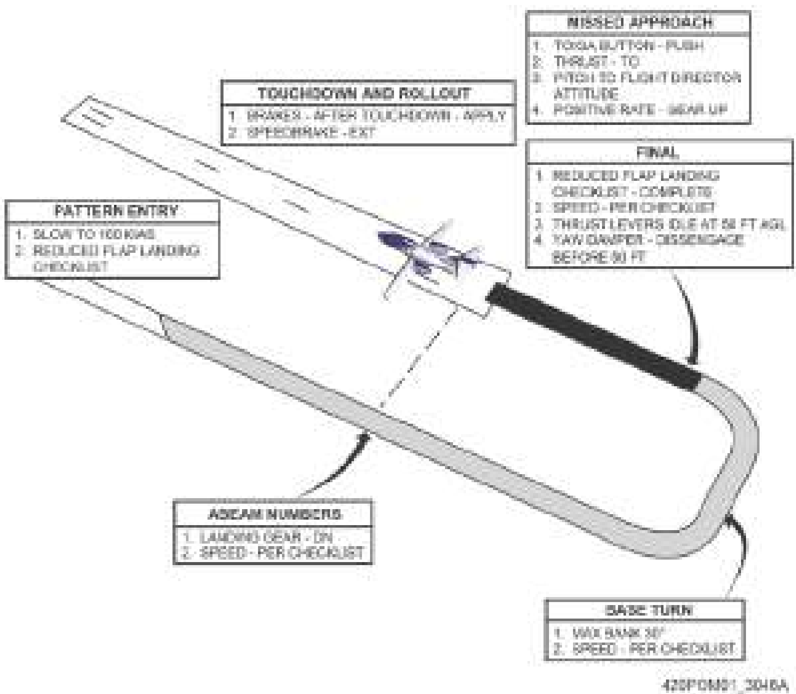

Figure 3-12. Visual Approach, No Flaps

TAWS Warning

Flap Override (if TAWS-A equipped) should be selected to avoid a nuisance alert.

EMERGENCY DESCENT

An emergency descent may be conducted utilizing the profile in the figure that follows.

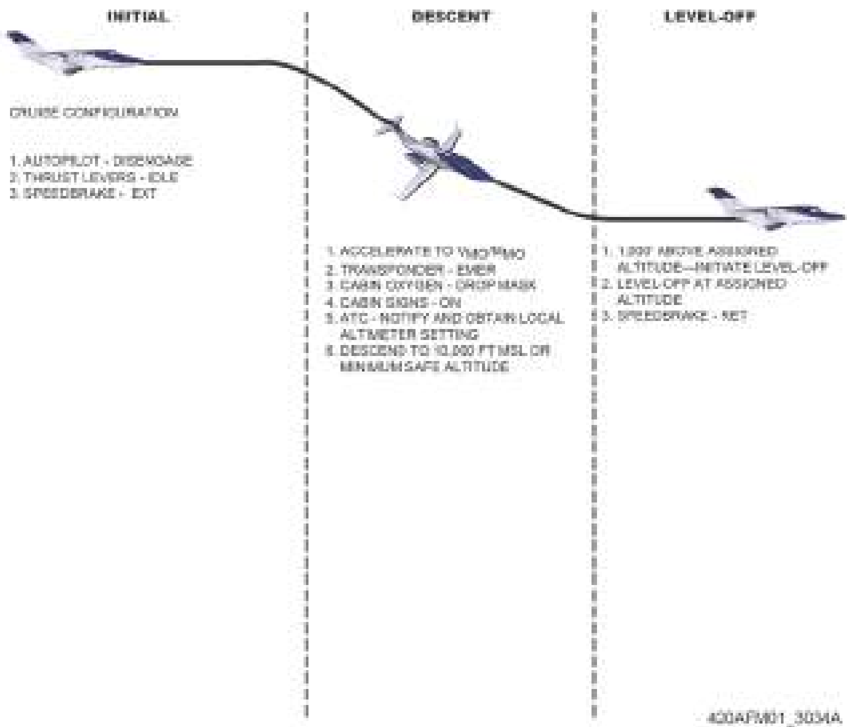

Figure 3-13. Emergency Descent

ADDITIONAL MANEUVERS

In addition to the normal and emergency operational skills and procedures, certain training maneuvers will be required during training for a type rating in the Honda HA-420.

STEEP TURNS

To initiate a steep turn, roll into a 45° bank in the desired direction while increasing the N_1 approximately 3%. Subsequently increase back pressure to maintain altitude or use pitch trim to relieve the control forces. At 200 KIAS, the pitch attitude in the turn is approximately 5°.

If your aircraft is equipped with optional Synthetic Vision, the flight path marker (FPM) is a useful tool when performing steep turns. The FPM depicts the approximate path of the aircraft. Keep the FPM symbol centered on the 0° pitch line of the attitude indicator and the airplane will remain at a constant altitude.

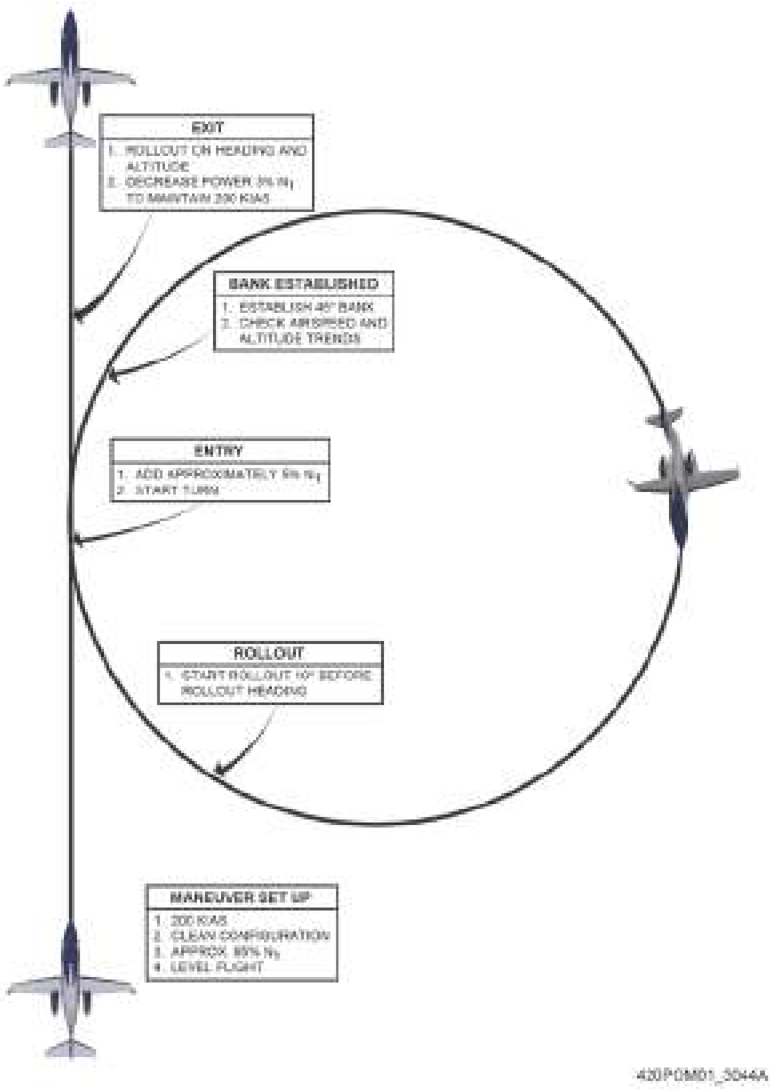

Figure 3-14. Steep Turns

STALLS

Stalls are to be completed at an altitude that will allow recovery to be safely completed at least 3,000 ft. AGL. Configure the airplane as required. Smoothly adjust pitch, power, and bank angle to induce a stall. At the first indication of a stall, promptly initiate recovery. Loss of altitude is acceptable and expected during the recovery.

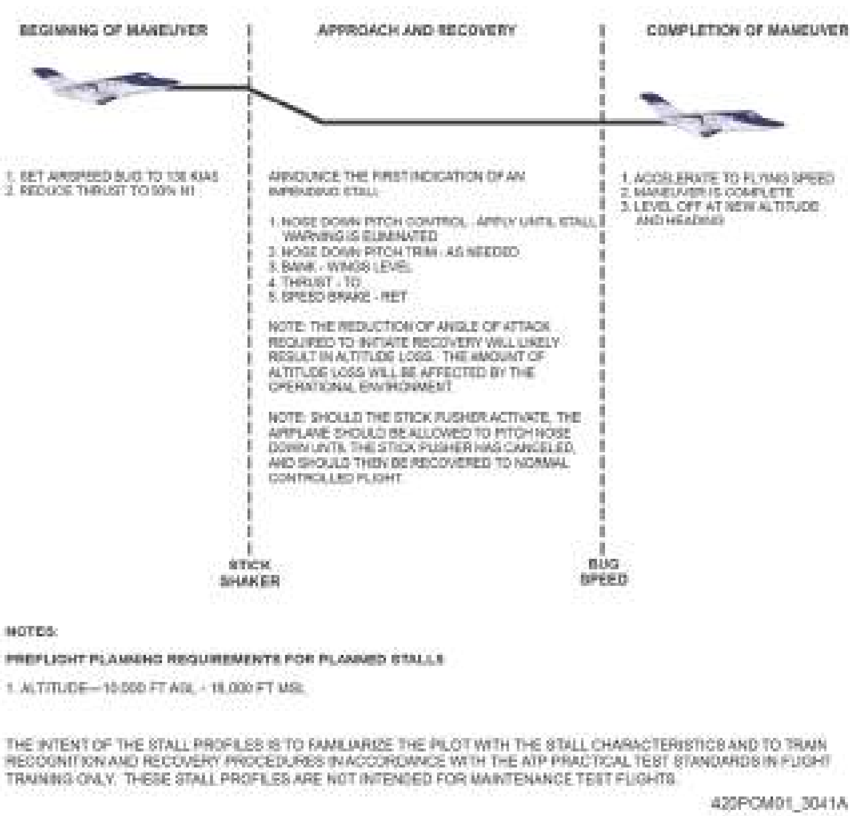

Figure 3-15. Approach to Stall Clean Configuration - Aircraft

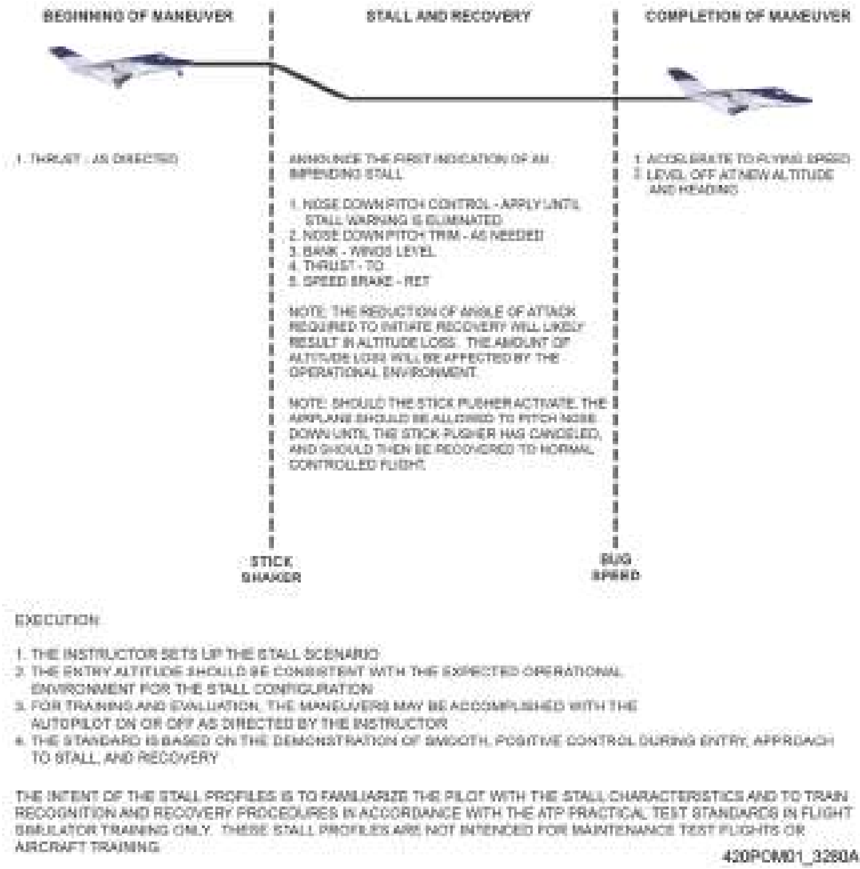

Figure 3-16. Approach to Stall Clean Configuration - Simulator

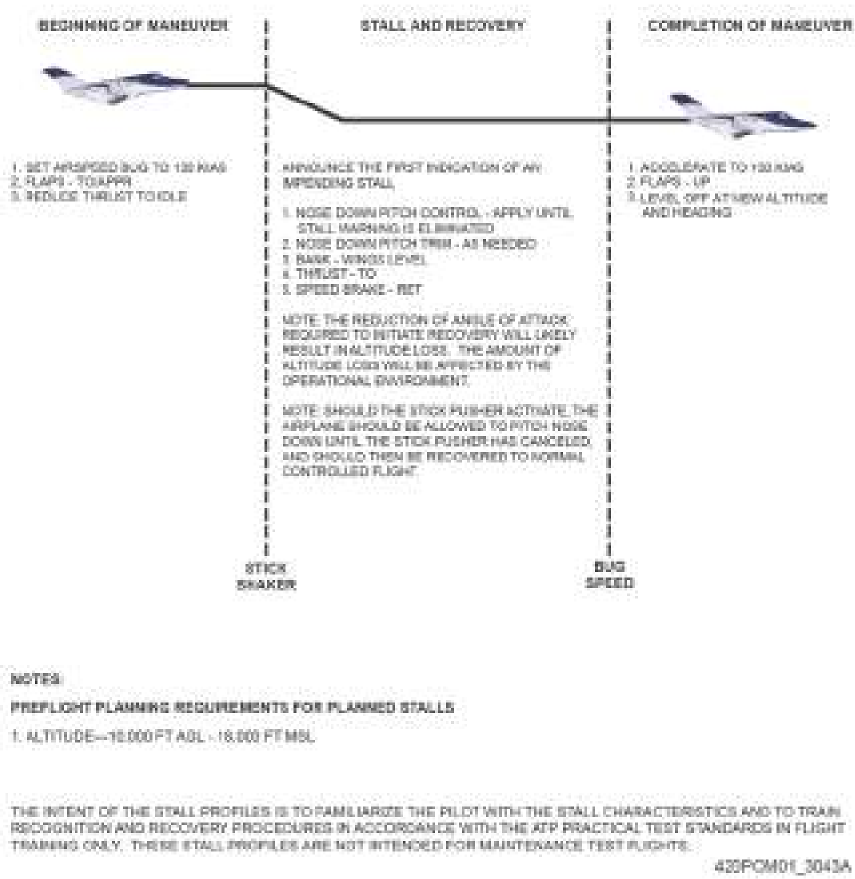

Figure 3-17. Approach to Stall Takeoff Configuration – Aircraft

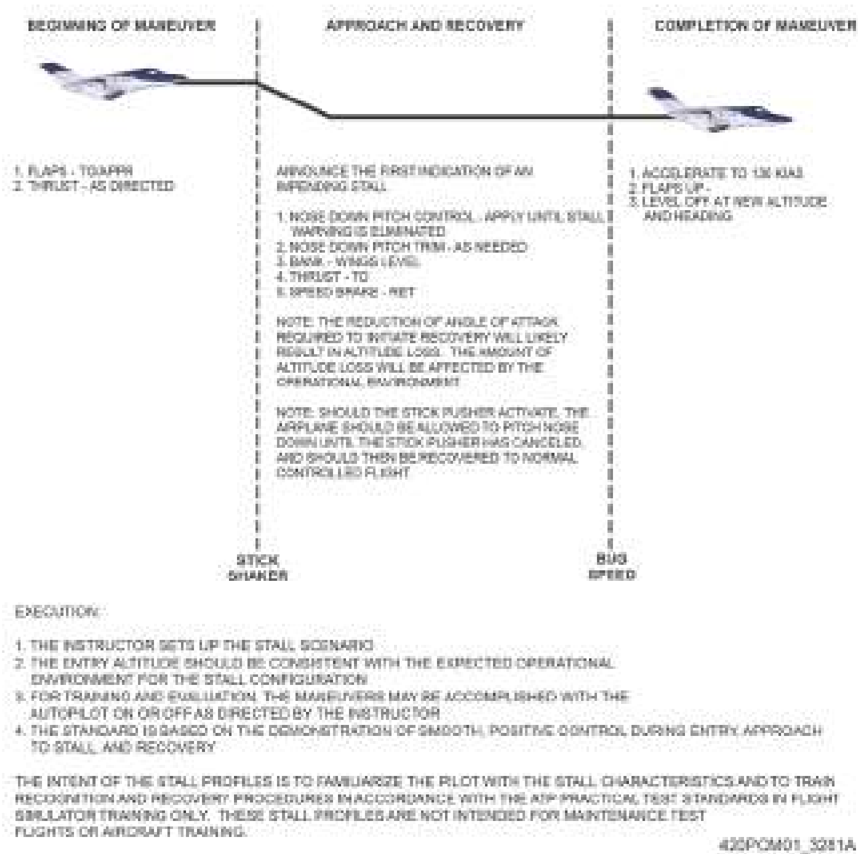

Figure 3-18. Approach to Stall Takeoff Configuration – Simulator

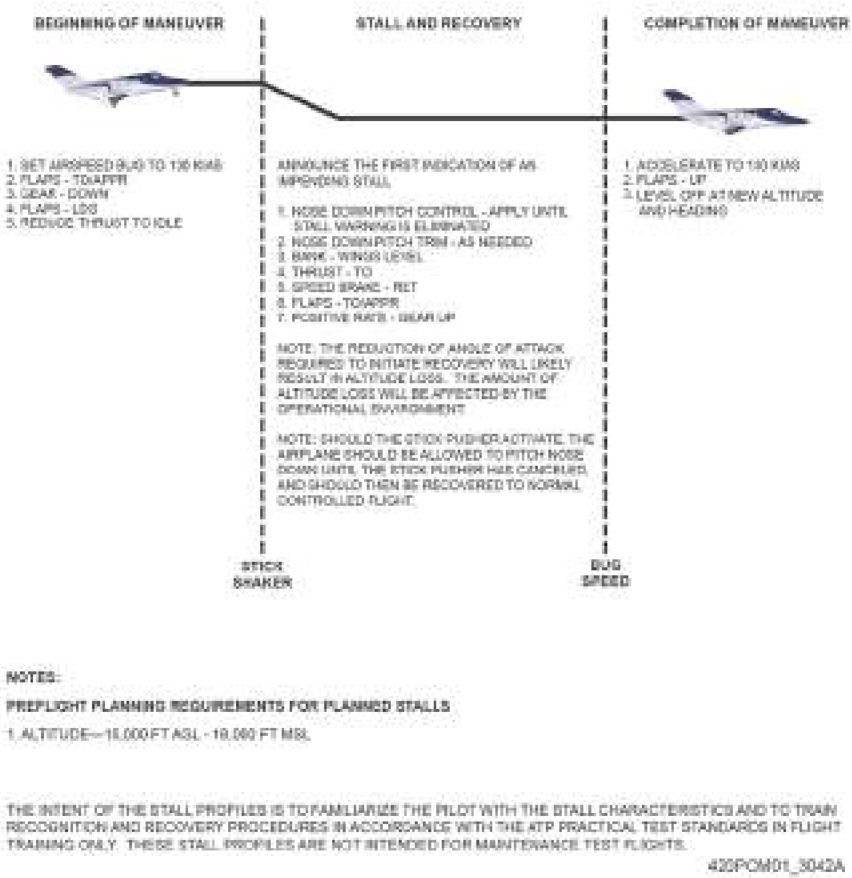

Figure 3-19. Approach to Stall Landing Configuration – Aircraft

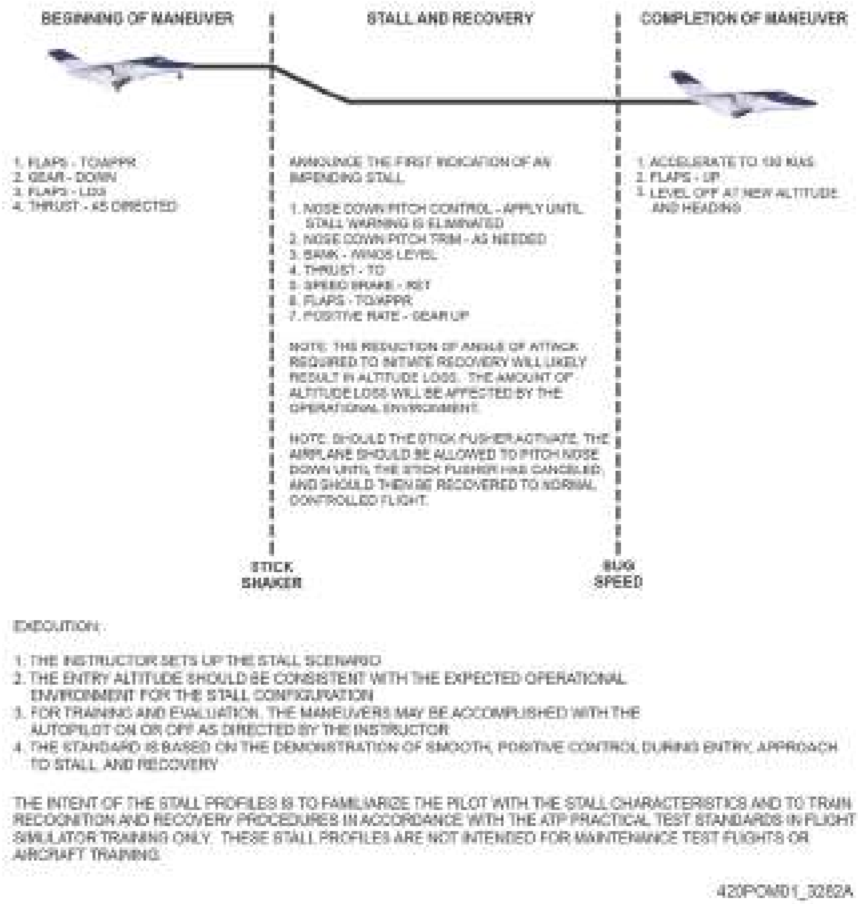

Figure 3-20. Approach to Stall Landing Configuration - Simulator

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SECTION 4

SERVICING, HANDLING, AND MAINTENANCE

TABLE OF CONTENTS

SERVICE, HANDLING, AND MAINTENANCE

GENERAL

This section provides information to supplement the HA-420 Aircraft Maintenance Manual. In the event any information herein conflicts with information in the HA-420 Aircraft Maintenance Manual, the HA-420 Aircraft Maintenance Manual takes precedence.

Aircrew should use material in this section to familiarize themselves with service and handling tasks authorized under 14 CFR Part 43.

TOWING

The HA-420 can be towed forward or pushed backward on hard surfaces if a tow bar is used. The tow bar attaches to the axle of the nose wheel. The towing vehicle must have a minimum drawbar pull of 12,000 lbs. A towbarless tug can be used as another method of towing the airplane.

CAUTION *Do not tow the airplane with the torque links connected. The nose wheel steering angle can be exceeded. If the steering angle is exceeded then damage to the airplane can occur.*

TOWING PROCEDURE

See Figure 4-1 for callout references**.**

1. Remove the ball-lock pin (2) that attaches the upper torque link (1) to the lower torque link (3).

NOTE When the nose wheel torque links are disconnected, the nose wheel can turn 360°.

2. Install the ball-lock pin (2) in the upper torque link (1) for storage. The pin should be installed through the storage holes in the steering collar.

NOTE Adapter cups are available that allow a universal tow bar to fit the HA-420 nose wheel axle.

3. Install the tow bar on the nose landing gear as follows:
    a. Turn the handle (4) to open the tow bar sufficiently to provide clearance for each side of the nosewheel axle
    b. Move tow-bar into position above the nosewheel axle.
    c. Turn the handle (4) until the tow-bar axle adapters (7) have fully engaged each side of the nosewheel axle.
4. If necessary, extend the tow-bar extension (6) so that it is longer than the nose of the airplane.
5. Connect the tow-bar to the towing vehicle.
6. Prepare the airplane for tow operations:
    a. Disconnect the airplane grounding wire.
    b. Disconnect ground power.
    c. Release the parking brake.
    d. Close the main entry door.
    e. Put a person at the end of each wing to make sure that the airplane does not touch other objects.
    f. Remove the airplane chocks.

NOTE Only qualified personnel should perform tow operation.

7. When the towing is complete, install chocks forward and aft of the main landing gear tires.
8. Disconnect the tow-bar from the towing vehicle.
9. Use the tow-bar to straighten the wheel and align the upper torque link with the lower torque link.

10. Remove the tow-bar from the nose landing gear.
11. Connect the nose landing gear torque links.
    a. Remove the ball-lock pin from the upper torque link.
    b. Install the ball-lock pin (2) to attach the upper torque link (1) to the lower torque link.
    c. Make sure that the ball-lock pin is locked and cannot fall out of the torque links.

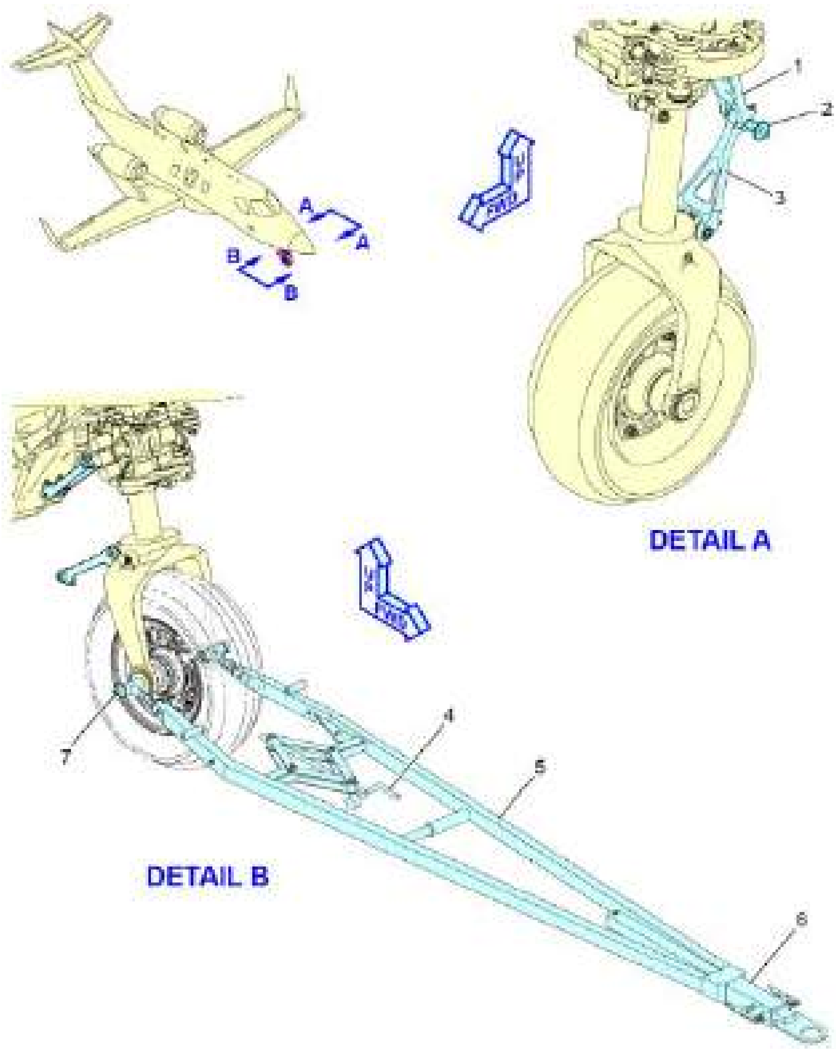

Figure 4-1. Nose Landing Gear Components

MOORING

1. Install a mooring pin (4) in the receptacle (3) in each pylon (Figure 4-2).
2. Install a mooring pin (2) in the receptacle (1) in the bottom of the aft fuselage.
3. Attach the mooring straps from the ground mooring points to the airplane mooring pins.
4. Tighten the mooring straps.

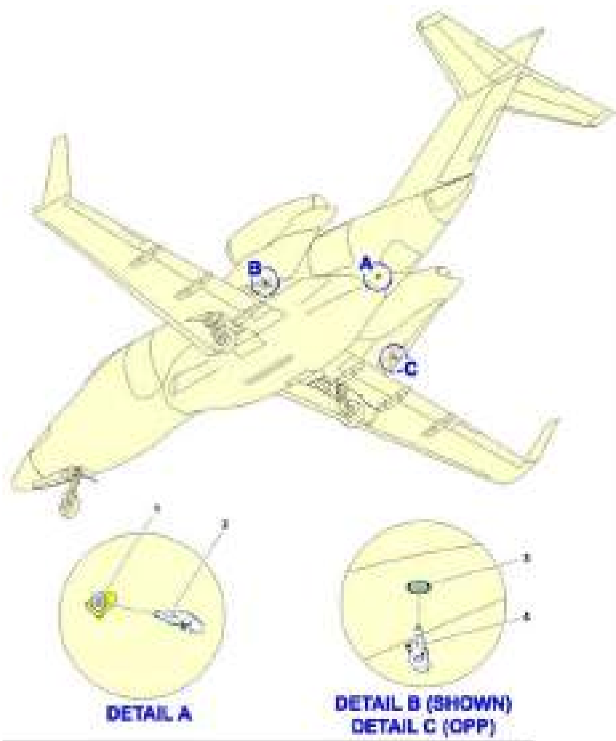

Figure 4-2. Airplane Mooring

COVERS

Remove/install engine, probe, and static covers shown in Figure 4-3 pre/post flight.

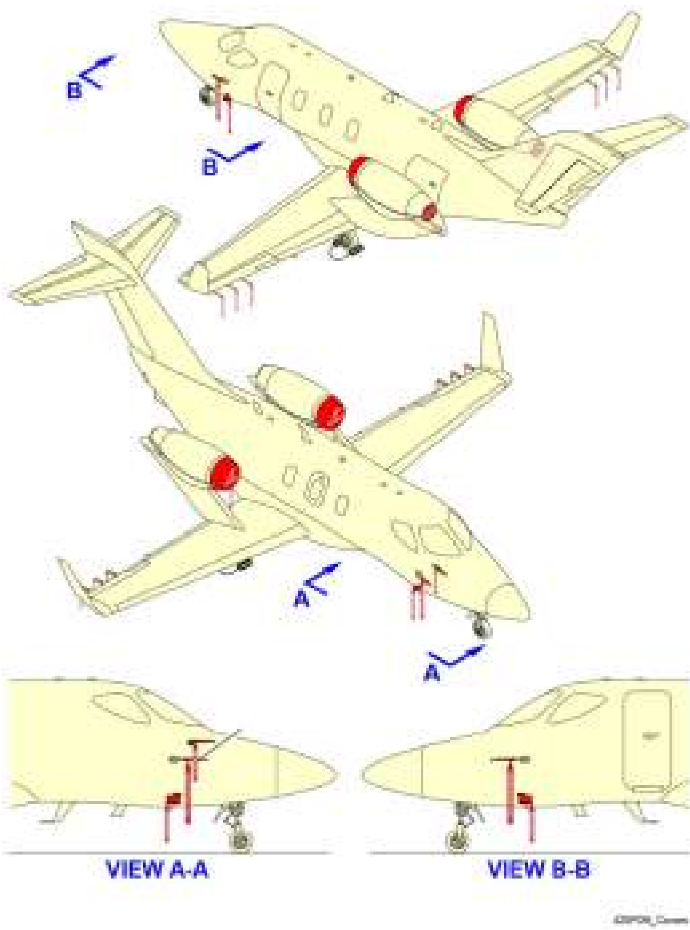

Figure 4-3. Storage Cover and Plugs

GUST LOCK

Remove/install external and internal gust locks in accordance with Figure 4-4.

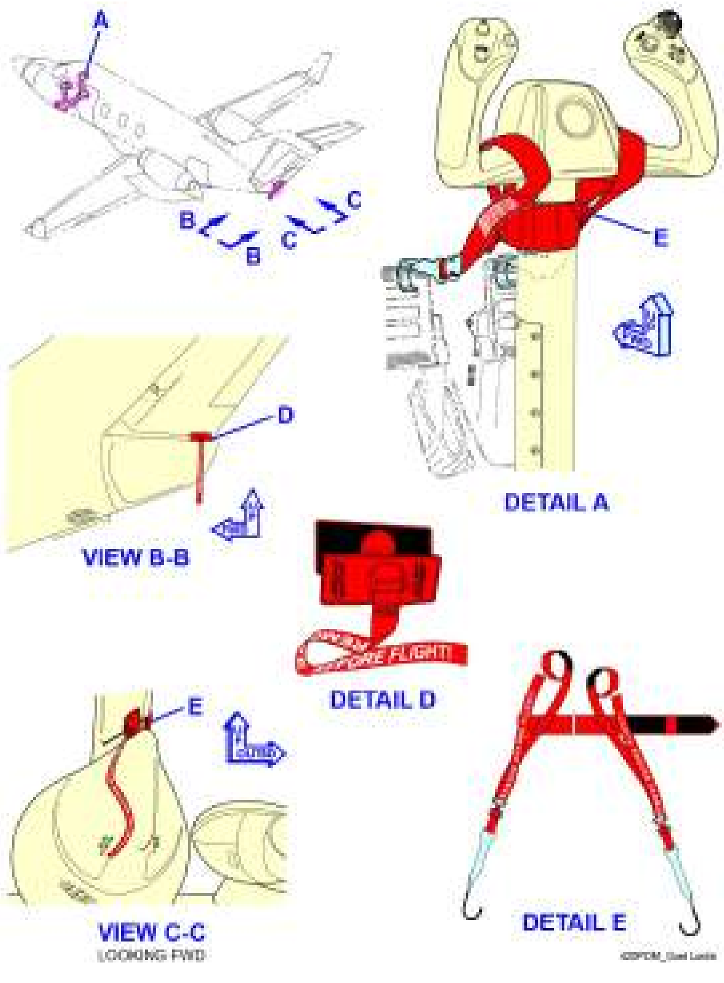

Figure 4-4. Gust Locks

EMERGENCY EXIT DOOR LOCK

Remove/install emergency exit door lock in accordance with Figure 4-5.

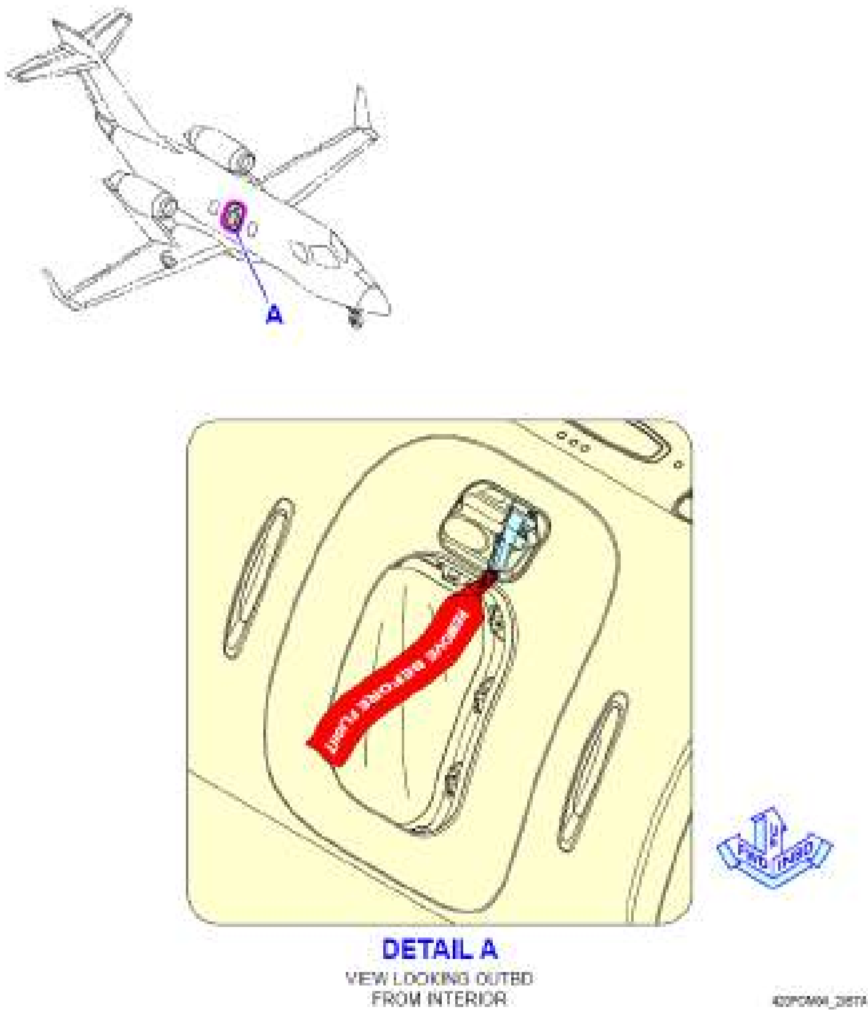

Figure 4-5. Emergency Exit Door Latch Assembly

FUEL SERVICING

The HA-420 model airplane does not use a pressure fueling system but a gravity feed system through a single port adapter, installed on the upper right side of the aft fuselage. There is an optional digital external fuel gauge installed on the fuselage skin adjacent to the fuel cap (Figure 4-6). The external fuel gauge includes a digital fuel quantity display, which shows the total fuel quantity. The external fuel gauge also contains three LED lights to show when each of the tanks is full and two LED lights to show if the fuel quantity units are in LBS or KGS. There is a refuel master switch, which is installed adjacent to the external fuel gauge that energizes the external fuel gauge and the fuel quantity signal conditioner.

NOTE The HA-420 AFM is approved for operation with or without the use of fuel system icing inhibitors (FSII) that meet specification MIL-DTL-27686 (EGME) or MIL-DTL-85470 (DiEGME). FSII are approved in amounts not more than 0.15% by volume.

There is no requirement to use FSII. If used, the inhibitor must be injected into a stream of fuel and not poured or splash-blended into the fuel tank. Fuel system icing inhibitor can be added into the fuel by an injector system downstream of the final filter/water separator on the fueling unit (truck or stand) or by injection into the fuel stream using aerosol cans at the appropriate fueling rate.

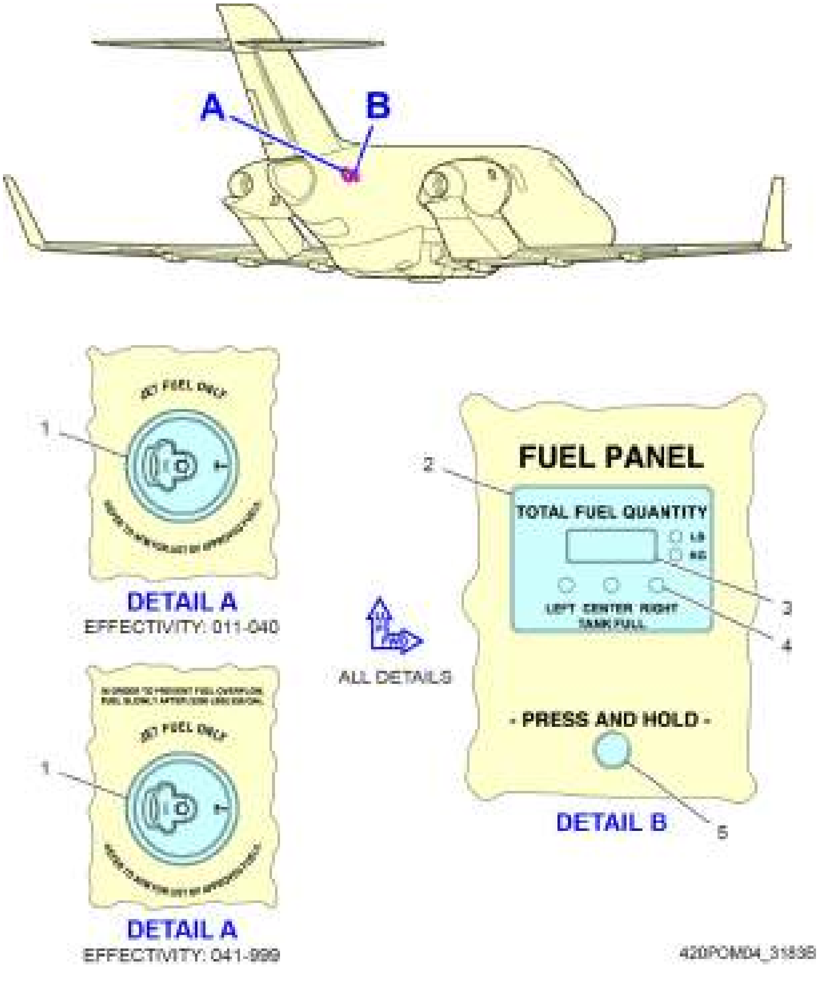

Figure 4-6. Fuel Filler Port and External Fuel Gauge

When the refuel master switch is pushed, the external fuel gauge illuminates all three fuel tank full indicators for approximately 3 seconds to verify indicator lights are operational. During refueling, the fuel first fills the carry-through tank, the wing tanks, and then the fuselage tank. As each tank becomes full, the appropriate indicator light will illuminate.

CAUTION *Do not start to add fuel if the airplane is not level. This can cause an incorrect fuel balance and damage to the airplane can occur.*

NOTE Do not turn the electric boost pumps ON during aircraft refueling. Doing so may cause fuel to leak into vent system and prevent the airplane from refueling to maximum capacity. If the electric boost pumps are ON as a result of low fuel quantity (220 lbs or less), select to OFF prior to refueling.

NOTE Use only the fuels and fuel additives specified in the AFM.

FUELING: OPTIONAL EXTERNAL FUEL GAUGE INSTALLED

1. Connect the fuel grounding cable plug to the receptacle in the pylon.
2. If the fuel nozzle is equipped with a bonding strap, touch the bonding plug or clamp to the engine exhaust nozzle before you remove the fuel cap.
3. Remove the fuel cap (1) from the filler port. Make sure that you do not let the fuel cap hit the side of the fuselage (Figure 4-6).
4. Put the fuel nozzle in the fuel port to add fuel.

5. Press and hold the refuel master switch (5).
   a. Verify the three fuel-tank full indicator lights will illuminate for 3 seconds as an operational check.

NOTE It takes approximately 5 seconds after pressing the refuel master switch before the correct fuel quantity is displayed. The fuel quantity is only displayed when the refuel master switch is held down continuously.

6. Add fuel.

CAUTION *To minimize risk of fuel fill overflow and spillage, maintain a slow, steady refuel rate as follows:*

When Fuel Level is:	***With Total Gallons:***	***Fueling Rate:***
<1500 lbs	*Less than 225 gal.*	*50 GPM (Approx. 4 gal. every 5 sec.)*
>1500 up to 2580 lbs	*225 to 385 gal.*	*25 GPM (Decrease fuel rate to half)*
>2580 lbs	*More than 385 gal.*	*5 GPM (Slow fuel rate significantly)*

a. Monitor the fuel quantity display (3) on the external fuel gauge (2). As each tank becomes full, the applicable fuel tank full indicator light (4) will illuminate.
b. When finished fueling, press and hold the refuel master switch (5) to verify the actual fuel load.

NOTE The fuel quantity indication lags the actual fuel quantity in the tank.

7. Remove the fuel nozzle.
8. Install the fuel cap on the filler port.
9. Remove the fuel grounding cable plug from pylon receptacle.

FUELING: OPTIONAL EXTERNAL FUEL GAUGE NOT INSTALLED

1. Connect the fuel grounding cable plug to the receptacle in the pylon.
2. If the fuel nozzle is equipped with a bonding strap, touch the bonding plug or clamp to the engine exhaust nozzle before you remove the fuel cap.
3. Remove the fuel cap (1) from the filler port. Make sure that you do not let the fuel cap hit the side of the fuselage (Figure 4-6).
   a. Turn on the aircraft battery.
   b. Select FUEL synoptic.
4. Add fuel.

CAUTION *To minimize risk of fuel fill overflow and spillage, maintain a slow, steady refuel rate as follows:*

When Fuel Level is:	***With Total Gallons:***	***Fueling Rate:***
<1500 lbs	*Less than 225 gal.*	*50 GPM (Approx. 4 gal. every 5 sec.)*
>1500 up to 2580 lbs	*225 to 385 gal.*	*25 GPM (Decrease fuel rate to half)*
>2580 lbs	*More than 385 gal.*	*5 GPM (Slow fuel rate significantly)*

c. Monitor on the cockpit display.

NOTE The fuel quantity indication lags the actual fuel quantity in the tank.

5. Remove the fuel nozzle.
6. Install the fuel cap on the filler port.
7. Remove the fuel grounding cable plug from pylon receptacle.
8. Turn off aircraft battery.

OIL SERVICING

Each engine has an oil tank that is integral to the intermediate compressor case. The engines use an electronic oil level sensor as the primary method of determining oil level (Figure 4-7). The electronic oil level sensor is installed on the engine intermediate case on the optical sight glass mounting pad located on the inboard side of the engine. The oil level reading is only correct on the ground when the engine is not in operation.

NOTE There may be disagreement between the oil level sensor status and the sight gage on the engine's outboard side when oil is near the add line and the aircraft is not level.

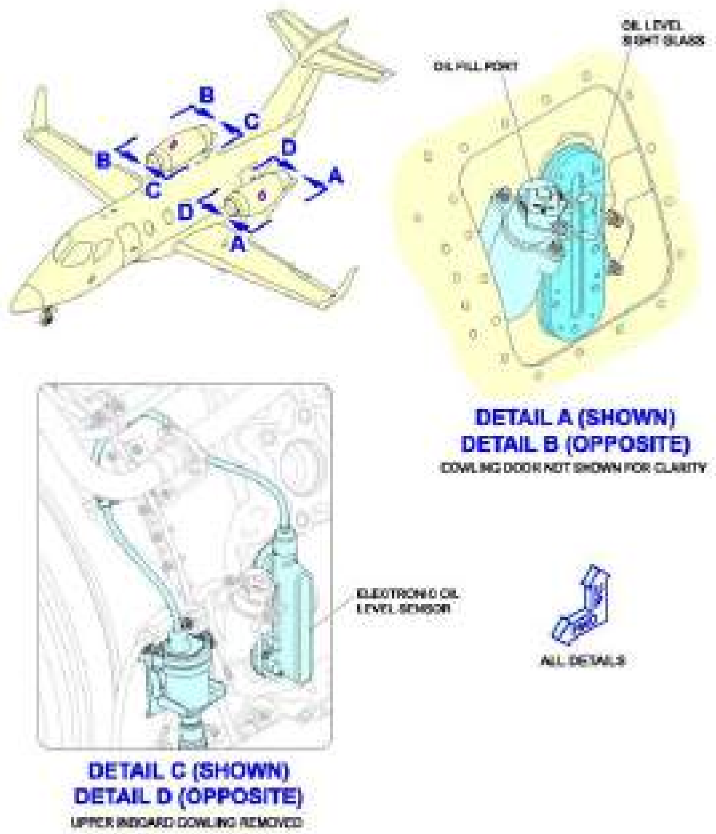

Figure 4-7. Oil Level Sight Glass and Electronic Oil Level Sensor

The output from the electronic oil level sensor shows the oil level on the STATUS synoptic. The oil level indication is either LOW (amber) or NORM (green), and is only available when the engines are not in operation. Each engine also has a graduated oil level sight glass on the outboard side of the engine as a secondary method of examining the oil level (Figure 4-7). The sight glass is calibrated to the same ground attitudes as the electronic oil level sensor.

NOTE It is permissible to dispatch with an amber LOW oil level on the STATUS page as long as the sight glass on the outboard side of the engine shows oil above the add line.

WARNING **Do not get engine oil on your skin or in your eyes. Wear gloves and safety glasses. Obey all health and safety instructions. If you get engine oil in your eyes, get medical aid immediately.**

WARNING **Do not touch the engine when it is hot. The engine stays hot after shutdown. A hot engine can cause burns.**

SERVICING THE ENGINE OIL SYSTEM

If possible, add oil only after the engine is shut down for more than 5 minutes, but not more than 30 minutes. If you add oil to a cold engine, it is possible to have too much oil in the tank when the oil temperature increases. This will not damage the engine, but it is not recommended.

OIL LEVEL CHECK

Examine the oil level at the oil sight gauge; if the oil level is at the FULL line, no oil servicing is necessary.

Optional If the oil level is between the FULL and ADD lines, you can add oil until the oil level is at the FULL line (observing the time constraints as mentioned above).

OXYGEN SERVICING

CAUTION *Use Aviators Breathing Oxygen only.*

NOTE Only qualified maintenance personnel should perform oxygen system servicing.

NOTE Oxygen duration tables required for mission planning are located in NORMAL PROCEDURES of the Airplane Flight Manual.

Oxygen is stored in a single 50 cubic foot, 1850 psig oxygen bottle located on the left side under the floor of the forward baggage compartment (Figure 4-8). The pressure green band on the gauge is from 1750 to 1850 PSI. To calculate the temperature compensated pressure (TCP), use the following formula ($T_{ambient}$ in °C).

$$TCP = [294.26/(T_{ambient} + 273.15)] \times P_{cylinder}$$

Oxygen quantity turns amber on the STATUS page when oxygen quantity is below 465 liters. The oxygen quantity displayed on the STATUS page is corrected for temperature.

Servicing is done through a service panel that is located on the aft interior wall of the nose baggage compartment (forward of the forward pressure bulkhead). In the service panel there is an oxygen bottle fill port, and a pneumatic pressure gauge. There is a visible green disk on the outside of the airplane located on the lower left nose of the airplane. In the event that the oxygen bottle becomes over pressurized, the cylinder contents will be discharged overboard and the green overboard discharge indicator will be ruptured or missing.

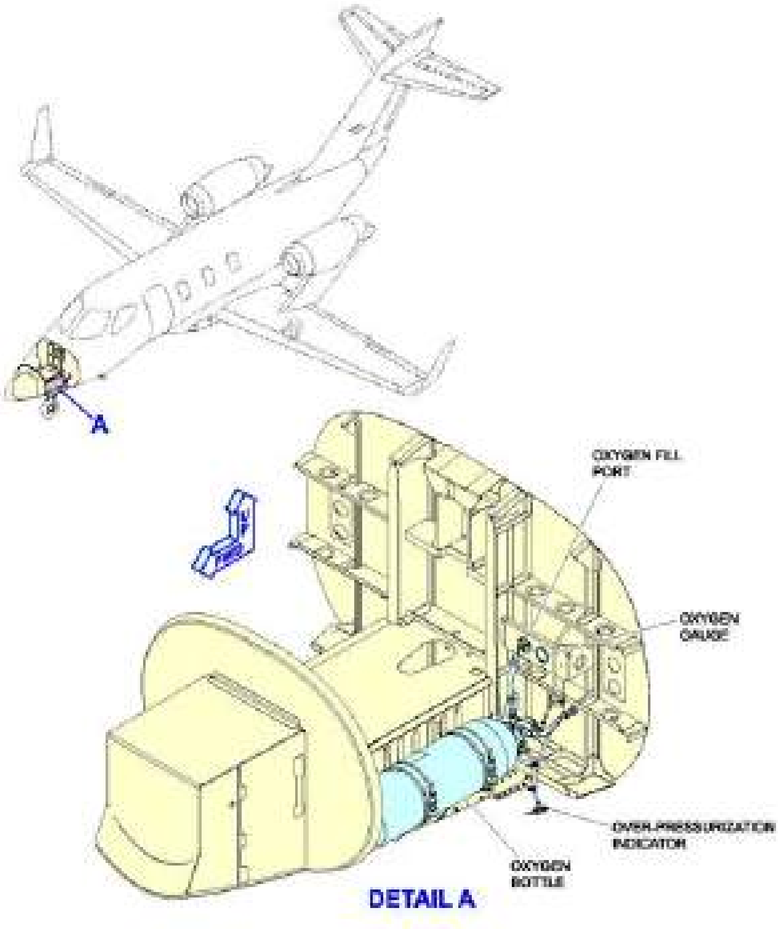

Figure 4-8. Oxygen Servicing Components

TIRES

Inspecting Tire Pressure

Calculate tire pressure with weight on wheels. The correct nose wheel tire pressure is 125 psi +5, -0 psi. The correct main wheel tire pressure is 212 psi ±5 psi.

1. Remove the cap (2) from the tire air valve (1) (Figure 4-9).
2. Connect the tire pressure gauge to the tire air valve.
3. If the NLG tire pressure is less than 125 psi or the MLG tire pressure is less than 207 psi, then qualified maintenance personnel should service the tires with compressed dry nitrogen.
4. Disconnect the tire pressure gauge from the tire air valve (1).
5. Replace the cap (2) on the tire.

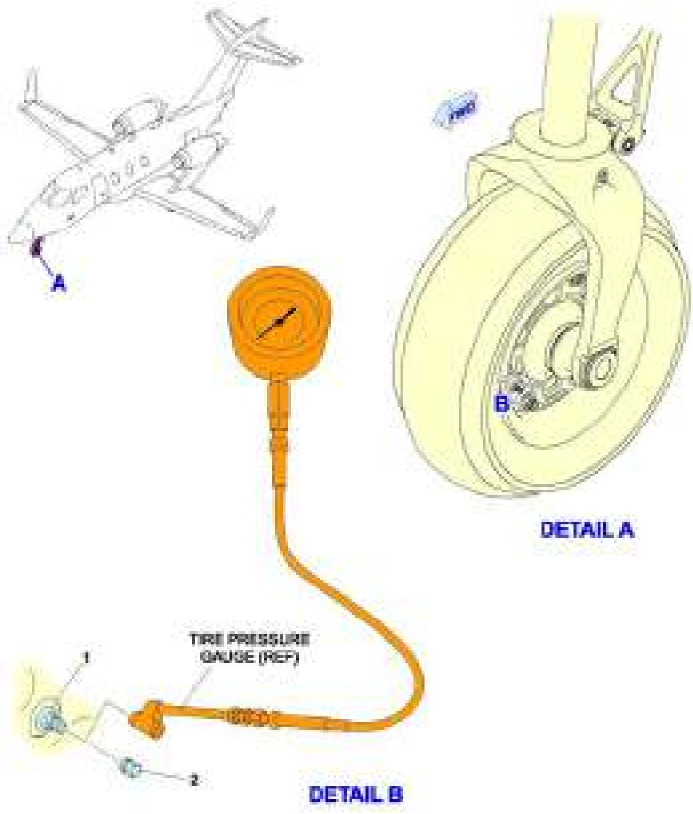

Figure 4-9. Aircraft Tire Servicing

WASTE WATER SERVICING

The toilet is serviced internally in the lavatory area or externally through an optional external service panel installed in the aft right fuselage. Service panel caps for the drain and flush tubes are in the service panel. When hoses from the service cart are attached to the service panel and power to the service cart is turned on, a gate valve is opened. A pump in the lavatory is operated by a switch in the toilet service panel and pumps the waste from the airplane into the service cart waste tank. After the water-supply tube valve on the service cart is opened, new flushing fluid is pumped from the service cart to the toilet by the fill switch on the airplane service panel. Reference the AMM for required fluids.

INTERNAL SERVICING

CAUTION *Wear personal protective equipment during servicing of the water system.*

1. Remove the toilet shroud panel assembly (Figure 4-10).
2. Pull the release lever (6) to open the bowl assembly (1) and install the waste tank cap (2) on the waste tank (3).
3. Make sure there are no leaks on the rinse fluid tank (4) or the waste tank (3).
4. Open the service cap (5) on the rinse fluid tank (4) and fill it with flushing fluid to the full line.
5. Install the service cap (5) on the rinse fluid tank (4).
6. Install the waste tank cap (2) on the waste tank (3).
7. Lift the waste tank (3) from the toilet cabinet.
8. Empty and clean the waste tank (3) at the correct cleaning area.
9. Install the waste tank (3) in the toilet cabinet.

10. Remove the waste tank cap (2) and store it in the toilet cabinet.
11. Close the bowl assembly (1).
12. Install the toilet shroud panel assembly.

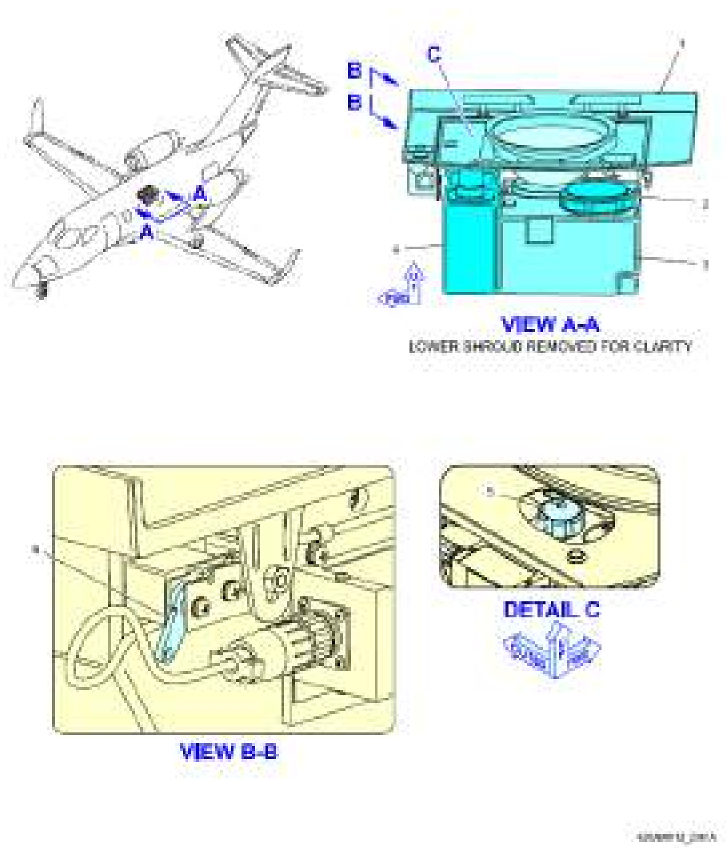

Figure 4-10. Internally Serviceable Toilet

EXTERNAL SERVICING

CAUTION *Wear personal protective equipment during servicing of the water system.*

1. Prepare the lavatory service cart for service. Refer to the manufacturer's instructions.

NOTE Only qualified personnel should operate the lavatory service support equipment.

2. Open the toilet service door.
3. Open the caps on the fill service port (4) and the waste service port (1) on the waste service panel (Figure 4-11).
4. Connect the lavatory servicing adapters to the lavatory service cart.
5. Connect the flushing fluid hose (3) to the fill service port (4) on the waste service panel.
6. Connect the waste fluid hose (2) to the waste service port (1) on the waste service panel.

CAUTION *Do not run the macerator pump for more than 15 seconds at a time. Multiple applications of the pump switch may be required.*

NOTE The macerator pump in the airplane lavatory can remove waste at a rate of one gallon every 5 seconds. The capacity of the lavatory waste tank is 2.37 gallons, or approximately 15 seconds.

7. Push and hold the MACERATOR PUMP switch (5) for a maximum of 15 seconds until the toilet waste tank is empty.
8. Wait 30 seconds for the waste fluid hose (2) to drain.
9. Pull the release lever to open the bowl assembly (1).
10. Use the lavatory service cart to pump flushing fluid into the toilet assembly until the flushing fluid flows from the weep hole (2). Reference the AMM for required fluids.
11. Wait 30 seconds for the flushing fluid hose (3) to drain.
12. Examine the waste tank (3) (Figure 4-12) and the flushing fluid tank (1). Make sure the waste tank (3) fluid is below the bottom of the macerator pump (4) and the flushing fluid tank (1) is full.
13. Close the bowl assembly (1).
14. Disconnect the flushing fluid hose (3) from the fill port (4) on the waste service panel.

NOTE The rinse fluid tank capacity is 1.6 gallons.

15. Disconnect the waste fluid hose (2) (Figure 4-11) from the waste port (1) on the waste service panel.
16. Close the caps on the fill and waste ports.
17. Close the toilet service door.

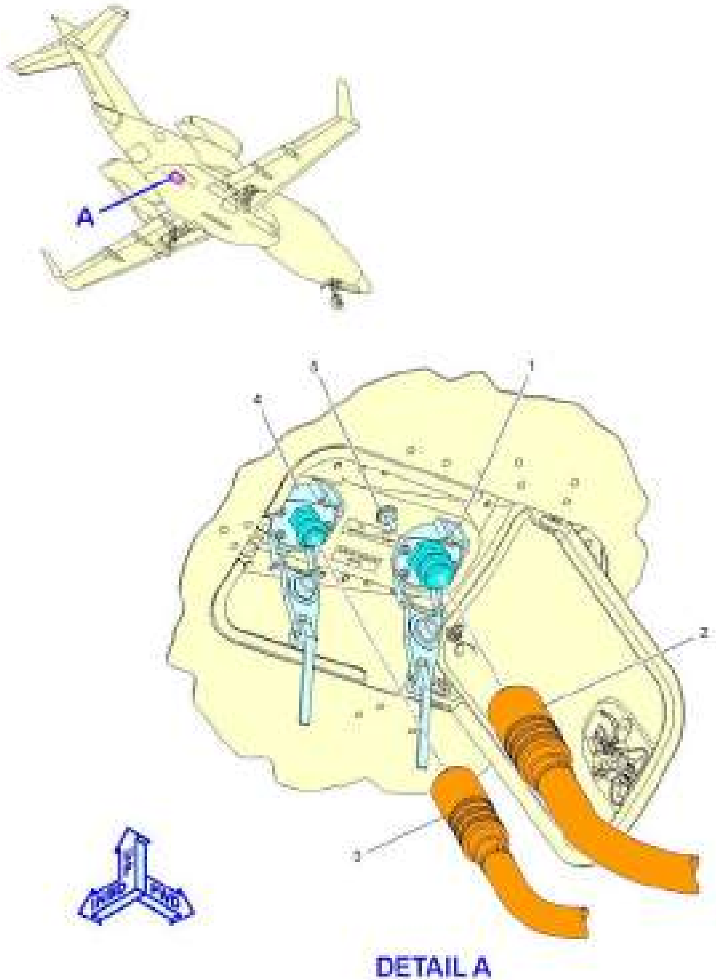

Figure 4-11. Waste Service Panel

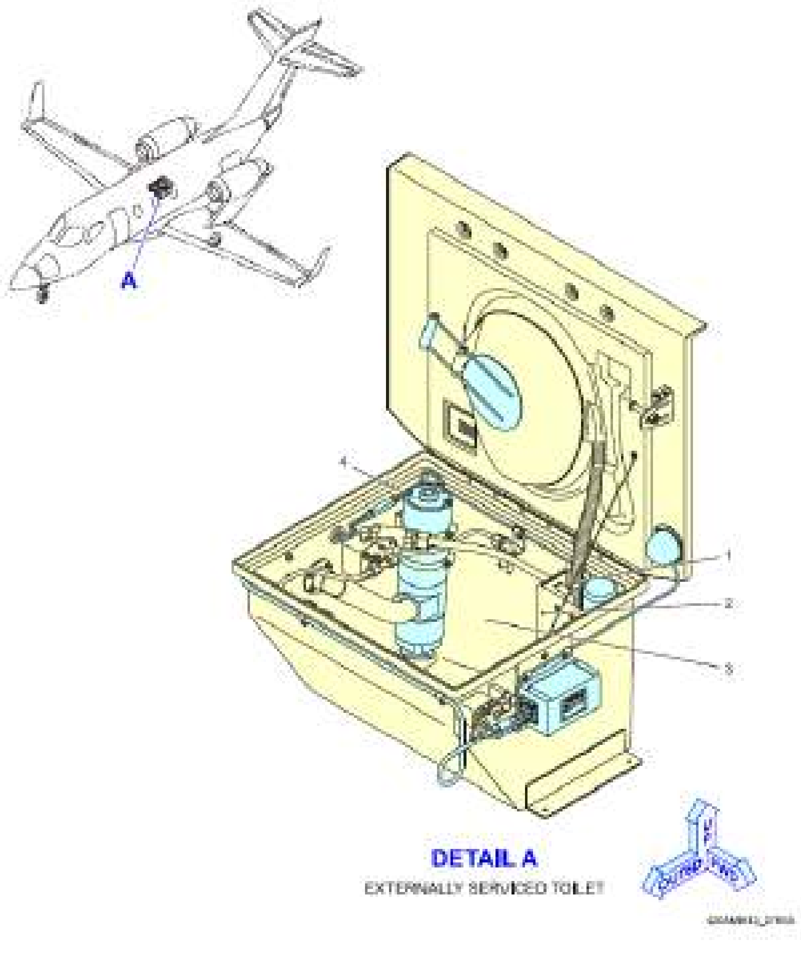

Figure 4-12. Externally Serviced Waste Water

NON-POTABLE/GREY WATER SERVICING

The optional non-potable and grey water tanks are installed in the bottom of the vanity. A pump is used to pump water to the faucet. The non-potable water tank has a volume of 0.58 gallons. The grey water tank has a volume of 1.0 gallons to prevent a water overflow. Quick-disconnect fittings are installed in the back of the tanks. The non-potable and grey water tanks are removed from the vanity for servicing. Both tanks must be removed at the same time, even if only one tank needs to be serviced.

CAUTION *Wear personal protective equipment during servicing of the water system.*

1. Open the vanity cabinet door (Figure 4-13).
2. Rotate latch (5) 90 degrees to remove tanks.
3. Remove the dual tank assembly (2 and 4) from the airplane. Separate the non-potable water tank (2) from grey water tank (4).
4. Examine the non-potable water tank (2) and the grey water tank (4) for leakage.

   NOTE Do not let the water make contact with the aircraft.

5. Remove the grey water tank cap (3).
6. Remove the grey water from the grey water tank (4).
7. Install the grey water tank cap (3) on the grey water tank (4).
8. Remove the non-potable water tank cap (1) and fill the non-potable water tank (2) with fresh, clean water from a municipal water supply, bottled water or equivalent.
9. Wipe the non-potable tank dry prior to installing the serviced tank assembly into the airplane.
10. Install the non-potable water tank cap (1) on the non-potable water tank (2).
11. Install the non-potable water tank (2) on the grey water tank (4).

12. Install the non-potable water tank (2) and the grey water tank (4) in the vanity cabinet.
13. Rotate latches to lock tanks in place.
14. Make sure fittings have mated correctly.
15. Close the vanity cabinet doors.

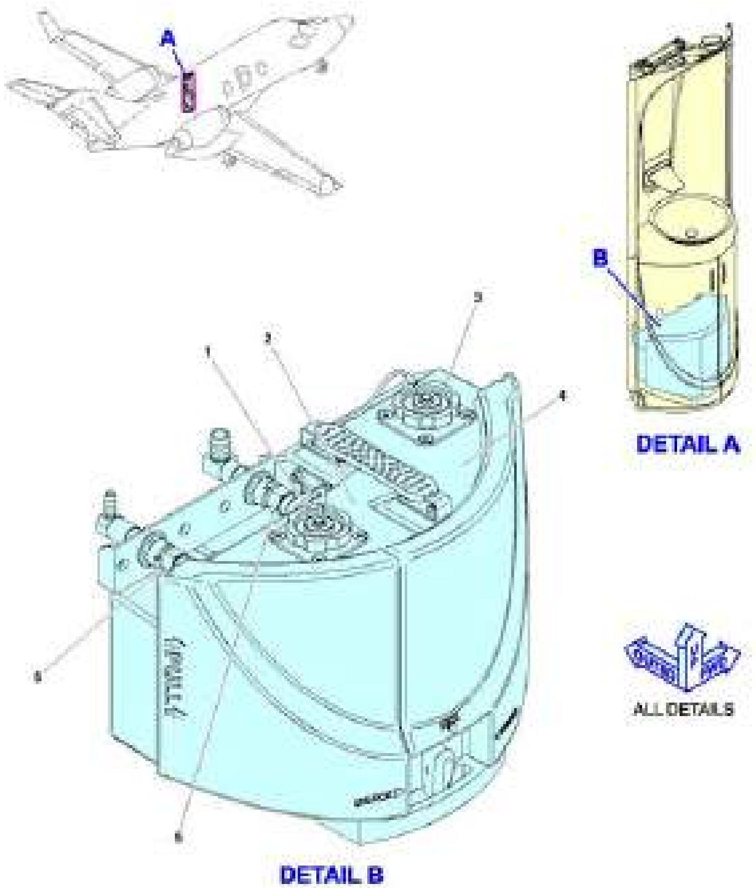

Figure 4-13. Non-Potable and Grey Water Tanks

SCREEN CLEANING

The Garmin screens can be cleaned using a microfiber or soft cotton cloth lightly dampened with clean water.

CAUTION *Do not use chemical cleaning agents, as these may damage the coating on the glass surface.*

WINDSHIELD CLEANING

The windshields should be cleaned using a lint free cloth with 50% water and 50% isopropyl alcohol.

CAUTION *Do not use chemical cleaning agents, as these may damage the hydrophobic material of the windshield.*

GROUND DE-ICING

This section contains procedures for de-icing HA-420 airplanes on the ground before flight. For additional information, refer to OPERATING IN ICING CONDITIONS (Section 4 - Normal Procedures) and ICING LIMITATIONS (Section 2 – Limitations) of the Airplane Flight Manual.

GENERAL

It is essential to takeoff with an aerodynamically clean airplane. The pilot-in-command has the responsibility to determine that all surfaces of the airplane (wing, vertical and horizontal stabilizers, flight controls and flaps) are free of frost, ice and snow before takeoff. If planning to take off in ground icing conditions, or if the aircraft has been previously contaminated, a ground de-icing/anti-icing procedure must be performed prior to takeoff.

Airplane de-icing/anti-icing may be accomplished in either a one-step or two-step process. During periods of precipitation, once the airplane has been de-iced, anti-icing is likely to be required. Close coordination with the flight crew and ground crew may be necessary to ensure the airplane is aerodynamically clean for departure; close coordination may be necessary with air traffic control to ensure that delays are minimal to keep the airplane aerodynamically clean before takeoff.

DE-ICING/ANTI-ICING FLUIDS

This section references three types of de-icing/anti-icing fluids referred to as Freezing Point Depressant (FPD) fluids. The Society of Automotive Engineers (SAE) and International Standards Organization (ISO) define Type I, II and IV fluids. Types I, II and IV fluids may be used as defined in ICING LIMITATIONS in Section 2 - LIMITATIONS of the Airplane Flight Manual. Type I and II fluids can be used for de-icing. Type IV fluids can be used for both de-icing and anti-icing.

Refer to TAKEOFF – ANTI-ICE FLUID PERFORMANCE ADDITIVES (Section 5 – Performance) of the Airplane Flight Manual for increased takeoff speeds and distances if Type II or IV fluids are used.

DE-ICING METHODS

The preferred method of de-icing is to place the airplane in a heated hangar. By placing the airplane in a heated hangar the entire airplane can be warmed. When using this method of de-icing it is imperative that a thorough pre-flight inspection be done. Runoff from melting frost, snow and/or ice may puddle around or near flight controls and could refreeze when the airplane is moved outdoors or during flight. These areas must be dry and unobstructed. Once the airplane is deemed aerodynamically clean, departure should take place within a short time if there is still precipitation. If anti-icing is required (for example, during precipitation), the process should begin as soon as possible after the airplane is clear of the hangar. Holdover time after anti-icing should be minimized.

Other methods of de-icing/anti-icing include mechanical means, spraying of de-icing fluids or a combination of both.

Using Mechanical Means to De-ice

Mechanical means include brooms, brushes, squeegees and nylon ropes. When de-icing is being accomplished by mechanical means ensure that ground personnel work from support stands placed near the aircraft. If stands are not available, extreme caution must be exercised when walking on aircraft surfaces to avoid slipping or sliding off aircraft. It is recommended that rubber or fabric footwear be worn when walking on aircraft surfaces. Use special care to avoid damage to antennas or aerodynamic devices such as wing tip triangles, wing bumps, vortex generators, etc.

Using Fluids to De-ice/Anti-ice

Heated solutions of de-icing fluids and water are normally used for de-icing. If required, anti-icing is accomplished by using more concentrated colder solutions of fluids which produces a lower freeze point on the airplane surfaces. Fluid manufacturers provide recommended dilution mixtures based on outside air temperatures (OAT) and precipitation conditions. The flight crew should consult with the de-icing crew to verify that the fluid mixture is suitable for the atmospheric conditions.

NOTE If the aircraft is going to be left outside overnight, consider applying cold Type I, II or IV de-ice or anti-ice fluid. This will aid in de-icing the aircraft the following day.

The ONE-STEP process is the application of heated, diluted de-ice fluid to remove ice, snow and/or frost from airplane surfaces and to protect the airplane from further accumulation.

The TWO-STEP process is de-icing with hot water or a hot mixture of water diluted with de-icing fluid followed immediately by treatment with anti-icing fluid. The two-step process is generally accomplished using Type II or IV fluid.

CAUTION *Care must be taken not to allow the aircraft surfaces to re-freeze between the de-icing and anti-icing processes.*

Holdover time is the estimated time de-icing/anti-icing fluid will prevent ice, snow and/or frost from forming or accumulating on the treated surfaces of an airplane. The protection time is dependent upon the conditions at the time and the fluid mixture selected. Be sure to use equipment designated for the fluids being applied. Equipment suitable for the application of Type I fluids may not be suitable for the application of Type II or IV fluids. The protective properties of Type II and IV fluids can be seriously degraded by mechanical shearing that is inherent in the design of some dispensing equipment. Mechanical or equipment shearing of many Type II or IV fluids may reduce their viscosity and therefore, the estimated holdover time. Since Type I fluids are not similarly affected, be sure to refer to the fluid manufacturer’s guidelines for the specific fluid being used.

Aircraft Ground holdover tables are approved by the SAE G-12 Committee and issued each year prior to the northern winter season. These are then reviewed by AEA (Association of European Airlines), FAA and TC (Transport Canada), who are the main practical sources of hold-over time information and each issues their own version of the hold-over time and associated support publications independently of each other and SAE.

The L and R CABIN INFLOW switches must be selected to OFF prior to conducting a de-icing /anti-icing procedure. Flaps should be retracted, and the control yoke should remain on the forward stop. Minimize spray into all inlets and control surface cavities.

After the de-icing/anti-icing procedure is complete, re-accomplish all necessary checklists. At a minimum, re-accomplish the BEFORE TAKEOFF CHECKLIST to verify the aircraft is in a safe configuration for takeoff.

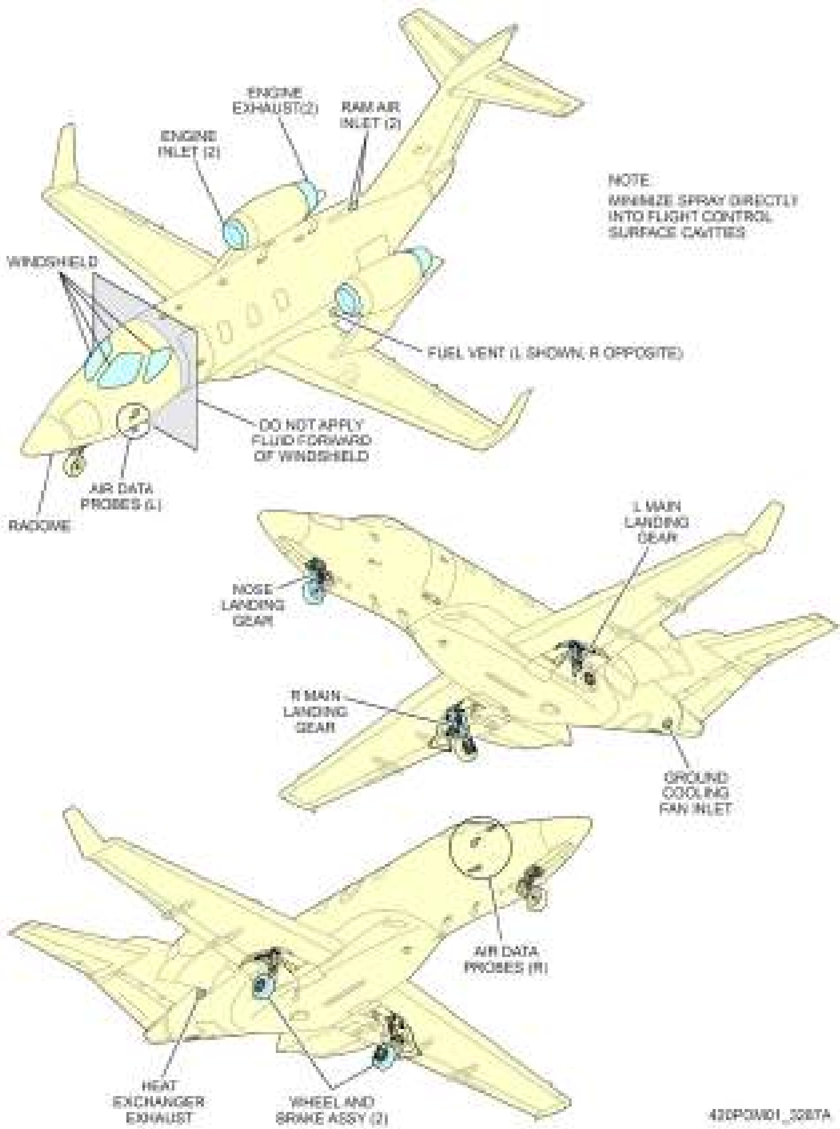

Figure 4-14. De-ice/Anti-ice Avoidance Areas

The areas listed below require special attention during the ground de-icing process.

CAUTION *If snow or ice has accumulated on the horizontal tail, the tail must be de-iced first*

Horizontal Tail

Remove all accumulations from the upper surface of the stabilizer and elevator. The gap between the elevators / elevator horn and horizontal stabilizer should be free of snow/ice accumulation. Ensure that elevator attach/hinge points and elevator horn are completely de-iced.

NOTE Minimize spray into the elevator control surface cavities.

Vertical Stabilizer/Rudder

The leading edge of the vertical stabilizer as well as the side panels and rudder should be cleaned of any snow/ice accumulation. The gap between the rudder and vertical stabilizer should be free of snow/ice accumulation. Ensure that rudder and rudder trim tab attach/hinge points are completely de-iced.

NOTE Minimize spray into the NACA inlets on the leading edge root of the vertical stabilizer.

NOTE Minimize spray into the rudder control surface cavities.

Fuselage

Remove snow top-to-bottom. Avoid spraying heated fluids directly on cabin and cockpit windows. Ensure that the radome area is clean. Remove any fluid runoff from cockpit windows and radome prior to departure. Avoid spraying directly on air data and ice detector probes.

CAUTION *Do not use Type II or IV fluid in areas forward of the aircraft windshield. Type II and IV fluid will shed during the takeoff roll and may obscure the windshield.*

CAUTION *Do not apply Type II or IV fluid to the radome.*

NOTE Ensure the area between the speedbrake and fuselage is completely de-iced. Minimize spray into speedbrake cavities.

NOTE Minimize spray into the ground cooling fan inlet and heat exchanger exhaust.

NOTE Minimize spray into the fuel vents.

Wing

Retract flaps after ensuring they are free of ice to UP prior to de-icing the wing. Ensure that the leading edge is free of ice. Ensure that aileron, aileron trim tab and flap attach/hinge points are completely de-iced.

CAUTION *Retracting the flaps to UP without ensuring they are free of contaminants may result in damage to the flaps or airframe.*

NOTE Minimize spray into the aileron control surface cavities.

Engines

Snow/ice removal from the engine inlet should be accomplished using mechanical means. Check the engine for freedom of movement. If the engine fan does not rotate freely, hot air or some other means is recommended to de-ice the engine. Ground crews should be cautioned to avoid spraying de-icing fluids directly into the engine. There is no need to apply fluid to the engine inlet because nacelle heat may be turned on while on the ground. The engines should be at idle during these ground operations.

Landing Gear

The tires, wheels, brakes, actuators, uplock mechanisms, struts and landing gear doors should be free of snow and ice. Pay special attention to forward facing parts of the nose landing gear and doors

CAUTION *Do not apply fluid to the landing gear, wheels, and brakes.*

Doors
All door seals and hinges should be free of ice and snow.

PREFLIGHT DE-ICING INSPECTION CHECKLIST

In addition to the normal preflight inspection, a de-icing inspection must be performed immediately following or during the ground de-icing/anti-icing process. All items below must be confirmed free of snow, ice and/or frost accumulation:

- Wing, including leading edges, upper and lower surfaces, aileron control surfaces, and winglet
- Flaps
- Vertical and horizontal stabilizers, including leading edges, horns, upper and lower surfaces, rudder, elevator and side panels
- Engine inlet and exhaust and nacelle precooler exhaust
- Windshield
- Antennas
- Fuselage
- Air data probes
- Fuel tank vents
- Inlets and exhausts
- Landing gear and gear doors and wheel and brake assemblies

Once the preflight inspection is complete and the airplane is clean and adequately protected, the airplane should depart as soon as possible.

A final inspection shall be performed prior to takeoff to ensure effectiveness of the de-icing procedure. The inspection should be conducted within 5 minutes of takeoff and may be conducted from inside the airplane. If a visual inspection is not sufficient to determine whether ice is adhering, perform a tactile check. Indications of loss of effectiveness of de-icing/anti-icing fluid or contamination on airplane surfaces include:

- Progressive surface freezing or snow accumulation.
- Random snow accumulation.
- Dulling of surface reflectivity (loss of gloss) caused by the gradual deterioration of the de-icing/anti-icing fluid to slush.

If operating in ground icing conditions, a visual and tactile check of the wing leading edge and upper surfaces must be performed as defined in ICING LIMITATIONS (Section 2 – Limitations) of the Airplane Flight Manual.

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SECTION 5

HONDA AIRCRAFT AVIATION GLOSSARY

The purpose of this section is to provide crew with the common terms and acronyms used in this Pilot's Operating Manual.

TERM	DEFINITION
AC	Advisory Circular
ACCU	Aircraft Component Control Unit
ADF	Automatic Direction Finder
ADS	Air Data System
ADS-B	Automatic Dependent Surveillance-Broadcast
AEO	All Engines Operating
AFCS	Automatic Flight Control System
AFM	Airplane Flight Manual
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
A/I F/I	Anti-Ice Flight Idle
A/I G/I	Anti-Ice Ground Idle

TERM	DEFINITION
ALT	Altitude
ALT SEL	Altitude Select
AMLCD	Active Matrix Liquid Crystal Display
AMMD	Airport Moving Map Display
Anti-Ice Systems	There are two anti-ice systems on the HA-420 aircraft that affect aircraft performance: 1. Engine anti-ice 2. Wing anti-ice
AOA	Angle of Attack
AP	Autopilot
APB	AFT Pressure Bulkhead
AP DISC / ACK	Autopilot Disconnect
APPR	Approach
APR	Approach Mode
APU	Auxiliary Power Unit
ASI	Aircraft Systems and Information (display)
ASV	Antiskid Control Valve
ATC	Air Traffic Control

TERM	DEFINITION
BALD	Bleed Air Leak Detection
BAS	Bleed Air System
BAT	Battery Bus
BC	Back Course
BIT	Built-In Test
BOV	Bleed Off Valve
BRG	Bearing
CAIV	Cowl Anti-Ice Valve
CAS	Crew Alerting System
CBIT	Continuous Built-In-Test
CBP	Circuit Breaker Panels
CDI	Course Deviation Indicator
CDM	Compressor Drive Module
CDU	Control Display Unit
CPCS	Cabin Pressurization Control System
CPDU	Cabin Pressurization Data Unit
CPL	Couple

TERM	DEFINITION
CPOS	Crew and Passenger Oxygen System
CRS	Copilot Course
CSC	Cruise Speed Control
CSP	Compact Smart Probes
C/T	Carry-through tank
CVFDR	Cockpit Voice Flight Data Recorder
CVR	Cockpit Voice Recorder
CWS	Control Wheel Steering
DA	Decision Altitude
DACU	Digital Antiskid Control Unit
DCMP	DC Electrical-Motor-Driven Hydraulic Pump
DCU	De-ice Control Unit
DH	Decision Height
DME	Distance Measuring Equipment
DN	Down
DTK	Desired Track
ECS	Environmental Control System

TERM	DEFINITION
ECP	Electrical Control Panel
ECU	Electrical Control Unit
EED	Emergency Exit Door
EGT	Exhaust Gas Temperature
EIIPS	Engine Inlet Ice Protection System
EIS	Entry into Service
EIS	Engine Indication System
ELT	Emergency Locator Transmitter
EMEDS	Electro-Mechanical Expulsive De-Icing System
END	Endurance
EPS	Electrical Power System
ESA	Enroute Safe Altitude
ESB	Energy Storage Banks
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
FAA	Federal Aviation Administration
FAC	Flap Actuator Controller

TERM	DEFINITION
FADEC	Full Authority Digital Engine Control
FAF	Final Approach Fix
FAS	Flap Actuation System
FAV	Fan Air Valve
FAVC	Fan Air Valve Controller
FAVTS	Fan Air Valve Temperature Sensor
FCSOV	Flow Control Shutoff Valve
FD	Flight Director
F/I	Flight Idle
FLC	Flight Level Change
FMA	Flight Mode Annunciation
FMV	Fuel Metering Valve
FOHX	Fuel Oil Heat Exchanger
FOD	Fuel Over Destination
FPMU	Fuel Pump and Metering Unit
FQSC	Fuel Quantity Signal Conditioner
GA	Go-Around

TERM	DEFINITION
GCF	Ground Cooling Fan
GCU	Generator Control Unit
G/I	Ground Idle
GPS	Global Positioning System
GP	Glide Path
GS	Glide Slope
GTC	Garmin Touch Screen Controllers
GUI	Graphical User Interface
HOT	Holdover Time
HDG	Heading
HDG SEL	Heading Select
High Speed Cruise	Cruise at MCT
HP	High Pressure
hPa	hectoPascals
HPRSOV	High Pressure Regulating Shutoff Valve
HSI	Horizontal Situation Indicator

TERM	DEFINITION
HTIPS	Horizontal Tail Ice Protection System
HX	Heat Exchanger
IAC	Integrated Avionics Computer
IAS	Indicated airspeed. The airspeed indicator reading as installed in the airplane. The information in this manual is presented in terms of knots indicated airspeed (KIAS) unless otherwise stated and assumes zero instrument error.
IBIT	Initiated Built In Test
IF	Intermediate Fix
IAF	Initial Approach Fix
ILS	Instrument Landing System
in Hg	Inches of Mercury
IRPS	Ice and Rain Protection System
ITT	Interstage Turbine Temperature
KCAS	Calibrated airspeed expressed in knots
KIAS	Knots Indicated Airspeed
ISA	International standard atmosphere
LDG	Landing

TERM	DEFINITION
LED	Light-Emitting Diode
LFE	Landing Field Elevation
LGCL	Landing Gear Control Lever
LGCU	Landing Gear Control Unit
LGCV	Landing Gear Control Valve
LH	Left Hand
LOC	Localizer
LOI	Loss of Integrity
Long Range Cruise	Flight condition that provides 99% of the Maximum Specific Range
LP	Low Pressure
LRU	Line Replaceable Units
LSA	Low Speed Awareness
LVDT	Linear Variable Displacement Transducer
M	Mach number. The ratio of true airspeed to the speed of sound.
MC	Master Cylinders
MCT	Maximum Continuous Thrust

TERM	DEFINITION
MDA	Minimum Descent Altitude
MDS	Mask Deployment System
MED	Main Entry Door
MET	Manual Electric Trim
MEL	Minimum Equipment List
MFD	Multi-Function Display
MHS	Magnetic Heading Sensor
M_I	Indicated Mach number. The Mach number reading as installed in the airplane. Zero instrument error is assumed.
MMEL	Master Minimum Equipment List
M_{MO}	Maximum operating Mach number (0.72 Mach). The Mach number that may not be deliberately exceeded in any flight condition.
MPD	Manifold Pressure Transducer
MSA	Minimum Safe Altitude
NAVAIDS	Navigational Aid
NLG	Nose Landing Gear

TERM	DEFINITION
NOTAM	Notice To Airman
NPRSOV	Nacelle Pressure Regulating Shutoff Valve
NWSS	Nosewheel Steering System
N_1	Engine Low-Pressure Fan Rotation Speed in Percent
N_2	Engine High-Pressure Fan Rotation Speed in Percent
OAT	Outside Air Temperature. (OAT = SAT)
OEI	One Engine Inoperative
OSP	Over-Speed Protection System
PC	Pre-Cooler
PD	Pressure Demand
PDU	Power Distribution Unit
PF	Pilot Flying
PFD	Primary Flight Display
PFW	Primary Flight Window
PIC	Pilot In Command
PMU	Permanent Magnet Alternator

TERM	DEFINITION
PNF	Pilot Not Flying
POFV	Primary Outflow Valve
POM	Pilot Operating Manual
POS	Position
Pressure Altitude	Altitude measured from standard sea level pressure (29.92 in hg) by a pressure altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this manual, altimeter instrument errors are assumed to be zero. Position errors may be obtained from the correction tables/charts.
PTT	Push-To-Talk
P0	Pressure Altitude
QD	Quick Don
QRH	Quick Reference Handbook
RA	Resolution Advisory
RAIM	Receiver Autonomous Integrity Monitoring
RBS	Rudder Bias System
RH	Right Hand
RIIPS	Recorder Independent Power Supply

TERM	DEFINITION
RNAV	Area Navigation
RVDT	Rotary Variable Differential Transformer
SACV	Service Air Check Valves
SAPRV	Service Air Pressure Regulating Valve
SAT	Static air temperature. The ambient free air static temperature obtained from either: 1) ground meteorological sources, or 2) from the total air temperature obtained from onboard temperature measurement adjusted for compressibility effects. (SAT = OAT)
SB	Service Bulletin
SCU	Steering Control Unit
SCVA	Steering Control Valve And Actuator Assembly
SD	Secure Digital
SIC	Second In Command
SID	Standard Instrument Departure
SL	Sea Level
SOV	Shutoff Valve
SOFV	Secondary Outflow Valve

TERM	DEFINITION
SPD SEL	Speed Select
SSR	Solid-State Relays
STAR	Standard Terminal Arrival Route
STBY	Standby
SV	Synthetic Vision
SVT	Synthetic Vision Technology
SWPS	Stall Warning/Protection System
TAS	True Air Speed
TAT	Total Air Temperatures
TAWS	Terrain Awareness Warning System
TBD	To Be Determined
TCAS	Traffic Alert And Collision Avoidance System
TFR	Temporary Flight Restrictions
TKE	Track Angle Error
TLA	Thrust Lever Angle
TMV	Temperature Modulating Valves
TO	Takeoff

TERM	DEFINITION
TOD	Top Of Descent
TOGA	Takeoff Go Around
TRK	Track
V_1	Takeoff Decision Speed
V_2	Takeoff Safety Speed
V_{AC}	Approach Climb Speed
VDC	Volts Direct Current
VDS	Vibration Detection System
VFR	Visual Flight Rules
VHF	Very High Frequency
V_{MO}	Maximum Operating Airspeed (270 Kcas). The Speed That May Not Be Deliberately Exceeded In Any Flight Condition.
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
VNV	Vertical Navigation
VOR	Very High-Frequency Omni-Directional Range
V_R	Rotation Speed

TERM	DEFINITION
V_{REF}	Landing Reference Speed
VS	Vertical Speed Mode
VSD	Vertical Situation Display
VSR	Vertical Speed Required
WAIV	Wing Anti-Ice Air Valve
WAIXV	Wing Anti-Ice Cross Flow Valve
WHC	Windshield Heat Controllers
WIPS	Wing Ice Protection System
WOW	Weight-On-Wheels
WTBF	Wing to Body Fairing
XDCR	Transducers
XTK	Crosstrack Error
YD	Yaw Damper
ZTS	Zone Temperature Sensor