



TECHSAVIATION

Training Center

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Airplane Doors and Windows

Doors-General

The airplane doors provide general access to compartments, servicing panels, and components.

There is a flight deck overhead door that provides an emergency exit to flight crew members when normal exits are not available.

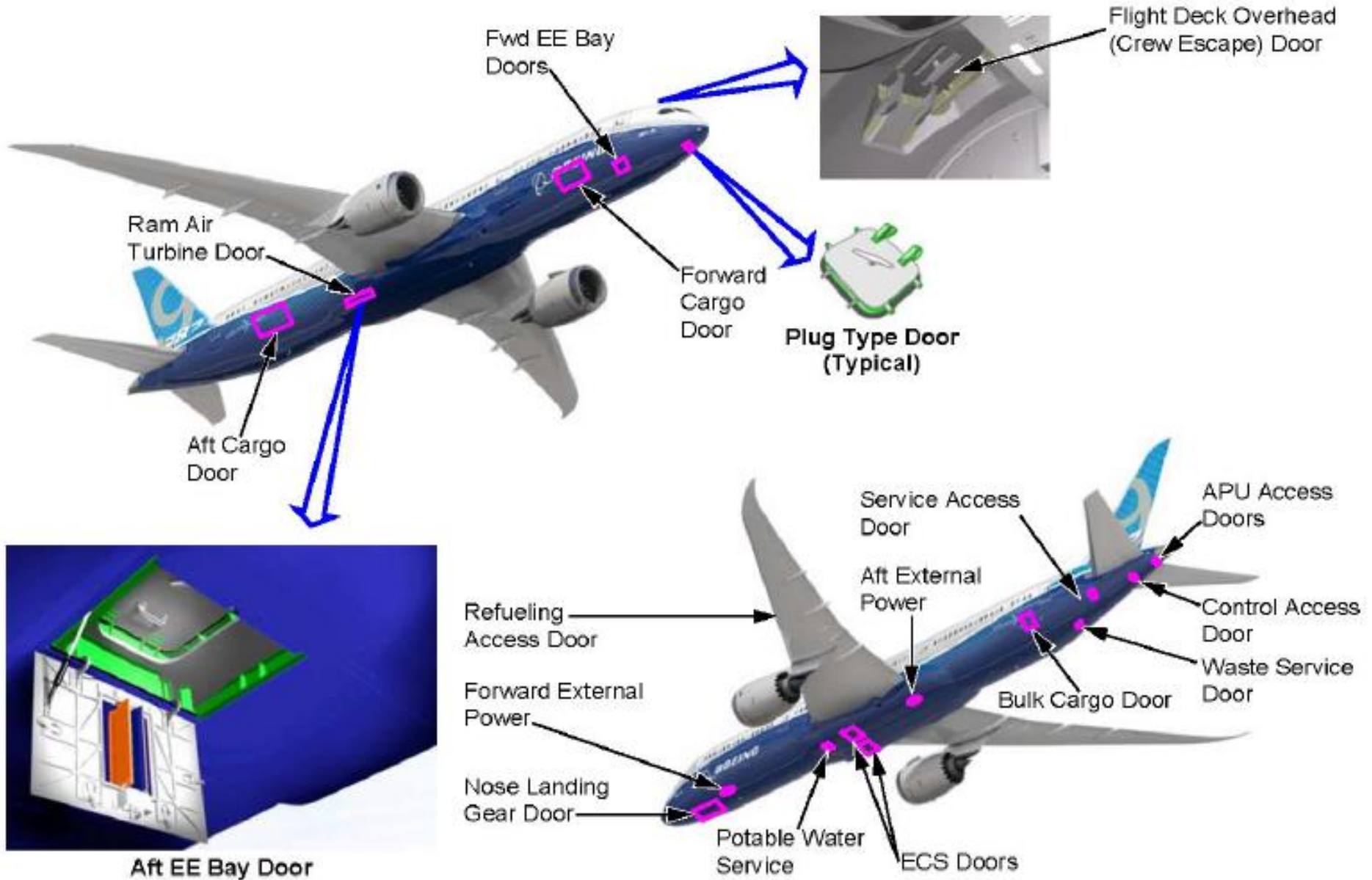
Description

The doors are made of a lightweight material and are flush with the exterior skin when stowed.

Generally, servicing doors and component access doors hinge on the forward side of the panel and have quick-release latches that give easy access into the door.

Compartment access doors are usually plug-type doors that have handles and latch pins that keep them secure.

The door warning system supplies data to the Common Core System (CCS) for indication. Door status is shown on the door synoptic page.



Passenger Entry Doors

The Passenger Entry Doors (PED) provide access to the airplane.

There are eight entry doors, four on each side of the airplane. The doors can operate in winds of up to a maximum of 40 knots.

Description

The eight PEDs are similar in size, shape, and construction. They are plug-type doors that are made of carbon fiber reinforced plastic. The door opening is 42 in (107 cm) wide and 72 in (183 cm) high.

Each PED has an Emergency Power Assist System (EPAS) and is equipped with a slide/raft.

An EPAS safety switch deactivates the system during maintenance (not shown).

These are the major components of the PEDs:

- Internal and external handles
- Door stops and roller guides
- Liners, panels, covers
- Latch mechanism
- Vent flap
- Hinge mechanism
- Hold open mechanism
- Mode select handle
- Girt bar
- EPAS module
- Flight lock mechanism.

Operation

The eight PEDs operate in the same way. The doors are operated from the interior or exterior using the handles. The doors open outward.

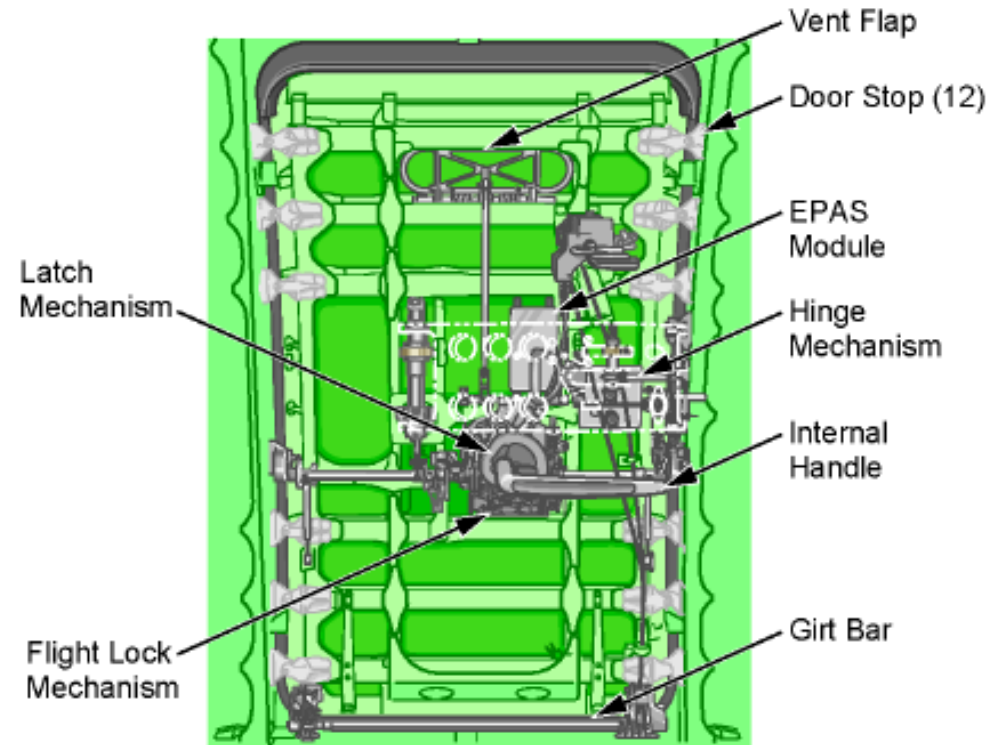
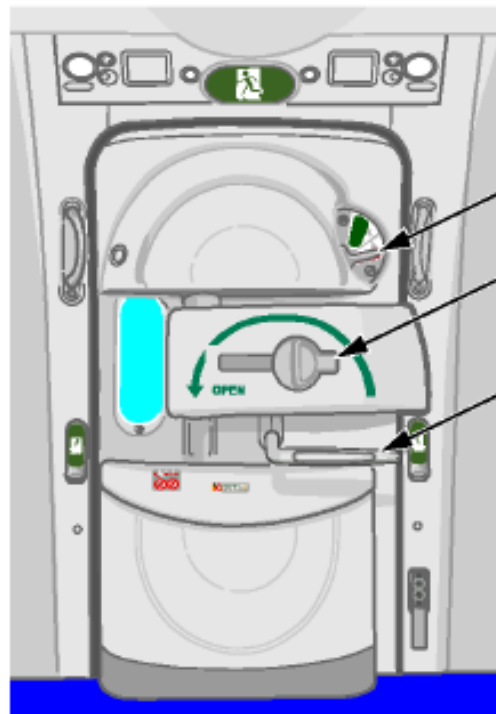
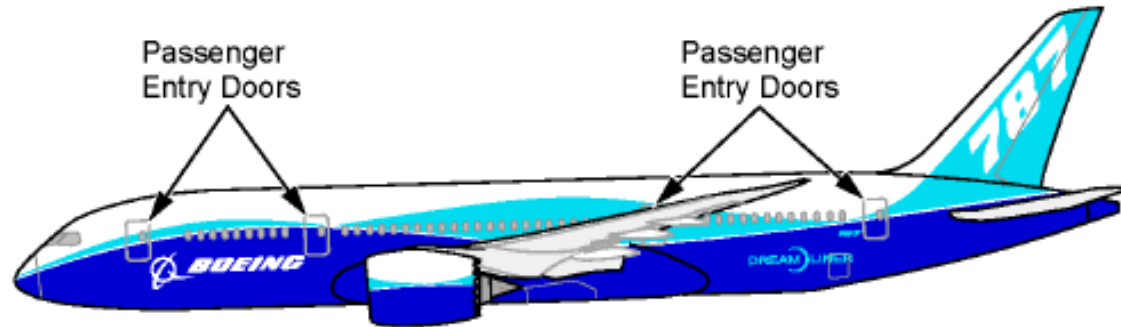
When the door is closed, the door stops on the door and door frame hold the pressurization load.

When the handle is turned, the vent flap opens and the latch mechanism unlocks the door.

The hinge mechanism holds the door parallel with the fuselage. The hinge permits movement up and down and lets the door turn outward. A hold open mechanism on the hinge arm engages on the fuselage and holds the door open.

A mode select handle controls the EPAS and slide deployment. When the two-position handle moves to arm, two things happen. An electrical signal goes to the EPAS module and the girt bar is mechanically moved into position.

A flight lock mechanism on each door prevents handle movement in flight.



Emergency Escape Slide

Each Passenger Entry Door (PED) has a slide/raft that gives the crew and passengers a fast evacuation path out of the airplane in an emergency.

Description

There are two different types of slide/rafts installed on the airplane, one lane and/or two lanes. The type of slide/rafts depends on the total passenger configuration. The two different slide/rafts are similar in description and operation.

The slide/rafts are inflatable structures made of nylon fabric. Each slide/raft can hold 57 people and can inflate in less than six seconds.

The slide/raft packs attach to the inner side of each PED, behind a bustle. A girt bar attaches the slide/rafts to the airplane floor.

The slide/rafts pack has:

- Inflation bottle
- Aspirator
- Packboard
- Girt bar
- Manual inflation handle
- Pressure gauge.

Operation

When the door Emergency Power Assist System (EPAS) is armed, the slide/rafts girt bar attaches to the airplane floor. As the door opens, the slide/raft releases from the door.

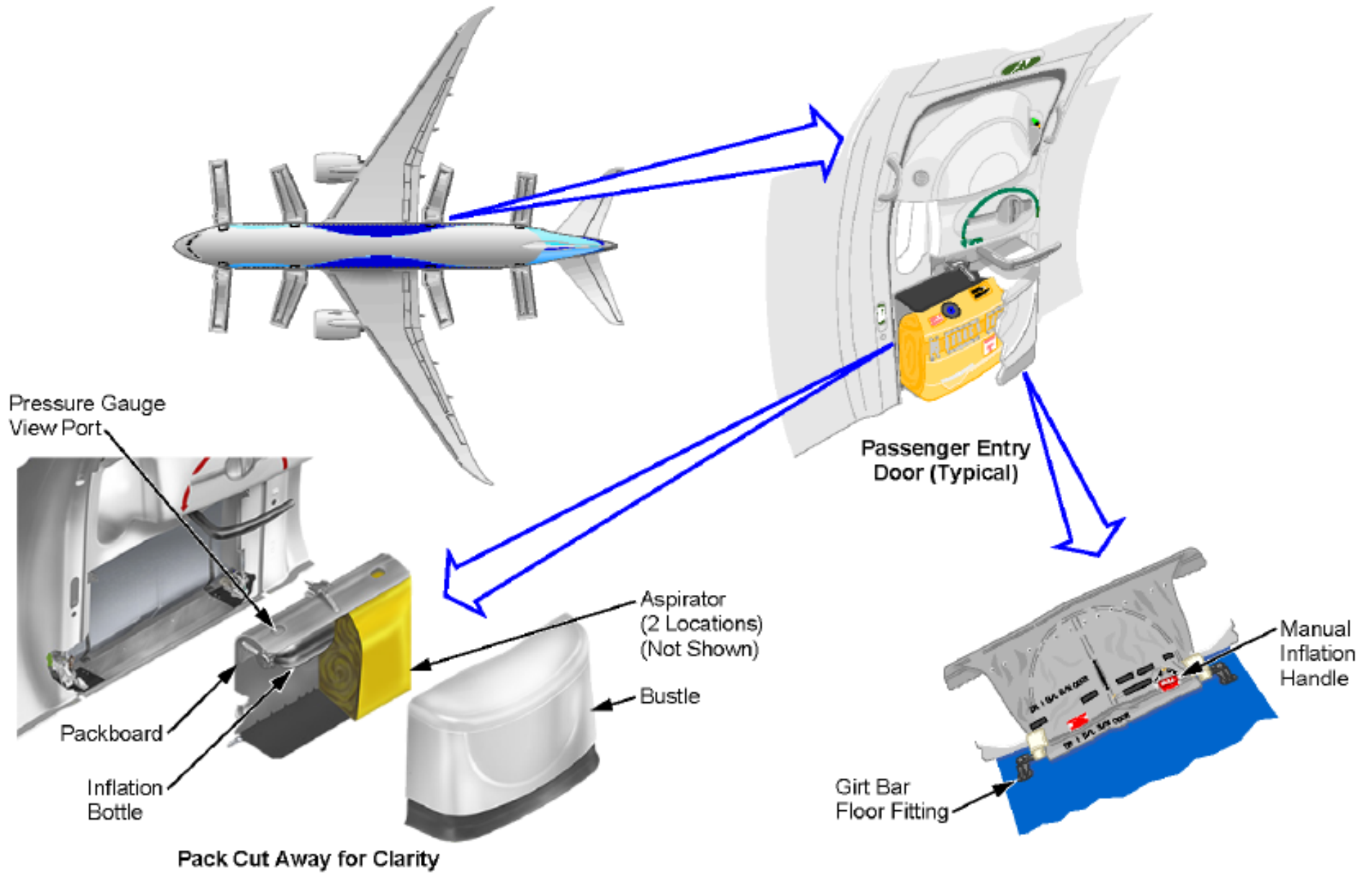
This starts the slide/raft inflation. High-pressure air releases into an aspirator, creating a jet pump effect. The high-pressure air and ambient air fill the slide/rafts to their limit.

When deployed and inflated, the escape slide/rafts extend from the door threshold to the ground or water.

The slide/rafts can be used as flotation life rafts when the girt bar is detached from the floor brackets.

If the slide/rafts do not inflate automatically, a manual handle in the door threshold can be pulled to start the inflation.

When using the external door handle, the EPAS and slide/rafts are automatically disarmed.



Cargo Doors

There are two hydraulically operated cargo doors on the right side of the airplane, one forward of the wing and one aft. The cargo doors provide access to the forward and aft cargo compartments to load and unload cargo. The door status appears on the door synoptic display. Both cargo doors operate in a similar manner.

Description

Each cargo door is 106 inches (269 cm) wide and 67 inches (170 cm) high. They are carbon fiber reinforced plastic with aluminum skin.

The doors are a non-plug type door. They hinge along the top edge and open outward away from the fuselage. Five cam latches along the bottom edge hold the doors locked and closed against airplane pressure loads.

The major door components are in the cargo compartments, on the doors or adjacent to the doors. Each door has a:

- Control panel
- Power pack
- Control valve
- Lock handle
- Lift actuator (2)
- Pull-in actuator (2)
- Latch actuator
- Proximity sensor (6).

Each door can open and close electrically or manually.

Each door has a stand-alone hydraulic system that is independent of the airplane hydraulic system. Pressurized fluid operates the door. The control panel, power pack, and control valve get electrical power when the airplane is on the ground with the two engines not in operation.

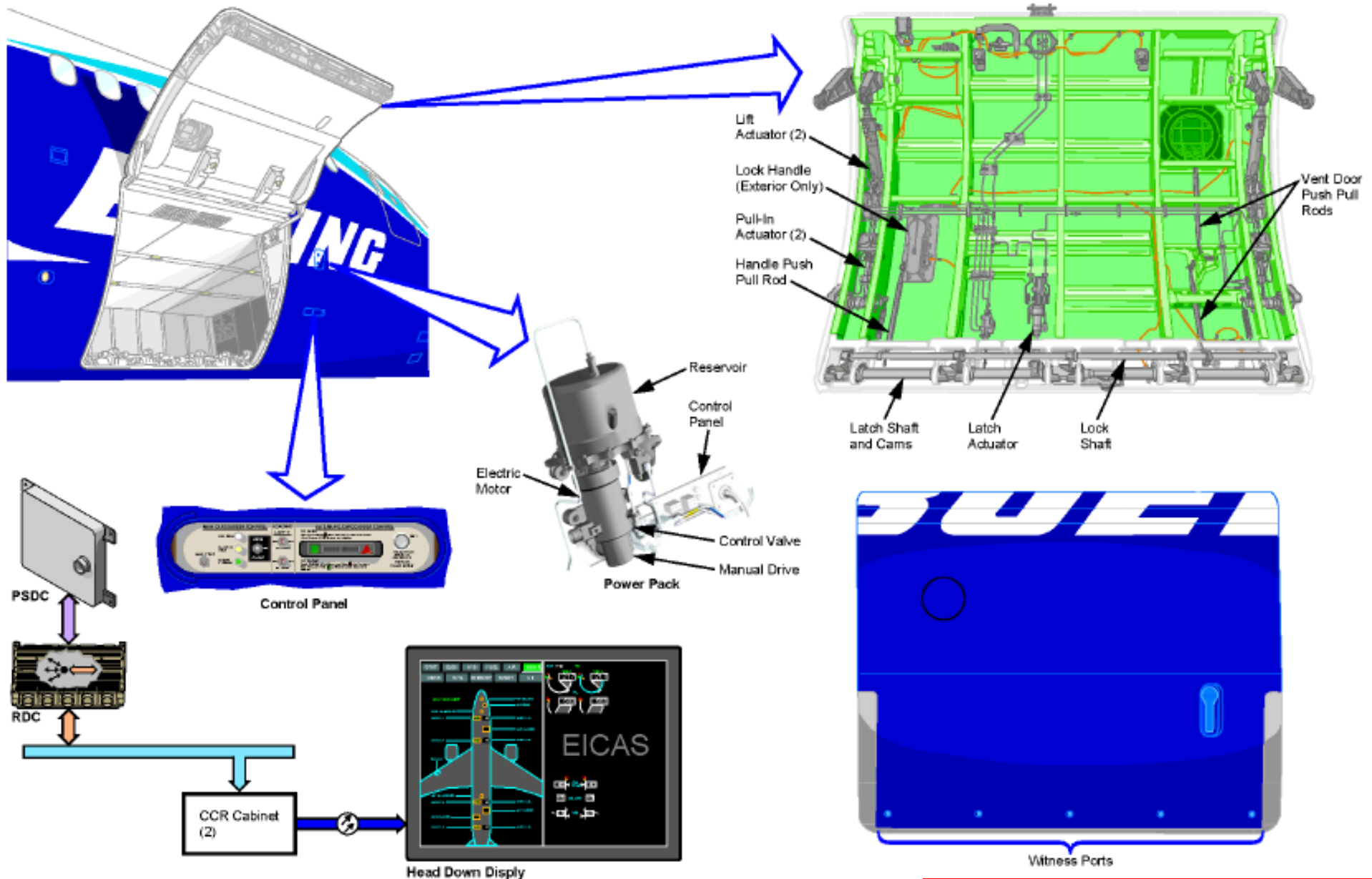
The control panel controls the normal and manual backup operation. The panel includes indicator lights for annunciation.

The power pack is made up of a reservoir, electric motor, and manual drive input. The power pack holds and pressurizes the fluid for door operation.

The lock handle is manually operated from the exterior of the airplane only. The handle manually controls the lock sectors and vent door.

The lift, pull-in, and latch actuators move the door from the fully closed and latched condition to the fully open position.

Proximity sensors on the doors monitor the door positions.



Bulk Cargo Door

The bulk cargo door provides access into the bulk cargo compartment to load and unload cargo. The door is on the left side of the airplane.

Description

The bulk cargo door is a manually operated plug-type door. The door opening is 40 inches (102 cm) wide and 46 inches (117 cm) high.

The door opens inward and upward into the fuselage. Differential pressure holds the door closed in flight.

The bulk cargo door components are:

- Interior and exterior latch handles
- Latch pins (2)
- Latch pin sensor (not shown)
- Door stop pins and pads (10)
- Hinge arm (2)
- Gas spring
- Damper
- Latch mechanism.

Operation

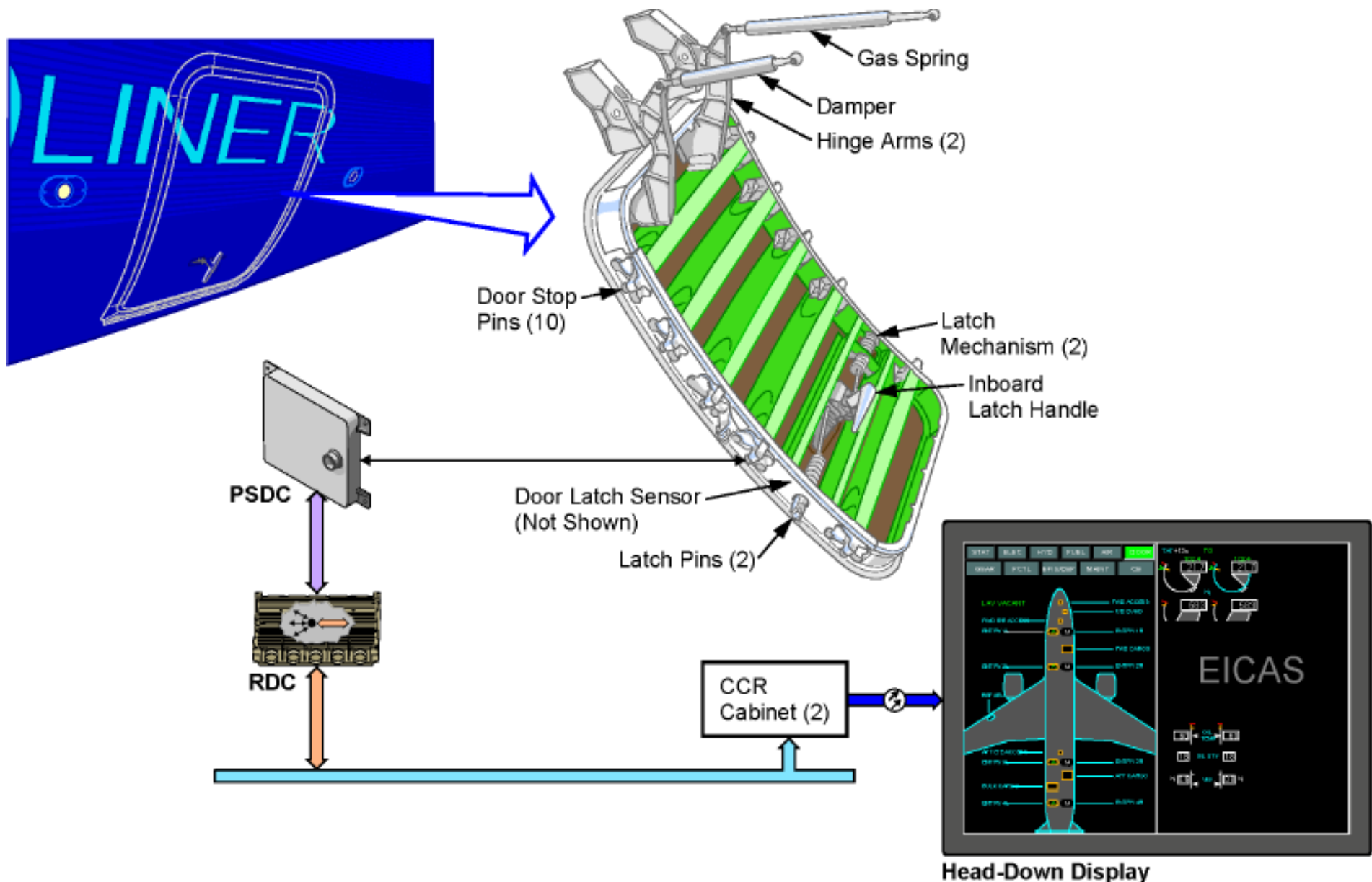
An interior or an exterior latch handle rotates to open the bulk cargo door. The exterior handle sits in a recess and is flush with the door. Movement of one of the two handles rotates a bell crank. This moves the latch mechanism and pins to unlock the door.

A latch sensor connects to the door frame and provides flight deck indication.

The door rotates upward on two hinge arms. A gas spring connected to one hinge arm assists in the door upward movement.

The door is pulled down to bring it flush with the fuselage and close the door. A damper connected to a hinge arm limits the rate of the closing door.

When the door is closed and locked, door stop pins and pads evenly distribute pressure loads around the door frame.



Door Warning System

The door warning system provides visual and aural indications to flight crew. Proximity sensors monitor the door positions.

Description

Visual information is shown for:

- Passenger Entry Doors (PED)
- Cargo doors
- Access doors
- Flight deck overhead door.

When any door is not closed, latched, and locked, three visual indications are shown. The three indications are:

- Messages
- Synoptic display
- Lights.

The Proximity Sensing System (PSS) is a hosted application in the Common Core System (CCS) and monitors door status.

Proximity Sensing Data Concentrators (PSDC) and Emergency Power Assist System (EPAS) modules monitor proximity sensors. This data goes to the CCS.

Operation

There is one EPAS module on each PED. The primary function of the EPAS module is emergency egress. The module also interfaces with the door and flight lock position sensors. This reduces the number of wires that cross the door hinge.

The PSDC excites and reads up to 16 proximity sensors that are close to it. It transmits the sensor near/far status and BITE information.

Door warnings are on:

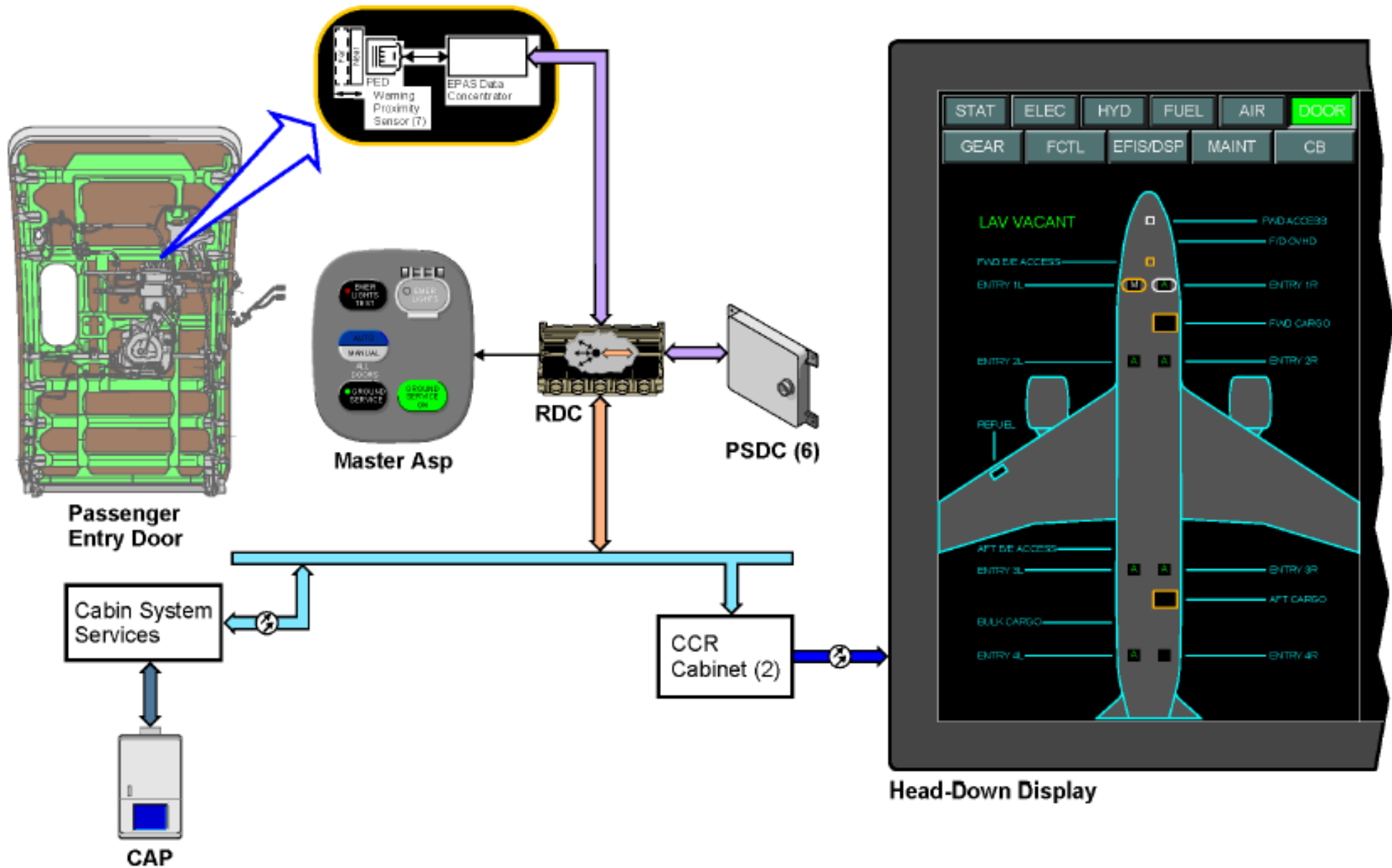
- Cabin Attendant Panels (CAP)
- Master Attendant Switch Panels (ASP)
- Door synoptic on a head-down display.

The master ASP gives indication (blue AUTO light) when all eight PED mode select switches are armed. A white MANUAL light appears when all eight doors are not armed.

The CAP gives indication when the PEDs are LOCKED or UNLOCKED.

The door synoptic shows the status of all doors. Specific symbols are used to identify the different doors.

The PEDs have a letter in their symbol when the door EPAS changes from armed to not armed (manual) or invalid.



Flight Compartment Access Door

The flight deck access door provides access into the flight compartment. The Flight Deck Access System (FDAS) is the primary means of locking the flight compartment door.

The system gives authorized personnel entry and provides enhanced security against intrusion.

Description

The FDAS is a hosted application in the Common Core System (CCS).

The FDAS has these major components:

- Keypad
- Door strike
- Switch module
- Power switch.

The FDAS maintenance control page can be used to program the FDAS settings and see the current status of the system.

Operation

There is a keypad on the cabin side of the flight deck adjacent to the door.

The keypad is used by authorized personnel for entry into the flight compartment. The keypad has five numeric buttons and three lights.

The door strike is on the inside right-hand flight compartment door post. The door strike has a solenoid operated lock pin that extends and retracts to lock and unlock the door.

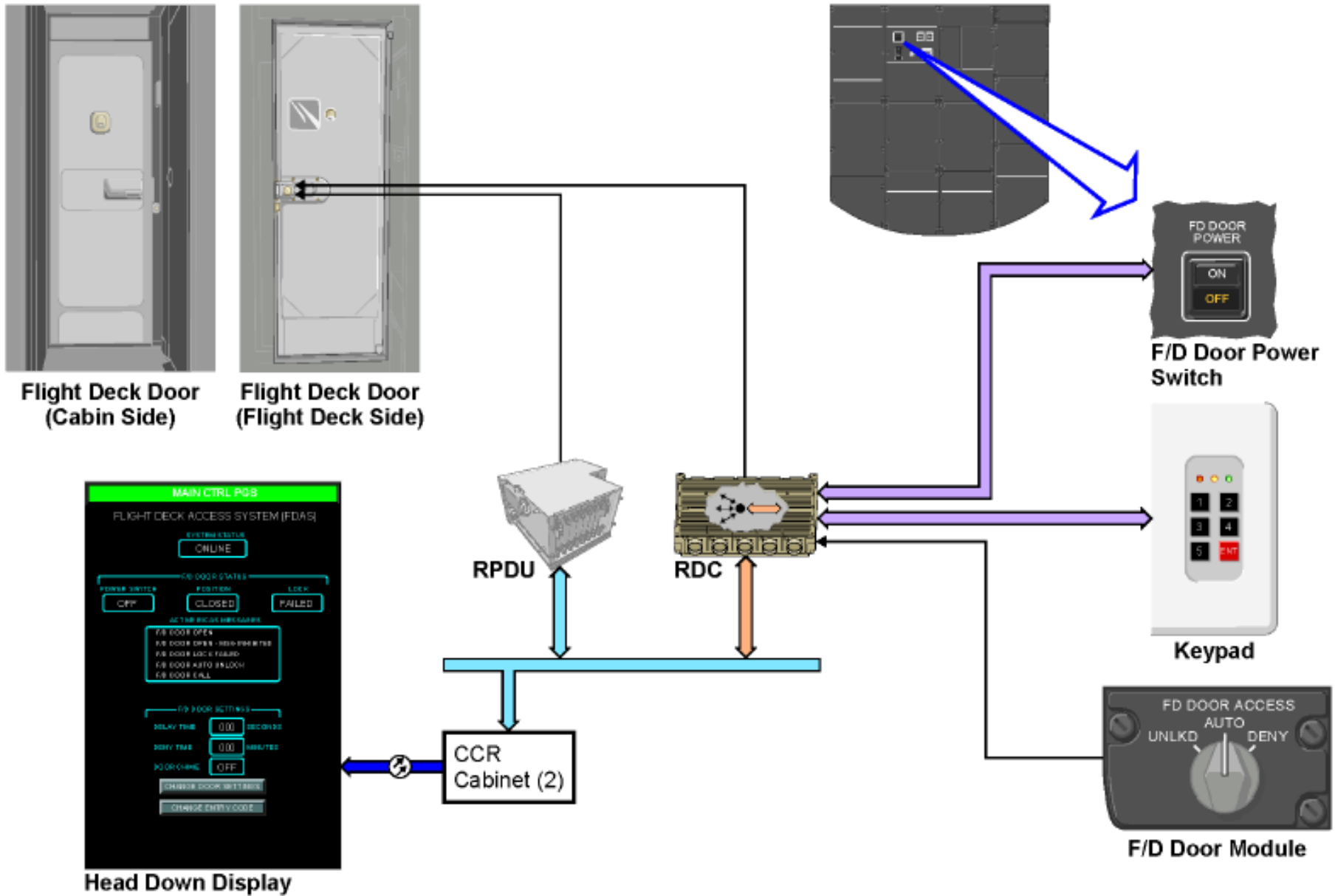
There is a Flight Deck (F/D) switch module on the P8 aisle stand. The switch module is a three-position switch that is spring-loaded to the center position.

The three switch positions are:

- UNLKD
- AUTO
- DENY.

The crew controls entry into the F/D with the F/D switch module.

The F/D door power switch is on the P5 overhead panel on the window heat control module. The switch keeps the door unlocked for maintenance.



Windows

Flight Compartment Windows

There are four flight deck windows. The windows are designated left 1 and 2 and right 1 and 2. The corresponding left and right windows are identically opposite assemblies.

The flight deck windows are composite and have a three-layer laminated construction. The three layers are:

- Glass
- Outer acrylic
- Inner acrylic.

An inner rubber gasket attached to the edge of the windows makes a pressure seal. A seal (aerosmoother) fills the space between the window frame and the fuselage skin to keep moisture out.

The sill retainers have an additional function as an aerodynamic seal and weather seal to keep moisture out.

NO. 1 Windows Description

The left No. 1 window is the captain windshield. The right No. 1 window is the first officer windshield.

The windshields are installed externally to the airplane.

The design of the No. 1 windows is to carry pressure loads and to withstand bird impact.

The windows use two conductive heat layers for primary heat (anti-ice) and anti-fog.

Each windows weighs 118 lb (53.5 kg).

NO. 2 Windows Description

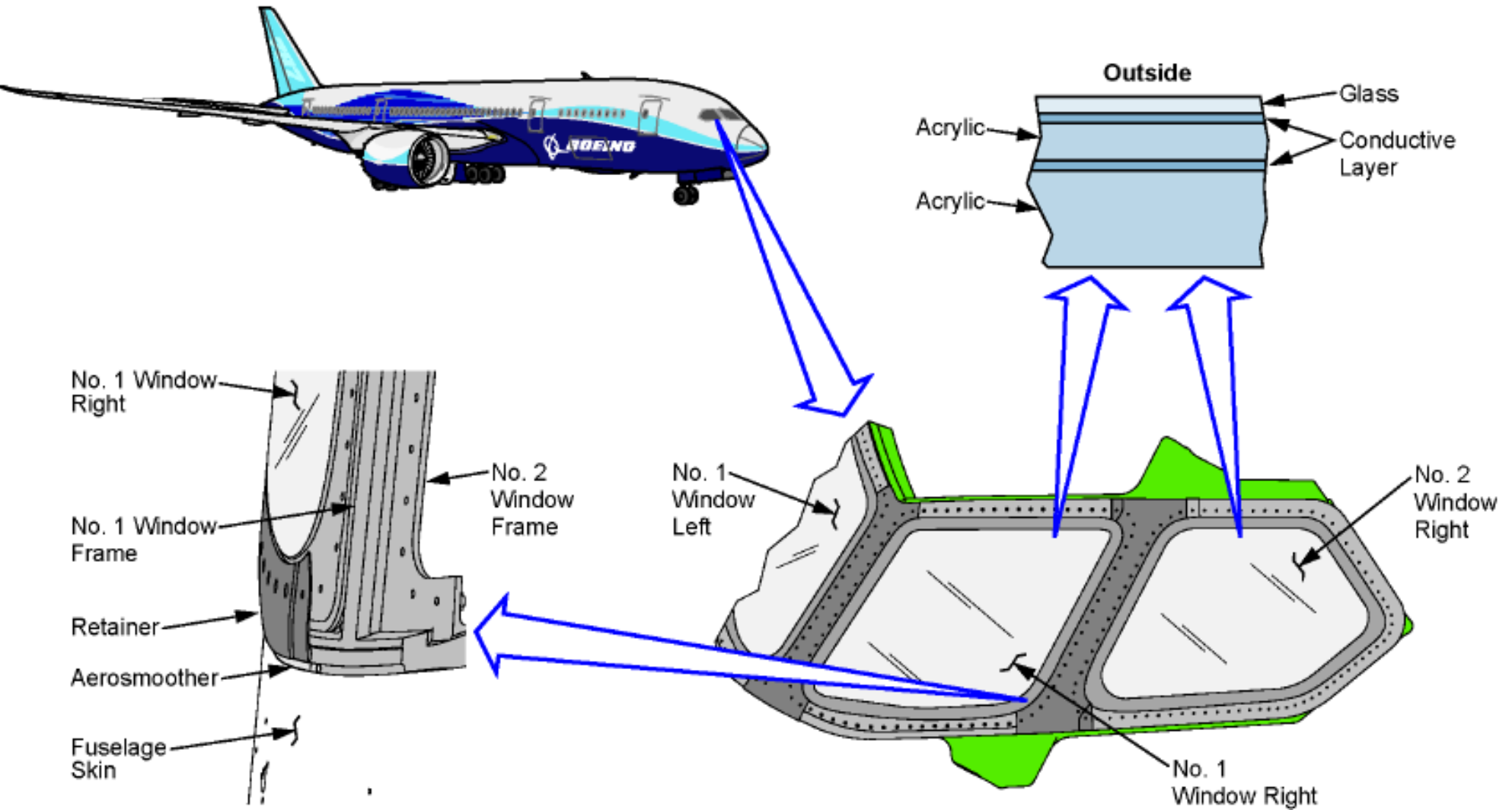
The left No. 2 window is the captain side window. The right No. 2 is the first officer side window.

The side windows are installed externally to the airplane.

The design of the No. 2 side windows is to carry pressure loads.

The side windows use one conductive heat layer for anti-fog.

Each window weighs 90 lb (40.8 kg).



Passenger Compartment Windows

The passenger compartment windows and the Passenger Entry Door (PED) windows are Electrically Dimmable Windows (EDW). This technology is used instead of traditional mechanical window shades. The EDW technology enhances the flying experience, improves comfort for the passengers, and increases the control of operation for the flight attendants.

Description

The passenger compartment windows and the PED windows are almost the same. The difference is the size and selectable levels of transparency.

The EDWs are a laminate plastic pressure pane with a composite window frame. Nut plates and retention clips hold the EDWs in position. The EDWs are plug type and install from the interior of the airplane.

Each EDW has three panes. The three panes are:

- Plastic outer pane
- EDW glass pane
- Plastic inner pane.

The EDW glass pane consists of two layers of glass with a gel material between them. The glass layers are bonded together. This seals the gel material inside. Two leads embedded between the glass layers give power.

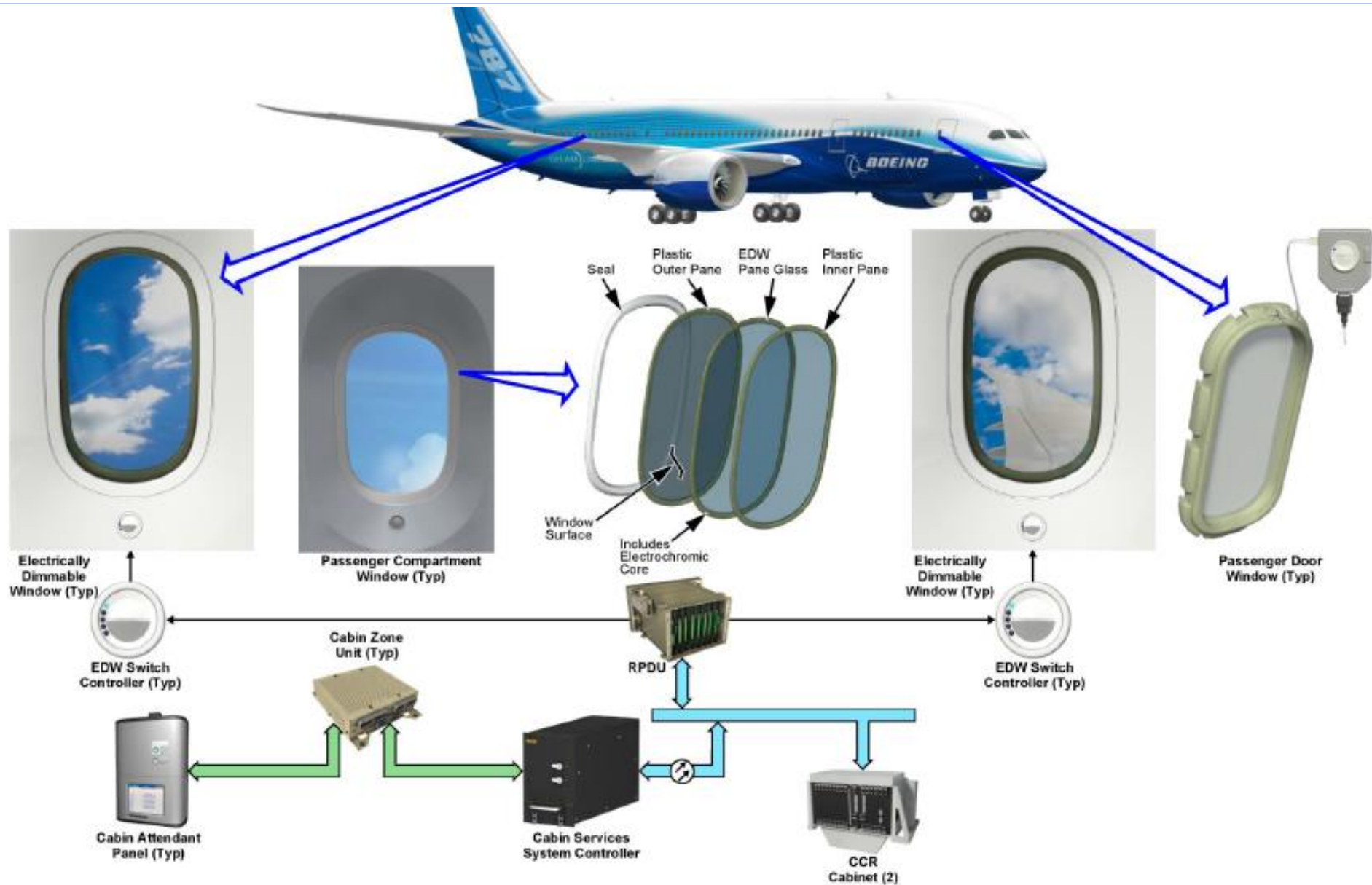
Operation

The passenger compartment EDWs are operated from the Cabin Services System (CSS) or the switch/controller below the window on the reveal. The PED EDWs can operate only from the switch/controller.

The CSS provides automatic or manual control of the passenger compartment EDWs. Crew members control the EDW function from the Cabin Attendant Panel (CAP) and the passengers from near the window itself. Automatic control is done by the CSS by using different airplane flight phases. The status of an EDW can also be checked at the CAP.

When power goes to the EDWs, the visible light transmittance changes. The PED EDWs have two selectable transparencies, transparent and opaque. The passenger EDWs have three additional intermediate settings.

The passenger EDWs return to the original transparent state whenever normal airplane power is removed or when airplane power is lost.



Cargo Handling

Cargo Handling System

The cargo handling system is a semi-automatic loading system. It electrically moves containerized cargo. The cargo must be manually restrained into their final positions.

Description

The forward and aft cargo handling systems are similar. The cargo handling system has:

- A power drive system
- Transfer elements
- Guidance hardware
- Restraint hardware.

The power drive system has two panels for each compartment. There is an external Main Control Panel (MCP) and joystick. There is also an interior Cargo Maintenance Display Unit (CMDU) with secondary control.

Power Drive Units (PDU) move the cargo into position. There are two types of PDUs, spring lift and self-lift. The self-lift PDUs are in the cargo ballmat areas. The spring lift PDUs are outside the doorway areas.

The 787-10 has four more spring lift PDUs in the forward cargo compartment, and the aft compartment, relative to the 787-9.

The transfer elements provide a roller surface to move cargo easily and in any direction.

Guidance hardware directs the cargo into position.

Restrain hardware secures the cargo.

Operation

The cargo handling system lets a single operator load or unload cargo. The CMDU acts as a controller by interfacing with the MCP, joystick, and PDUs. The CMDU interfaces with the Common Core System (CCS). Remote Power Distribution Unit (RPDU) provide power to the system.

Operators use the MCP and joystick to control the cargo. A green ON/OFF light shows that the system has power. The cargo door must be OPEN to operate the cargo handling system. A five-position joystick is used to move the cargo in, out, forward, and aft.

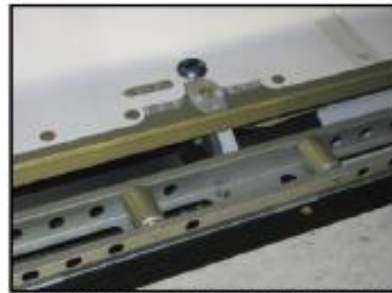
Joystick inputs go to the CMDU. The CMDU controls the PDUs through a Remote Data Concentrator (RDC) and RPDUs.

The CMDU monitors each PDU functionality and status on a CAN bus. A screen on the CMDU shows system status of selections, activities, PDU operation, and maintenance information.

The CMDU also communicates with the CCS for BITE information and software updates.



Fwd Cargo Compartment (Aft Similar)



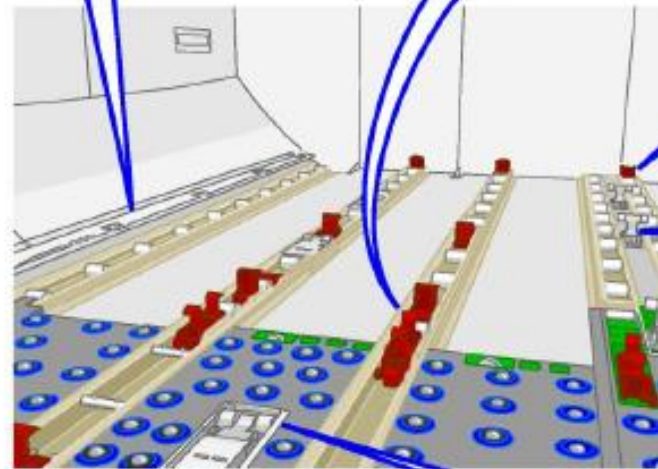
Side Guide & Roller Tray (Example)



Pallet Lock (Example)



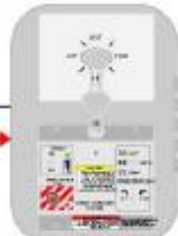
End Lock



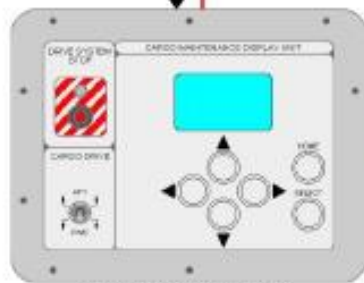
Cargo Compartment Area



Center Lock



Main Control Panel (MCP)



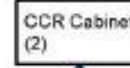
Cargo Maintenance Display Unit (CMDU)



RDC



RPDU



CCR Cabinet (2)



Power Drive Unit (PDU) (Example)