About This Book

This book supplies an introduction to the 777 airplane systems. This book uses a basic airplane configuration, but it has information on some common options. The description of the systems includes:

- Component location
- Component installation
- System operation.

To get more system information, refer to other Boeing publications, such as the Airplane Flight Manual, Operations Manual, Airplane Maintenance Manual, and Detail Specification. If the information in this book does not agree with the information of any of these publications, the publications should be used.

This book reflects the design of the airplane as of the date of printing. It is for training purposes only.

Features

The 777 is a new airplane model designed for ETOPS (extended range operation with two-engine airplanes).

The 777 has an advanced flight deck made for two crew operation. It has digital avionics and flat panel liquid crystal displays.

An airplane information management system (AIMS) supplies:

- Primary display functions
- Flight management data
- Data conversion gateway functions
- Central maintenance functions
- Communications management
- Airplane condition monitoring
- Flight data acquisition
- Thrust management functions.

Other features include:

- Fly-by-wire technology
- More than 80,000 lbs of thrust per engine (more than 70,000 lbs for first delivery airplane)
- ARINC 629 data buses
- Ultrasonic fuel quantity measuring
- Six-wheel landing gear trucks with steering
- An air data inertial reference system
- Use of fiber optic technology
- A cabin services system.

- Principal Characteristics
- Payload Capabilities
- Ground Operations

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<table>
<thead>
<tr>
<th></th>
<th>777 - 200</th>
<th>777 - 200 IGW</th>
<th>777 - 300</th>
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<tbody>
<tr>
<td>Maximum Weight, Lb (Kg)</td>
<td></td>
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<td>Taxi</td>
<td>537000 (243600)</td>
<td>634500 (287800)</td>
<td>662000 (300300)</td>
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<td>Takeoff</td>
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<td>Engines Thrust, Lb</td>
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<td>Pratt &amp; Whitney</td>
<td></td>
<td></td>
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<tr>
<td>PW4077</td>
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<tr>
<td>RB211-Trent 877</td>
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<td>90000</td>
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</tr>
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<tr>
<td>RB211-Trent 890</td>
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<tr>
<td>Fuel Capacity</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>U.S. Gal (L)</td>
<td>31000 (117300)</td>
<td>44700 (169200)</td>
<td>45220 (171200)</td>
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<td>Seating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three Class</td>
<td>305</td>
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<td>368</td>
</tr>
<tr>
<td>Two Class</td>
<td>375</td>
<td>375</td>
<td>451</td>
</tr>
<tr>
<td>All Economy (10 Abreast)</td>
<td>440</td>
<td>440</td>
<td>550</td>
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<tr>
<td>Lower Hold Volume</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cubic Feet (Cubic Meters)</td>
<td>5656 (160)</td>
<td>5656 (160)</td>
<td>7652 (214)</td>
</tr>
<tr>
<td>Maximum Operating Speed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Knots Cps (Mach)</td>
<td>330 (0.87)</td>
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</tbody>
</table>

**Principal Characteristics**

The 777 is a new twin-engine airplane. It is for medium and long range flights. The 777 size is between a 767-300 and a 747-400.

Boeing defines these three 777 airplanes:

- **777-200** (4000 to 5000 miles).
- **777-200 Increased Gross Weight (IGW)** (6000 to 7000 miles).
- **777-300** (777-200 stretched).

**Payload Capabilities**

Seat combinations include:

- Six-abreast first class
- Seven or eight-abreast business class
- Nine or ten-abreast economy class.

The 777 gives better passenger comfort and appeal with a new entertainment system and flexible cabin configuration.

**Ground Operations**

Doors, service connections, and access panels are easy to access. It is possible to service these locations at the same time. This decreases turnaround times.

The central maintenance computing function (CMCF) of the airplane information management system (AIMS) collects fault information, and supplies a central location for access to maintenance data and system test. This decreases turnaround times.

A powered cargo system decreases load and unload times.
777 Dimensions

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Fuselage

The fuselage is a pressurized semi-monocoque structure. It is made with circumferential frames, longitudinal stringers, stressed skin and pressure bulkheads.

The fuselage includes many improvements that were identified by the Boeing aging fleet program.

FUSELAGE SECTIONS

These are the major fuselage sections and their station numbers (STA).

Section 41 (STA 92.5 - 655). This section contains these items:
- Radome
- Flight deck
- Forward pressure bulkhead
- Forward equipment center
- Nose gear wheel well

- Main equipment center
- Forward cargo door (right side)
- Forward part of the forward cargo compartment.

Section 43 (STA 655 - 1035). This section contains the aft part of the forward cargo compartment

Section 44/45 (STA1035 - 1434). This is the center portion of the fuselage. It contains these items:
- Wing center section
- Keel beam
- Main gear wheel wells.

Section 46 (STA 1434 - 1832). This section contains these items:
- Aft cargo door (right side)
- Aft cargo compartment.

Section 47 (STA 1832 - 2150). This section contains these items:
- Bulk cargo door (right side)
- Bulk cargo compartment.

Section 48 (STA 2150 - 2570). This section contains these items:
- Aft pressure bulkhead
- Stabilizer compartment
- APU firewall
- APU inlet and exhaust
- APU compartment.

All sections except sections 45 and 48 contain parts of the passenger compartment.
Control Stand

The control stand has controls that are easy to reach by either pilot.

These are the components on the control stand:

- Thrust levers
- Flap lever
- Stabilizer position indicators
- Alternate flaps controls
- Fuel control switches
- Stabilizer cutout switches
- Parking brake lever
- Alternate pitch trim levers
- Speedbrake lever.

The control stand also has two cursor control devices. The cursor control devices let the flight crew get access to additional data on some multifunction displays.
Other Flight Deck Components

Necessary equipment in the flight deck includes:

- Emergency equipment
- Manual stowage
- Flight kit stowage
- Smoke goggles
- Oxygen masks
- Suitcase stowage
- Cup holders.
Electrical Power System Components

The electrical power system supplies 115 volt ac and 28 volt dc electrical power to the airplane. These are the power sources:

- Two integrated drive generators (IDGs)
- APU generator
- Two backup generators
- Ram air turbine (RAT) generator
- Main and APU batteries
- External power.

There is one IDG on each engine. They are the primary source of ac power in flight. An additional source of ac power is the APU generator. Each generator supplies up to 120 kVA.

There is one backup generator on each engine. They are variable speed variable frequency generators. Each supplies up to 20 kVA of ac power. A backup converter changes the variable frequency power to constant frequency power. Each backup generator also contains two permanent magnet generators (PMGs) that supply power to three flight control dc (FCDC) power supply assemblies.

A RAT generator is another source of backup ac power. It supplies up to 7 kVA.

For ground operations, there are two external power connectors. These are on the forward, right side of the fuselage. Each external power connector is rated for 90 kVA of ac power.

These electrical system components are in the main equipment center:

- Generator control units (GCU) (4)
- Bus power control unit (BPCU)
- Backup converter
- Electrical load management system (ELMS) panels (7)
- FCDC power supply assemblies (PSA) (2)
- Transformer rectifier units (TRU) (5)
- Battery charger
- FCDC batteries (2).

One FCDC PSA and its related battery are in the E5 rack.

The main battery is in the main equipment center. The APU battery and charger are in the E10 rack. Both batteries supply 28 volt dc power.
Fuel

Features

FUEL CAPACITY

One center tank and two main tanks hold 302,000 pounds (137,000 kgs) in the 777-200 IGW. The 777-200 has a smaller center tank so that the airplane holds 209,000 pounds (94,700 kgs).

FUEL TANK COMPONENT REPLACEMENT WITHOUT DEFUELING

Many fuel system components are removable from the lower surface of the wings, and from the rear spar, without defueling.

AUTOMATIC CENTER TANK SCAVENGE

When the fuel in the center tank gets low, the main tanks automatically feed the engines. The remaining fuel in the center tank automatically transfers to the main tanks.

AUTOMATIC FUEL JETTISON SYSTEM

The fuel jettison system dumps fuel overboard to reduce airplane gross weight. This prevents overweight landings. The jettison system is turned on by the pilots and automatically stops at the maximum landing weight. The pilots can also manually select the quantity of fuel to jettison.

ULTRASONIC FUEL QUANTITY INDICATING SYSTEM (FOIS)

The FOIS uses an ultrasonic system and an advanced microprocessor to measure fuel quantity.

WATER DETECTION

Ultrasonic sensors detect water that settles in the bottom of a tank. The CMCS shows a maintenance message to alert the ground crew of water in a tank.

FUEL SYSTEM SYNOPTIC DISPLAY

This synoptic display shows a schematic of the fuel feed system.

• Fuel Tanks and Vent System
• Pressure Refuel System
• Engine and APU Fuel Feed Systems
• Jettison and Defuel Systems
• Fuel Quantity Indicating System
• Controls and Indications
**777 Fuel Tank Capacities**

<table>
<thead>
<tr>
<th></th>
<th>Gallons</th>
<th>Liters</th>
<th>Lbs.**</th>
<th>Kgs.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Tank (each)</td>
<td>9,300</td>
<td>35,200</td>
<td>62,870</td>
<td>28,515</td>
</tr>
<tr>
<td>Center Tank</td>
<td>26,100</td>
<td>98,800</td>
<td>176,436</td>
<td>80,028</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>44,700</td>
<td>169,200</td>
<td>302,172</td>
<td>137,052</td>
</tr>
</tbody>
</table>

*777-200 IGW Airplane
**Density = 6.76 lb/gal (81 kg/l)*

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**Fuel Tanks**

The fuel system has three fuel tanks: two main tanks and one center tank. The tanks are part of the wing structure and the center wing section.

Most fuel system components are inside the tanks. These are the components on the rear spar:

- Boost pumps
- Scavenge jet pumps
- Valve actuators

You can remove these components on the rear spar without defueling.

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**Fuel Vent System**

The fuel vent system keeps the fuel tanks near ambient pressure during all flight phases, airplane attitudes, and refueling/defueling operations. Each fuel tank is vented, through channels in the wing, to the surge tanks.

The vent channels also permit fuel overflow into the surge tank if necessary.
Features

ENGINE

The PW4000 engine for the 777 is a growth version of earlier PW4000 engines. The engine core is common to the earlier engines. With a new 112 inch (2.84 meter) diameter fan and wide-chord shrouded fan blades, the engine can produce more than 90,000 pounds of thrust.

POWERED DOOR OPENING SYSTEM (PDOS)

Both the thrust reverser assemblies and fan cowlings have a powered door opening system.

INDICATION

Most engine parameters go to the AIMS from the electronic engine control (EEC). Primary display system pages show engine parameters and dispatch information. Four maintenance pages show engine maintenance data.

CONTROL

The PW4000 uses a dual channel, full authority digital electronic control (FADEC) system. The main component of the FADEC system is the electronic engine control (EEC). The EEC controls:

- Engine systems
- Starts and autostarts
- Thrust reverser operation.

The EEC also supplies fault monitoring information to the central maintenance computing system (CMCS).

FUEL

A servo fuel heater improves cold temperature starting.

Power Plant - P&W

- Engine Specifications
- Engine Cowling
- Engine Indication
- Engine Control System
- Engine Fuel System
- Engine Air System
- Engine Start and Ignition
- Engine Oil System
- Engine Exhaust System
**Engine Specifications**

**Pratt & Whitney 4000**

The Pratt & Whitney 4000 engine is a high bypass ratio, two-spool turbofan engine. The low pressure shaft (N1) includes:

- 112-inch fan
- Six-stage low pressure compressor (LPC)
- Seven-stage low pressure turbine (LPT).

The high pressure shaft (N2) and combustion sections are common to previous PW4000 engines. The high pressure shaft includes an eleven-stage high pressure compressor (HPC) and a two-stage high pressure turbine (HPT).

The PW4000 engines have different takeoff thrust ratings. An external program plug selects different software in the EEC to set the ratings. The last two digits of the engine series number give the thrust rating.

Most of the engine line replaceable units (LRUs) attach to the core of the engine or the gearbox. You open the thrust reverser assembly to get access to these components. Some LRUs attach to the fan case and you open the fan cowls to get access to them.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Takeoff Thrust</th>
</tr>
</thead>
<tbody>
<tr>
<td>PW4074</td>
<td>74,500 lbs</td>
</tr>
<tr>
<td>PW4077</td>
<td>77,200 lbs</td>
</tr>
<tr>
<td>PW4084</td>
<td>84,600 lbs</td>
</tr>
<tr>
<td>PW4090</td>
<td>90,000 lbs</td>
</tr>
</tbody>
</table>
Power Plant P&W

Engine Left Side and Forward Gearbox Components

Engine Right Side and Aft Gearbox Components
Engine Cowling

Fixed and hinged cowls make up the engine nacelle. The cowls permit smooth airflow through and around the engine. They also protect the components on the engine.

The fixed cowls include these:
- Inlet cowl
- Nozzle
- Plug.

These components attach to engine flanges.

Hinged cowls include the fan cowl and thrust reverser assembly. They hinge on the strut and latch on the bottom. Unlike earlier PW4000 engines, there is no core cowl on this engine.

You open hinged cowls to get access to engine components. The fan cowls and thrust reverser assemblies open hydraulically with the powered door opening system (PDOS). The PDOS has these components:
- Fan cowl opening actuators (2)
- Thrust reverser assembly opening actuators (2)
- Strut-mounted pump/power pack
- Control switches (one set per side).

The PDOS is a self-contained system. If there is no electrical power, you can override the PDOS and open the hinged cowls mechanically.
Features

THRUST

The GE90 is a high bypass turbofan engine with a 123 inch (3.12 meter) fan diameter. The engine produces more than 90,000 pounds of thrust.

POWERED DOOR OPENING SYSTEM

The fan cowls and thrust reverser assemblies have a powered door opening system.

EGT PYROMETER

An EGT pyrometer uses an infrared sensor to measure turbine blade metal temperature.

DUAL SPRAY DUPLEX FUEL NOZZLES

Each fuel nozzle assembly has two spray nozzles on it for different spray patterns and changes in fuel scheduling.

Power Plant - GE

- Engine Specifications
- Engine Cowling
- Engine Indication
- Engine Control System
- Engine Fuel System
- Engine Air System
- Engine Start and Ignition
- Engine Oil System
- Engine Exhaust System

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GE90

The GE90 engine is a high bypass ratio, two-spool turbofan engine. The low pressure shaft (N1) has these components:

- 123-inch (3.12m) fan
- Three-stage low pressure compressor (LPC or booster)
- Six-stage low pressure turbine (LPT).

The high pressure shaft (N2) has these components:

- Ten-stage high pressure compressor (HPC)
- Two-stage high pressure turbine (HPT).

The GE90 engines have different takeoff thrust ratings. Software pin programming in the electronic engine control (EEC) changes the ratings.

Most of the engine line replaceable units (LRUs) attach to the core of the engine or the gearbox. You open the thrust reverser assembly to get access to these components. Some LRUs attach to the fan case and you open the fan cowls to get to them.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Takeoff Thrust</th>
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<tbody>
<tr>
<td>GE90-76B</td>
<td>76,400</td>
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<td>GE90-85B</td>
<td>84,700</td>
</tr>
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<td>GE90-90B</td>
<td>90,000</td>
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</table>
Power Plant - GE

Engine Left Side and Forward Gearbox Components

Engine Right Side and Aft Gearbox Components

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**Engine Cowling**

Fixed and hinged cowls make up the engine nacelle. The cowls permit smooth airflow through and around the engine. They also protect engine components.

The fixed cowls include the inlet cowl and plug. These attach to engine flanges.

Hinged cowls include the fan cowl and thrust reverser assembly. They hinge on the strut and latch on the bottom. Unlike earlier GE engines, there is no core cowl on this engine.

You open hinged cowls to get access to engine components. The fan cowls and thrust reverser assemblies open hydraulically with the powered door opening system (PDOS). The PDOS includes these components:

- Fan cowl opening actuators (2)
- Thrust reverser assembly opening actuators (2)
- Strut-mounted pump/power pack
- Control switches (one set per side).

The PDOS is a self-contained system. If there is no electrical power, you can override the PDOS and open the hinged cowls mechanically.
Features

ENGINE

The Rolls-Royce Trent 800 engine is a growth version of earlier RB211 engines. With its advanced wide-chord fan blades, the engine can produce over 90,000 pounds of thrust.

POWERED DOOR OPENING SYSTEM (PDOS)

Both the thrust reverser assemblies and fan cowlings have a powered door opening system.

INDICATION

Most engine parameters go to the AIMS from the electronic engine controller (EEC). EICAS pages show engine parameters and dispatch information. Four primary display system maintenance pages show engine maintenance data.

CONTROL

The Trent engine uses a dual channel, full authority digital electronic control (FADEC) system. The main component of the FADEC system is the electronic engine controller (EEC). The EEC controls:

- Engine systems
- Starts and autostarts
- Thrust reverser operation.

The EEC also supplies fault monitoring information to the central maintenance computing system (CMCS).

- Engine Specifications
- Engine Cowling
- Engine Indication
- Engine Control System
- Engine Fuel System
- Engine Air System
- Engine Start and Ignition
- Engine Oil System
- Engine Exhaust System
RB211 Trent 800

The Rolls-Royce RB211 Trent 800 engine is a high bypass ratio, three-spool turbofan engine. The low pressure shaft (N1) has these components:

- 110 inch (2.8 m) fan
- Five-stage low pressure turbine (LPT).

The intermediate pressure shaft (N2) has these components:

- Eight-stage intermediate pressure compressor (IPC)
- Single stage intermediate pressure turbine (IPT).

The high pressure shaft (N3) turns the external gearbox and has these components:

- Six-stage high pressure compressor (HPC)
- Single stage high pressure turbine (HPT).

The Trent 800 engines have different takeoff thrust ratings. An external data entry plug selects different software in the EEC to set the ratings.

Most of the engine line replaceable units (LRUs) are on the fan case of the engine or the gearbox. You open the fan cowl to get access to these components. Some LRUs are on the core of the engine and you open the thrust reverser assembly to get to them.

<table>
<thead>
<tr>
<th>Engine</th>
<th>Takeoff Thrust</th>
</tr>
</thead>
<tbody>
<tr>
<td>TREN7 875</td>
<td>74,600 lbs</td>
</tr>
<tr>
<td>TREN7 877</td>
<td>77,200 lbs</td>
</tr>
<tr>
<td>TREN7 884</td>
<td>84,300 lbs</td>
</tr>
<tr>
<td>TREN7 890B</td>
<td>90,000 lbs</td>
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</tbody>
</table>
**Engine Cowling**

Fixed and hinged cowls make up the engine nacelle. The cowls permit smooth airflow through and around the engine. They also protect the components installed on the engine.

These are the fixed cowls:
- Inlet cowl
- Turbine exhaust nozzle
- Turbine exhaust plug.

These components attach to engine flanges.

Hinged cowls include the fan cowl and thrust reverser assembly. They hinge to the fan cowl support beam and the strut. The cowl latches are on the bottom. There is no core cowl on the engine.

You open hinged cowls to get access to engine components. The fan cowls and thrust reverser assemblies open hydraulically with the powered door opening system (PDOS).

The PDOS has these components:
- Fan cowl actuators (2)
- Thrust reverser assembly actuators (2)
- Strut-mounted pump/power pack
- Control switches (one set per side).

The PDOS is a self-contained system. You can override it and open the hinged cowls mechanically.
Features

OPERATES ON THE GROUND OR IN FLIGHT

The auxiliary power unit (APU) is an electrical and pneumatic power source for aircraft systems on the ground or in flight.

PNEUMATIC POWER SOURCE

The APU load compressor supplies pneumatic power up to an altitude of 22,000 feet (6700 m).

ELECTRICAL POWER SOURCE

A 120 kVA APU generator supplies electrical power up to the service ceiling of the airplane.

DUAL STARTING SYSTEM

The APU has an electric and an air turbine starter. The air turbine starter starts the APU when there is air pressure in the pneumatic system.

EDUCTOR COOLING SYSTEM

The APU has an eductor air/oil cooling system in place of the more usual mechanical fan.

AUTOSTART

The APU automatically starts if the airplane is in the air and both the left and right transfer buses lose power.

APU OIL HEATERS

The APU oil heaters operate continuously to increase APU starting reliability.

FULL AUTHORITY DIGITAL ELECTRONIC CONTROL

The APU control system uses microprocessor electronics to supply automatic, full-authority digital electronic control for all APU operating conditions.

DUAL OPERATING MODES

The APU may operate in either the attended or unattended mode. In the attended mode, only safety related faults cause automatic protective shutdowns. In the unattended mode, all faults that may damage the APU cause protective shutdowns.

OPERABLE DURING REFUELING

The APU operates normally during refueling operations.

CLUSTER COMPONENT DESIGN

For easier line maintenance, the following subsystem components are in functional clusters:

- Fuel
- Lubrication
- Ignition
- Pneumatic.

These clusters are line replaceable units.

OPERATIONAL HISTORY RECORDING

A data memory module records APU operation data.

OPTIONAL EXHAUST MUFFLER

An optional exhaust muffler in the exhaust duct decreases exhaust noise.

Auxiliary Power Unit

- Auxiliary Power System
- Control and Indication
- Fuel System
- Pneumatic System
- Ignition and Starting System
- Lubrication System
Auxiliary Power System

The auxiliary power system supplies electrical and pneumatic power to the airplane. This permits independent ground operation. The auxiliary power system is also available for use in flight.

The auxiliary power unit (APU) is an AlliedSignal Engines 331-500. The APU is in the tail cone of the aircraft.

The APU controller (APUC) controls and monitors the APU starting sequence, normal operation, and shutdown. The APUC does protective shutdowns, if necessary, to prevent damage to the APU.

The APU can start at all altitudes up to the service ceiling of the airplane (43,100 feet / 13,100m). Electrical power is available up to the service ceiling and pneumatic power is available up to 22,000 feet (6700m).

To make maintenance easier, some subsystem components are in removable clusters.

A data memory module (DMM) attaches to the left side of the APU inlet plenum. The DMM makes a record of APU operation data including:

- Number of starts
- Type of start (electric or pneumatic)
- Operating hours
- Time in the different operating modes
- Average generator load.
Main Landing Gear

The main landing gear strut includes an air-oil shock absorber. A drag brace and a side brace transmit loads from the strut to the airplane structure. Over-center mechanisms lock both braces when the landing gear is fully extended.

A landing gear door on each main gear wheel well opens and closes during gear retraction and extension.

Each truck has three axles. A brake and a wheel-tire assembly are at the end of each axle for a total of six wheels on each main landing gear. The aft axle pivots for main gear steering.

NORMAL OPERATION
The main landing gear uses hydraulic pressure from the center system to retract and extend. Sequence valves control the door and gear movement.

Drag brace and side brace downlock actuators lock the gear in the extended position. Uplock hooks lock the landing gear in the retracted position.

The main landing gear trucks tilt approximately 13 degrees forward wheels up with the gear extended in flight. The gear trucks tilt about 5 degrees forward wheels down when the gear is up and locked, or in transit.

ALTERNATE EXTENSION
The alternate extension system permits landing gear extension if the center hydraulic system has no pressure. An alternate extend power pack supplies hydraulic pressure to unlock the landing gear doors and the landing gear. The doors open and the gear extends by their own weight. The gear doors stay open after an alternate extension.

GROUND DOOR OPERATION
The alternate extension system permits you to open the doors when the airplane is on the ground. The doors open by their own weight. Center system hydraulic pressure closes the doors.
Nose Landing Gear

The nose landing gear strut includes an air-oil shock absorber. A folding drag brace transmits loads from the strut to the airplane structure. At full extension or retraction of the nose gear, the over-center mechanism of the lock link locks the drag brace.

The forward doors of the nose gear wheel well operate hydraulically during gear retraction and extension. The aft doors operate by mechanical linkages that connect to the nose gear. The aft doors close only when the gear retracts.

NORMAL OPERATION

The nose landing gear uses center system hydraulic pressure to retract and extend. Sequence valves control forward door and landing gear movement.

ALTERNATE EXTENSION

Nose gear alternate extension uses hydraulic pressure from the alternate extend power pack. The forward doors open and the landing gear extends by their own weight. The forward doors remain open after an alternate extension.

GROUND DOOR OPERATION

The alternate extension system permits you to open the forward doors when the airplane is on the ground. The forward doors open by their own weight. The doors close with hydraulic pressure from the center system.
Flight Control Systems

PRIMARY FLIGHT CONTROL SYSTEM

The primary flight control system (PFCS) is a modern, three-axis, fly-by-wire system. The fly-by-wire design permits a more efficient structural design. Some benefits of this design are increased fuel economy, and smaller vertical fin and horizontal stabilizer. This technology lets the airplane meet strict safety requirements with decreased weight and supplies improved control and protection.

The PFCS supplies manual and automatic airplane control and envelope protection in all three axes. There is stability augmentation in the roll, pitch, and yaw axes.

The PFCS calculates commands to move the control surfaces with sensor inputs from these components:

- Control wheels
- Control column
- Rudder pedals
- Speedbrake lever
- Pitch trim switches.

These are the control surfaces for roll control:

- Two ailerons
- Two flaperons
- Fourteen spoilers.

For pitch control, there are two elevators and a moveable horizontal stabilizer.

There is a tabbed rudder for yaw control.

HIGH LIFT CONTROL SYSTEM

The high lift control system (HLCS) supplies increased lift at lower speeds for takeoff and landing.

High lift surfaces include one inboard and one outboard trailing edge flap on each wing. There are seven leading edge slats and one Krueger flap on each wing.
Engine Fire Extinguishing

The two engine fire extinguishing bottles are in the forward cargo compartment. They are aft of the cargo compartment door and outboard of the liner. They contain Halon. Each bottle has two discharge squibs. The squib is an electrically-operated explosive device which breaks the seal on the discharge port. Pipes connect both bottles to discharge nozzles in each engine compartment.

When you pull a fire switch:

- The squib arms
- Fuel supply to the engine stops
- Engine generators electrically disconnect
- Hydraulic fluid supply to the engine-driven pump stops
- Engine bleed air valves close
- Engine thrust reverser is deactivated.

Discharge lights and the primary display system give indications of fire bottle discharge.

The ELMS does an automatic squib test during each flight leg. You can also use the MAT to do a squib test. Status messages show inoperative squib circuits.
Cargo Compartment Fire Extinguishing System

The cargo compartment fire extinguishing bottles are in the forward cargo compartment. They are aft of the cargo compartment door and outboard of the liner. The bottles are filled with Halon and pressurized with nitrogen. Tubes and flow valves connect the bottles to the forward, aft and bulk cargo compartments.

Each bottle has one discharge squib. Each flow valve has two squibs. The squib is an electrically-operated explosive device which breaks a seal in the bottle and in the flow valve. Halon flows from the bottle through the flow valve to the selected cargo compartment.

The cargo fire/engine control panel has forward and aft cargo fire arm switches and a discharge switch.

Push the forward or aft cargo fire arm switch to arm the system. Push the discharge switch to:

- Open the flow valve
- Release halon from the dump bottles
- Start a timer in ELMS for the discharge of the metered bottles.

This is how the metered bottles discharge:

- If the airplane is on the ground when the discharge switch is set, one metered bottle will discharge 20 minutes after the dump bottles.
- If the airplane is in the air but lands less than 20 minutes after the switch is set, one metered bottle will discharge at landing.
- If the airplane is in the air 20 minutes after the switch is set, all of the metered bottles will discharge.

The filter/regulator causes the metered bottles to discharge slowly for long-term fire suppression.

It takes 180 minutes for all three bottles to completely discharge (-200).

It takes 240 minutes for all four bottles to completely discharge (-300).

A pressure switch in the discharge line turns on the light in the discharge switch. A pressure switch in each bottle shows bottle discharge on the primary display system. The primary display system also shows the condition of the squibs.

The ELMS does an automatic squib test during each flight leg. You can also use the MAT to do a squib test. Status messages show inoperative squib circuits.
Three-Class 305 Passengers

Three-Class 328 Passengers

Two-Class 375 Passengers

Two-Class 400 Passengers

One-Class 418 Passengers

One-Class 440 Passengers

*Interior Arrangements (-200)*
Lower Lobe Attendants Rest

**ENTRANCE ENCLOSURE**

The entrance enclosure gives access to the LLAR from the passenger compartment. It contains an attendant switch panel to give control for the lights and fire extinguishing in the LLAR.

**LLAR**

The LLAR gives an area for flight attendant rest while the airplane is in the air. It contains sleeping bunks and storage compartments for personal belongings. The module has these systems and equipment:

- Lighting
- Passenger address
- Cabin interphone
- Ventilation
- Temperature control
- Smoke detection
- Fire extinguishing
- Supplemental oxygen
- Emergency equipment.

The LLAR is a two piece module, similar in size and shape to a unit load device (ULD). You can load it in two pieces through a small aft cargo door. It can be loaded through the large aft cargo door in one piece.

All service connections from the airplane systems to the LLAR are at the umbilical disconnect panel.

There are two hatches that give access to the LLAR. The hatch in floor of the entrance enclosure gives usual access to the module. There is a second hatch in the ceiling of the LLAR that gives emergency exit.
Cabin Systems

First Class Seats

Economy Class Seats

Overhead Stowage Bins

OVERHEAD STOWAGE

There are overhead stowage bins for carry-on items. They are above the outboard and center seats.

The center stowage bins move downward for easier use by the passengers. In higher density seating areas, they also move outboard toward the aisle.
**Doors**

Doors give access to these areas:

- Passenger and flight compartments
- Cargo compartments
- Equipment centers
- Service areas.
Entry Doors

There are four passenger entry doors on each side of the airplane (-200).

There are five passenger entry doors on each side of the airplane (-300).

The door openings have sufficient width to let two people go through the door at the same time.

The doors are plug type that open outward. There are stops on the door and on the door frame. The door stops put the pressurization load on the frame stops.

All of the doors operate manually from inside and outside the airplane. A single hinge arm attaches the middle of the door to the door frame. The mechanism that connects the door to the hinge lets the door:

- Move up and down
- Turn in relation to the hinge arm.

As the door opens, it first moves up so the door stops can move over the frame stops. The door then moves outward and forward. The programming mechanism chain keeps the inboard side of the door toward the airplane. The door does not turn in relation to the airplane. The inboard side of the door always faces inboard.

A hold-open mechanism holds the door in the open position.

The mode select lever lets the cabin attendants arm the emergency power assist system (EPAS) and the escape slides. The EPAS uses compressed gas from a reservoir to help open the doors in an emergency. The gas goes from the reservoir to an actuator (not shown). The actuator connects to the programming chain. It uses the chain to open the door.

Each door has a flight lock assembly that locks the door when airspeed is more than 80 knots.
Emergency Escape System

There is an escape slide/raft at each passenger entry door. A bustle covers each slide/raft.

Each slide/raft has two passenger lanes. Lights on the end of the slides come on when the slides are inflated. They are safe for use in winds up to 25 knots, and with the collapse of one or more of the landing gear.

The mode select lever on the door lets the cabin attendants arm the emergency power assist system (EPAS) and the escape slides. The EPAS opens the door when it is armed and you move the interior door handle to the open position.

As the door opens, the slide/raft releases from the door. This starts the slide/raft inflation sequence.

When you use the external door handle, the EPAS and escape slide automatically disarm.
Cargo Doors

BULK CARGO DOOR

The bulk cargo door opening lets you load items that are not in containers or on pallets.

The door is a plug type that opens inward and upward. Two hinge arms attach the top of the door to the airplane. There are exterior and interior handles. The door operates manually. A counterbalance helps you open the door.

SMALL CARGO DOOR

The small cargo door is standard on the aft cargo compartment. The door opening lets you load cargo in containers and one-half size pallets.

The door opens outward. Two hinge arms attach the top of the door to the airplane. Electric actuators open and close the door.

The door is a plug type. There are stops on the door and door frame. As the door closes, it lowers to a position where the door stops are inboard of the frame stops. When the airplane is pressurized, the door stops put the pressurization load on the frame stops. This holds the door closed.

There are control panels inside and outside of the compartment.

LARGE CARGO DOOR

The large cargo door is standard on the forward cargo compartment, and optional on the aft. The size of the door opening is sufficient for cargo on pallets.

A continuous hinge along the top of the door attaches it to the airplane. The door opens outward.

The door is not a plug type door. Latches and locks hold the door closed. Electric actuators lock and unlock, and open and close the door.

There are control panels inside and outside of the compartment.

October 1996
Door Synoptic Display

The door synoptic display shows the doors. An amber box identifies an open door. The box goes away when the door is closed.

An option shows if a door is in the manual (disarmed) or automatic (armed) mode. The symbol M identifies a door in the manual mode. The symbol A identifies a door in the automatic mode.
Cabin Systems

Windows

The flight deck has three windows on each side. Number one window is in the front. Number three window is in the back. The number two window opens from inside the flight deck.

There is a window in each passenger entry door.

Passenger compartment windows are along both sides of the passenger compartment.

Note:

▷ Overwing Passenger Entry Door on -300 Not Shown
<table>
<thead>
<tr>
<th>A/B</th>
<th>AMI</th>
<th>airline modifiable information</th>
</tr>
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<tbody>
<tr>
<td>ac</td>
<td>AMU</td>
<td>audio management unit</td>
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<td>ACE</td>
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<td>APUC</td>
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<td>ARINC</td>
<td>Aeronautical Radio, Incorporated</td>
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<td>BITE</td>
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<td>credit card reader</td>
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<td>CAPT</td>
<td>converter circuit breaker</td>
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<td>charge</td>
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<td>center hydraulic isolation system</td>
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<td>cabin interphone</td>
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<td>CMCF</td>
<td>central maintenance computing function</td>
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<td>central maintenance computing system</td>
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<tr>
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<td>continuous</td>
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<td>CPC</td>
<td>cabin pressure controller</td>
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<td>CPM</td>
<td>core processor module</td>
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<tr>
<td>cprs</td>
<td>compressor</td>
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<tr>
<td>CPS</td>
<td>cabin pressure sensor</td>
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<tr>
<td>CRT</td>
<td>cathode ray tube</td>
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<tr>
<td>CSC</td>
<td>cargo system controller</td>
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</table>
CSCP cabin system control panel
CSDS cargo smoke detection system
CSS cabin services system
CSMU cabin system management unit
CTAI cowl thermal anti-icing
CTC cabin temperature controller
CTU cabin telecommunications unit

D
dc direct current
DCGF data conversion gateway function
DCMF data communication management function
DCMS data communication management system
DCV directional control valve
ded dedicated
DFDAF digital flight data acquisition function
DFDR digital flight data recorder
DH decision height
disch discharge
DLGF data load gateway function
DLODS duct leak and overheat detection
DLS data load system
DME distance measuring equipment
DMM data memory module
DMS debris monitoring sensor
DSF display system function
DSP display select panel
DU display unit

E
EAI engine anti-ice
ECS environmental control system
ECML left environmental control system card
ECSMC ECS miscellaneous card
ECSR right environmental control system card
EDI engine data interface
EDIIF engine data interface function
EDIU engine data interface unit
EDP engine driven pump
EEC electronic engine control (PW, GE)
EEC electronic engine controller (RR)
EEU ELMS electronics unit
EFIS electronic flight instrument system
EFIS CP EFIS control panel
EGT exhaust gas temperature
EICAS engine indication and crew alerting system
ELMS electrical load management system
EMC entertainment multiplexer controller
EP external power
EPC external power contactor
EPCS electronic propulsion control system
EPR engine pressure ratio
ERP eye reference point
ERU engine relay unit
ETOPS extended range operation with two-engine airplanes

F
FADEC full authority digital electronic control
FBW fly-by-wire
FCDC flight controls dc
FDAR flight data acquisition function
FDH flight deck handset
FDDI fiber distributed data interface
FDR flight data recorder
FDRS flight data recorder system
FLCH flight level change
FLPRN flaperon
FCLF flight control
FT inst flight instrument
FMCF flight management computing function
FMCS flight management computing system
FMU fuel metering unit
F/O first officer
F/O fuel/oil (cooler)
FOC fuel/oil cooler
FPA flight path angle
FPV flight path vector
FQIS fuel quantity indicating system
FQPU fuel quantity processor unit
FREQ frequency
FSEU flap slat electronics unit
F/D flight director

G
GBST ground based software tool
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>GCB</td>
<td>generator circuit breaker</td>
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<td>GCU</td>
<td>generator control unit</td>
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<td>GES</td>
<td>ground earth station</td>
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<td>GH</td>
<td>ground handling</td>
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<td>GND</td>
<td>ground</td>
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<tr>
<td>GPS</td>
<td>global positioning system</td>
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<td>GPSSU</td>
<td>global positioning system sensor unit</td>
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<tr>
<td>GPWC</td>
<td>ground proximity warning computer</td>
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<tr>
<td>GPWS</td>
<td>ground proximity warning system</td>
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<td>IGW</td>
<td>increased gross weight</td>
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<td>ILS</td>
<td>instrument landing system</td>
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<tr>
<td>ind</td>
<td>indicator</td>
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<tr>
<td>INPH</td>
<td>interphone</td>
</tr>
<tr>
<td>IOM</td>
<td>input/output module</td>
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<td>IP</td>
<td>intermediate pressure</td>
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<td>IPC</td>
<td>intermediate pressure compressor</td>
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<td>IPT</td>
<td>intermediate pressure turbine</td>
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<td>IRP</td>
<td>integrated refuel panel</td>
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<td>IRIS</td>
<td>inertial reference system</td>
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<td>inertial reference unit</td>
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<td>ISLN</td>
<td>isolation</td>
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<td>IV</td>
<td>isolation valve</td>
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<td>IVD</td>
<td>interactive video downloader</td>
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<td>HDG</td>
<td>heading</td>
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<td>HIRF</td>
<td>high intensity radiated field</td>
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<td>HLCS</td>
<td>high lift control system</td>
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<tr>
<td>HF</td>
<td>high frequency</td>
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<td>HP</td>
<td>high pressure</td>
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<td>HPA</td>
<td>high power amplifier</td>
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<td>HPC</td>
<td>high pressure compressor</td>
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<td>HPSOV</td>
<td>high pressure shutoff valve</td>
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<td>high pressure turbine</td>
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<td>HYDIM</td>
<td>hydraulic interface module</td>
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<td>HX</td>
<td>heat exchanger</td>
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<td>IC</td>
<td>intercabinet</td>
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<td>IDG</td>
<td>integrated drive generator</td>
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<td>IDS</td>
<td>ice detection system</td>
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<td>IFE</td>
<td>in-flight entertainment</td>
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<td>IGV</td>
<td>inlet guide vane</td>
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<td>M</td>
<td>maintenance access terminal</td>
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<td>MAT</td>
<td>mode control panel</td>
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<td>MCP</td>
<td>main equipment center</td>
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<td>MEC</td>
<td>main engine start</td>
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<td>MES</td>
<td>multi-function display</td>
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<td>MGD</td>
<td>main gear steering control unit</td>
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<td>MLW</td>
<td>maximum landing weight</td>
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<td>NAV</td>
<td>navigational aid</td>
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<td>NAVAID</td>
<td>navigational display</td>
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<td>ND</td>
<td>navigation display</td>
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<td>O</td>
<td>outside air temperature</td>
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<td>OAT</td>
<td>overhead electronics units</td>
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<td>OEU</td>
<td>overhead panel ARINC 629 system</td>
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<td>OPAS</td>
<td>overhead panel bus controller</td>
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<tr>
<td>OVRD</td>
<td>override</td>
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<tr>
<td>OPR</td>
<td>once per revolution</td>
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<td>OPU</td>
<td>overspeed protection unit</td>
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<td>oxy</td>
<td>oxygen</td>
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<td>PA</td>
<td>passenger address</td>
</tr>
<tr>
<td>PA/CIN</td>
<td>passenger address/cabin interphone</td>
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<td>PC</td>
<td>personal computer</td>
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<td>PCU</td>
<td>passenger control unit</td>
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<td>PDU</td>
<td>power control unit</td>
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<td>PDCU</td>
<td>panel data concentrator unit</td>
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</table>
PDOS  powered door opening system
PDS   primary display system
PDF   primary display function
PDU   power drive unit
PFC   primary flight computer
PFCS  primary flight control system
PFD   primary flight display
PIIC  passenger in-flight information computer
PMA   permanent magnet alternator
PMAT  portable maintenance access terminal
PMG   permanent magnet generator
PNEU  pneumatic
POS   position
PRAM  prerecorded announcement machine
press pressure
PRSOV pressure regulating and shutoff valve
pri   primary
prox  proximity
PSA   power supply assembly
PSEU  proximity sensor electronics unit
PSS   proximity sensor system
PSU   passenger service unit
ptr   printer
PTT   push-to-talk

Q
QAR   quick access recorder

R
RA    radio altimeter
RAT   ram air turbine
RCC   remote charge converter
rcvr  receiver
RF    radio frequency
RFU   radio frequency unit
RIB   right inboard
RLY   relay
ROB   right outboard
RT    receiver-transmitter
RTO   rejected takeoff
RTP   radio tuning panel

S
SAARU secondary attitude air data reference unit
SATCOM satellite communication system
SCU   signal conditioning unit
SDM   speaker drive module
SDU   satellite data unit
SEC   secondary
SEL   select
SELCAL selective calling
SEPC  secondary electrical power contactor
SPM   surface position monitor
SMP   stabilizer position modules
SLV   sync lock valve
sta   station
STAB  stabilizer
STCM  stabilizer trim control module
sql   squelch
SVC   service
sw    switch
sys   system

T
TAC   thrust asymmetry compensation
tach  tachometer
TAI   thermal anti-icing
TAT   total air temperature
TB    track ball
TBB   transfer bus breaker
TCAS  traffic alert and collision avoidance system
turbine case cooling
turbo case cooling
TCC   turbine case cooling
TDU   telephone distribution unit
TIC   turbine impingement cooling
TLA   thrust lever angle
TMCF  thrust management computing function
TMCS  thrust management computing system
takeoff go-around
tire pressure monitor unit
TRK   track
TRU   transformer rectifier unit
T/R   thrust reverser
tail strike assembly
turbine vane and blade cooling
turbine vane cooling

U
UB    utility bus
ULB   underwater locator beacon
ULD   unit load device
UTC   universal time (coordinated)

October 1996
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