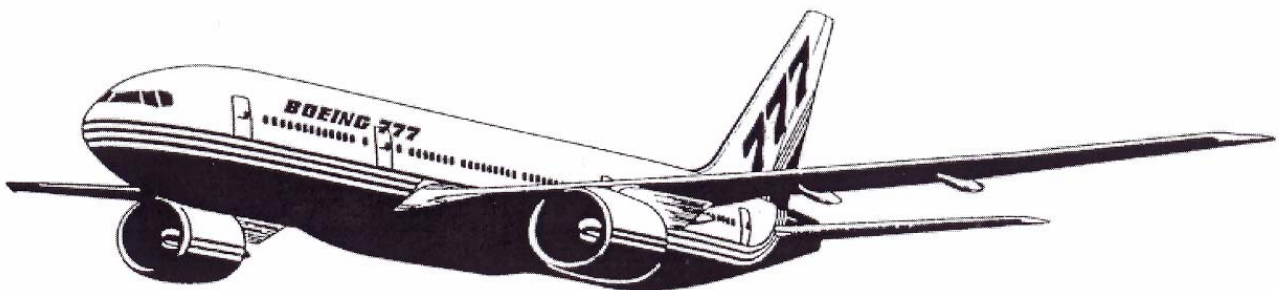




Lufthansa Technical Training

Training Manual B 777

ATA QUICK REFERENCE General





Lufthansa Technical Training

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General Descriptions



Figure 1 B777



ATA AIR CONDITIONING

Airconditioning



Figure 2 Airconditioning (Pack)



Airconditioning

ECS Miscellaneous Cards**PRIMARY AND BACK-UP CONTROL / INDICATION**

When the Crad Files get Power, the right ECSMC is Primary and the left ECSMC is Backup. The Primary and Backup Configuration changes at each Air-Ground transition.

ISOLATED CONTROL

The left ECSMC gives Control and Indication for the aft Cargo Heating System, also monitors Duct Pressure and Air Flow in the Equipment Cooling System. The right ECSMC gives Control and Indication for the Bulk Cargo Heating System, also monitors Duct Pressure and Air Flow in part of the Equipment Cooling System.

Low Airflow Condition

The Flow Control and Shutoff Valves control Air Flow into the Packs. The Packs makes internal adjustment to help Control Air Flow. This is called the Economy Cooling MOde. The System can also make adjustments to the Engine Bleed Air Supply System to help increase Flow through the Pack.

Engine Bleed System Bias

For some Low Conditions, the Flow Control System sends Signals to the Pneumatic System. These Signals adjust the Engine Bleed Air Temperature or HPSOV setpoint. Lower Bleed Air Temperature lets the Pack operate with less restriction Air Flow. A higher HPSOV Setpoint lets the Pneumatic System supply more Air at Low Engine Power Settings.

Pack Flow Control

The CTC and ASCPC measure the Pack Air Flow, control the Flow Control and Shutoff Valves and monitor Pack Temperature.

CTC FUNCTIONS

If the APU is on, the CTC closes the Lower Valve and opens the Upper Valve .

The Upper Valve controls Flow at LOW Altitudes.

The Lower Valve controls Air Flow at high Altitudes.

If the Upper or Lower Valve Fails, the other Valve controls the Flow at all Altitudes.

The CTC closes the Upper and Lower Valves if:

- Pack Switches OFF
- Flow Schedule 0
- Compressor Discharge Overheat
- Pack Outlet Overheat
- Pack Failure

ASCPC FUNCTIONS

Closes the Upper and Lower Valves if any of these Conditions occur:

Pack Switch OFF

Stall Warning

Compressor Discharge Overheat

If the CTC Fails or loses Power, the ASCPC gives Backup Flow Control.

An Overheat Condition at either Temperature Sensor closes the Valves.

ASCPC sends one of five Flow Schedules to the CTC. A Stall Warning or Ground Engine Start Condition causes the ASCPC to send Flow Schedule 0. The CTC closes the Flow Control and Shutoff Valves for Flow Schedule 0.

Flow Sensor

Supplies two Types of Air Pressure Information, Pack Inlet and Pack Inlet Differential to the related CTC and ASCPC. The Controllers use the Pressure Information to help calculate the Rate of Air Flow from the Pneumatic System into the Airplane.



Airconditioning

Flow Control and Shutoff Valves

- Control the Air Flow to the Packs
- Upper and Lower are interchangeable
- Operate by an Pneumatic Actuator
- Spring-Loaded close
- Fail Safe open by Muscle Pressure

With no Power supply Pressure pushes the Valve to open.

With Power the Torque Motor Bleed Air moves one Side of the Pneumatic Actuator. This permits the Spring to move the Valve.

One Torque Motor connects to the CTC. The other connects to the ASCPC. The CTC gives Normal Control. The ASCPC gives Backup Pack Flow Control, if the CTC cannot operate.

A Proximity Switch sends a Signal to the CTC when the Valve is closed.

Primary Heat Exchanger Inlet Temperature Sensor

Monitors the PRI HX Inlet Temperature. Temperature Data goes to the Cabin Temperature Controller (CTC). It uses the Data with Data from the Flow Sensor to calculate Pack Mass Air Flow.

Is interchangeable.

Pack Flow Schedules

The ASCPC sets the Flow Schedule that the Cabin Temperature Controllers use to control Air Flow into the Packs. Flow Schedule 1 gives the largest Air Flow to the Packs. Schedules 2,3 and 4 give less and less Air Flow to the Packs. Schedule 0 stops the Air Flow into the Packs. The ASCPC sets these Schedules when necessary to reduce the Engine Bleed Air Load or to make more Flow available to other Systems.

Operates only when the Engines supply Air to the Packs.

Schedules 1,2 and 3 give a constant Volumetric Air Flow to the Packs. The related Mass Air Flow decreases as Cabin Altitude increases.

FLOW SCHEDULE 1

Is related to the number of Passenger Seats in the Airplane.

FLOW SCHEDULE 3

Is not related to the number of Seats.

FLOW SCHEDULE 4

Gives a minimum Flow to Pressurize the Airplane and to operate the ACM. The Flow Rate has a relation to the Cabin Altitude.

For Stall Warning during Takeoff, Schedule 0 makes sure the ADP gets enough Air for Auto-Slat Deployment.

If you start just one Engine, the Pack does not operate until two Minutes after Start. The Pack OFF Light stays on during these two Minutes.

CTC Flow Control

The CTC controls the Upper Flow Control and Shutoff Valve if the Airplane Altitude is Low.

The CTC controls the Lower Valve if the Airplane Altitude is high.

If one of the Valves Fails, the CTC controls the other Valve at all Altitudes.

If any Recirculation Fans are inoperative when the CTC uses Schedule 1, the CTC increases the Flow Rate. This keeps the total Airplane Ventilation rate constant.

If the forward or aft Cargo Fire Switch is armed, the CTC sets the Schedule 2 Flow Rate (except when Schedule 0 is active). Schedule 2 supplies sufficient fresh Air for the Airplane Occupants and keeps Smoke out of the Passenger Compartment and Flight Deck.



Airconditioning

Ozone Control

Keeps Ozone Concentrations in the Air Flow to a satisfactory Limit when the Airplane is at higher Altitudes.

Economy Cooling Check Valve

Permits Air Flow around the ACM Compressor when the Pack starts to operate or when the Pack has an ACM Failure.

When it is open, the Air flows directly from the Primary Heatexchanger to the Secondary Heatexchanger.

Low Limit Valve

Controls the Amount of Rehaeter Air that goes around the first Stage Turbine of the ACM. The CTC uses this to Limit the Output Air Temperature of the first Stage Turbine above 1 Degrees so that Water in the Air does not Freeze.

Second Stage Turbine Bypass Valve

Controls the amount of Condenser Air that goes around the Second Stage Turbine of the ACM. The CTC uses the Turbine Bypass Valve to control Pack Outlet Temperature.

Economy Cooling Valve

Opens to let Air go around the ACM Turbine 1 and the Water Separation Parts of the Pack.

Opens when the Pack Functions are in the Economy Cooling Mode or the Standby Cooling Mode.

Is electrically controlled and pneumatically actuated.

Spring Loaded Closed

With no Power to the Solenoid, Control Pressure opens the Valve.

When the Solenoid is energized, the Valve closes.

Conditioned Air Check Valve

Prevents a decrease of Cabin Pressure if an Air Conditioning Duct Failure occurs in the ECS Bay.

Fan Bypass Check Valve

Permits Air to go around the ACM at higher Ram Air Flow.

Is a Flapper Type Valve. If some Parts of the Valve are missing, it can cause Problems for Cooling on Ground.

Trim Air Pressure Regulation and Shutoff Valve

CTCs use the Trim Air PRSOV to keep the Trim Air Supply Pressure between 2 and 8,5 PSI above Cabin Pressure. The Usual Pressure is 5 PSI above Cabin Pressure. The related ASCPC gives Backup. The Fault Light turns on and the Advisory Message TRIM AIR L (R) shows when:

- Related Zone Duct Overheat
- Related Trim Air Switch set to out
- Related Trim Air System has a Fault (Trim Air PRSOV, Controller, Pressure Sensor)

The left CTC gives control of the TAPRSOV

The CTC can adjust the Regulation Value as necessary to control the Zone Temperature. The CTC does this only when the Trim Air Modulating Valve Fails for more than 10 percent to open.

DUCT OVERHEAT

For Zones (88 Degrees) causes the related TAPRSOV to operate in one of these two ways :

- If the left Pack Outlet Temperature is less than 71 Degrees the TAPRSOV is latched closed
- If the left Pack Outlet Temperature is equal to or more than 71 Degrees then the TAPRSOV closes but does not latch

ASCPC CONTROL

It can close the TAPRSOV to decrease the Load on the Pneumatic System. Closes the Valve if:

- Airplane is in a Stall Condition
- left Trim Air Switch is set to the Out Position



Airconditioning

Zone Temperature Control and Indication

System adjusts Flight Deck and Passenger Cabin Zone Temperature to set Values.

You can see which CTC Control Channel is in Control on the Air Conditioning Maintenance Page.

The ASCPC's work with the CTC's to give Backup Shutoff Control for the FCV's and TAPRSOV's if the related CTC's Fail or lose Control of the Valves. The ASCPC's also use the FCV's to give Backup Control of Pack Flow if the related CTC fails.

Flight Deck Temperature Control set the target Temperature for the Flight Deck. Low temp.Value is 18 Degrees. High Temp. Value is 29 Degrees.

AUTOMATIC MODE

The left CTC controls the Flight Deck Trim Air Modulating Valve to keep the Zone Temperature as the Target Value. The RVDT of the Flight Deck Trim Air Modulating Valve gives Valve Position to the left CTC.

MANUAL MODE

ELMS removes Control of the Flight Deck Trim Air Modulating Valve from the CTC. ELMS supplies Power to the Flight Deck Trim Air Modulating Valve.

You can set the Temperature in each Area plus or minus 6 Degrees from the Master Temperature Value.

CABIN ZONE TEMPERATURE CONTROL

The CTC's calculate a Zone Target Temperature for each Temperature Control Zone.

If both Elements of the Zone Air Temperature Sensor fails, the CTC's use the Duct Temperature Sensor as an alternate, this is called the ALTERNATE MODE.

LOSS OF LEFT SIDE TRIM

The left CTC sets the left Pack to hold the Flight Deck Target Temperature. The right CTC sets the right Pack to hold the necessary Mix Manifold Temperature.

Cabin Area has priority over the Flight Deck.

LOSS OF RIGHT SIDE TRIM

The right CTC sets the right Pack to hold the necessary Mix Manifold Temperature. The left Pack follows the right Pack until the Flight Deck Trim Modulating Valve is closed. The Flight Deck Trim Modulating Valve is closed. The left CTC then controls the left Pack to keep the Flight Deck at the Target Temperature down to a Minimum of 18 Degrees.

OVERHEAT CONDITIONS

The applicable CTC starts to close the Trim Air Modulating Valve if the related Zone Duct Air Temperature increases to 71 Degrees. The related Trim Air Pressure Regulating and Shutoff Valve latches closed if the Duct Temperature increases to 88 Degrees for 10 seconds.

SINGLE TRIM MODULATING VALVE FAILURE

If a Trim Air Modulating Valve is not fully closed and has a Failure, the applicable CTC controls the Pressure Reference for the related Trim Air PRSOV to keep the Zone Duct Temperature to a Limit.

If the RVDT in a Valve has a Failure, the applicable CTC operates the Valve with no Position Feedback. This Type of Control is called OPEN LOOP CONTROL.

Trim Air PRSOV

The CTC uses the TAPRSOV to give Shutoff Control and to Control the Pressure of the Air that goes to the Trim Air Modulating Valves. The CTC also use the Valve to give Backup Zone Temperature Regulation.

Is electrically Controlled and pneumatically Operated.

Is Fail-Safe Off, if no Power goes to the Torque Motor.

Must be locked in closed Position.

Trim Air Pressure Sensor

MONitors Air Pressure at the Outlet of the TAPRSOV



Airconditioning

Zone Trim Air Modulating Valve

Controls the Flow of Air from the Pneumatic System to each Zone.

Operates by an electrical Actuator.

The CTC controls the Actuator to open or close the Valve.

RVDT gives a Valve Position Output to the CTC.

Forward Equipment Cooling System

Cools the Equipment that needs active Cooling and removes Smoke from the Flight Deck.

Uses Cabin Air to cool Electrical and Electronic Equipment.

Has two parts, Supply and Vent (Exhaust).

Uses cabin Differential Pressure and the Override Valve to remove Smoke from the Flight Deck.

The left and right ECS MISC Cards give control. The right Card gives primary Control when the Airplane gets Power and the left gives Backup Control.

Two Equipment Cooling Controllers (ECC) control the Supply Fans and the Override Valve.

AUTOMATIC MODE

One Supply Fan operates (right is Primary)

The Override Valve is closed to ambient and open for supply to these Areas:

- Fwd Cargo Comp.
- MEC
- Fwd Equipment Center
- Flight Deck

The Vent Fan pulls Air from:

- MEC
- Flight Deck

Operates most of the time. The Fan is OFF for Engine Start.

Air goes to the Vent Valve and forward Cargo Heat Valve. Only one of the Valves is open at a time. When the Total Air Temperature (TAT) goes above 12,8 Degrees, the Vent Valve opens and the Cargo Heat Valve closes. The Air goes to the Area near the forward Outflow Valve in the MEC. When TAT goes below 10 Degrees, the forward Outflow Cargo Heat Valve opens and the Vent Valve closes. The Air goes to heat the forward Cargo Compartment.

OVERRIDE MODE

Cools the Equipment without the Supply and Vent Fans. This Mode uses Cabin Differential Pressure to cause Airflow through the Equipment.

These Conditions causes the Override Mode:

- Equipment Cooling Switch on the Air Conditioning Panel set to OVRD
- Low Flow in MEC and F/D Supply Ducts and Airspeed more than 150Kts
- Left and Right Supply Fans failed OFF
- Smoke in Supply or Vent Duct
- Forward Cargo Fire Extinguishing System armed

Override Mode causes these Effects:

- Bulk Cargo Ventilation Fan goes OFF (Sw. in OVRD)
- Both Supply Fans Stop
- Override Valve goes to OVRD Position which opens the Supply Duct to ambient
- Cabin Differential Pressure pushes Cabin Air through the Components and out of the Airplane
- Converter Supplemental Cooling Fan comes on
- Vent Fan Stops
- Forward Cargo Heat Valve closes if it is open (Low Flow does not cause the Valve to change Position)
- Vent Valve opens if it is closed (Low Flow does not cause the Valve to change Position)



Airconditioning

Supply Fans

Give Air to the Supply Part of the forward Equipment Cooling System for Blow through Cooling.

One Fan operates at a time (Right is Primary, left is Backup).

Override Valve (Cooling and Smoke removal Valve)

Permits Differential Cabin Pressure to remove Smoke and Cool the Electronic and Electrical Components.

When one Valve is open, the other is closed.

Vent Fan

Pulls Air from the Vent Part of the forward Equipment Cooling System to give Cooling. It sends the Air to the forward Cargo Heat Valve and the Vent Valve.

Vent Valve

Lets Equipment Cooling Vent (Exhaust) Air go to the Area near the forward Pressurization Outflow Valve.

Forward Cargo Heat Valve

Lets Equipment Cooling Vent Air flow to the forward Cargo Compartment.

Equipment Cooling Controller (ECC)

Supplies control of the Supply fans and the Override Valve.

Each has two independant Channels, one for the Supply Fan Control and one for the Override Valve Control.

Pressurization System

Two Parts that have a relation to the Pressurization System:

- Cabin Pressure Control
- Cabin Pressure Relief

The Cabin Pressure Control System controls the amount of Air that flows out of the Airplane. This keeps the Cabin Air Pressure in Limits at Altitude.

The Cabin Pressure Relief System keeps the internal Pressure of the Airplane to a Limit.

OUTFLOW VALVES

The Flight Crew sets Automatic or Normal Control for one or both of the Outflow Valves from the Flight Deck. In the AUTO MODE, the usual Position of the Valves is controlled so that they are not the same. The Valve Position is set so that 20 percent of the Total Ait Outflow goes through the FWD Valve and 80 percent goes to through the AFT Valve.

PRESSURE RELIEF

Positive Pressure Relief Valves and Negativ Pressure Relief Valves keep the Difference between Cabin Pressure and Ambient Pressure in Limits.

AUTO CONTROL

The left ASCPC usually controls the Position of the Valves.

MANUAL CONTROL

The Flight Crew controls Cabin Rate of change and Cabin Altitude by manually Controlling the Position of the Outflow Valves.

Outflow Valves

The Outflow Valve Control Unit has two Channels. Left Channel controls the left Outflow valve and the right Channel the right Valve.

In AUTO Mode the Valve can open or close completely in less than 10 seconds.

In MANUAL Mode the Valve closes or opens in approximately 27 seconds.

One Valve can operate in AUTO Mode and the other in MANUAL Mode at the same time.



Airconditioning**Recirculating System**

Puts Cabin Air back in the Air Conditioning Distribution System.

The right Cabin Temperature Controller (CTC) supplies usual control for all Recirculation Fans. The left CTC supplies Backup Control.

The left and right ECSMC's monitor for Fan Overheat Conditions.

ELMS controls Power to the Fan's.

OVERHEAT

If an Overheat Switch opens, the ESCMC sends an Overheat Signal to the CTC. The CTC latches the Fan OFF. If the Fan latches OFF because of an Overheat Condition, you can cycle the Recirculation Fan Switch OFF then to ON to release the Latch.

NORMAL OPERATION

The Upper and Lower Fans usually operate continuously on the Ground and in Flight. Single Pack Ground Operation with high Ambient Temperature may cause a lower Fan to Stop.

NON-NORMAL OPERATION

If the forward or aft Cargo Fire Arm Switch are in the Armed Position, the ELMS and CTC turn Off the Lower Fans. If an Upper or Lower Fan has a Failure and Pack Schedule 1 is in Effect, the Pack Flow Rate increases. This keeps the Total Cabin Ventilation Rate constant.

Bulk Cargo Ventilation

The Fan increases the Ventilation. The Fan pulls Air from the Passenger Compartment and moves it into the Bulk Cargo Compartment. The Fan operates when the Bulk Cargo Heating System is set to high.

Lavatory / Galley Ventilation

There are two Fans. Only one Fan operates at a time. The right Fan is Primary, the left is the Backup. At Power Up, the left Fan comes on, is tested and goes off. The right Fan then comes on, is tested and keeps on. The Fan pulls Air from:

- Lavatories
- Galleys
- Zone Temperature Sensors
- Cargo Temperature Sensors
- Electrical and Electronic Equipment

Heating**FORWARD CARGO HEATING**

Uses warm Air from the Equipment Cooling System to keep the Temperature in Limits.

The forward Cargo Heat Valve opens to let this Air go into the forward Cargo Compartment Heat Duct.

On Ground, the Valve normally moves between open and closed as ambient Temperature changes. The forward Cargo Heat Valve closes when the Temperature at the TAT Probe is more than 13 Degrees, it opens when the Temperature is less than 10 Degrees.

The forward Cargo Heat Valve is open in the Air.

The Position of the Heat Valve changes so that its Position is opposite the Position of the Vent Valve.

ECSMC's control the Valves.

AFT AND BULK CARGO HEATING

Uses Air from the Pneumatic System to keep the temperature within Limits.

The Aft and Bulk Cargo Compartments each have two Heat Valves. One Functions as a Shutoff Valve, the other as an Temperature Control Valve.

The Cargo Temperature Select Panel gives Manual Control of the Temperature for the Aft and Bulk Cargo Compartments. This Selectors set the Temperature for High (21 Degrees), Low (7 Degrees) or Off.

Operation of the Valves is from ECSMC's.



Airconditioning

Supplemental Heating

Where the Heat from Trim Air is not sufficient, auxiliary Heaters add more Heat to these Areas:

- Flight Crew Feet
- Flight Crew Shoulders
- Doors

IN AIR

- Galleys

ON GROUND

Aft Equipment Cooling System

Gives Cooling for Equipment in the aft Part of the Airplane.

The System gives Backup Cooling for Satcom Equipment (The SATCOM Fans come on if both Lavatory / Galley Fans do not operate).

SATCOM Backup Cooling Fan

Pulls Air through Racks if the Lavatory / Galley Ventilation System does not operate.

The right ECSMC gives Primary Control when the Airplane gets Power and the left ECSMC gives Backup Control. When the Airplane changes from Air to Ground, the Card in Control changes.

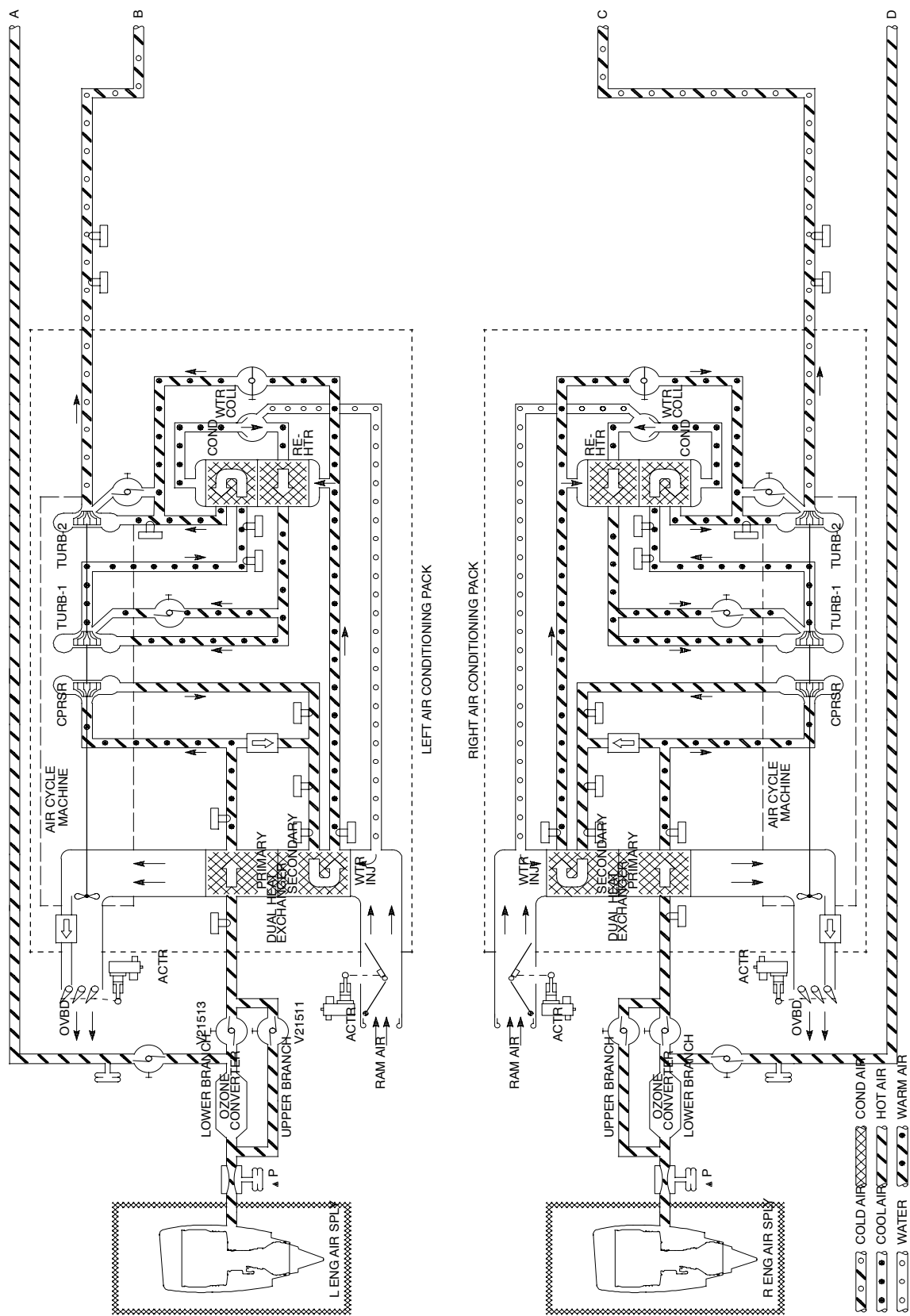


Figure 3 Airconditioning Schematic



ATA ELECTRICAL POWER



Electrical Power



Figure 4 Electrical Power (MEC)



Power Sources

There are five Main Power, two Backup and two Standby Power Sources.

MAIN POWER SOURCES :

- Left IDG (120 KVA)
- Right IDG (120 KVA)
- APU Generator (90 KVA)
- Primary External Power (90 KVA)
- Secondary External Power (90 KVA)

BACKUP POWER SOURCES :

- Two Backup Power Generators

Each Backup Generator can continuously supply 20 KVA.

STANDBY POWER SOURCES :

- Ram Air Turbine (RAT) Generator
- Main Battery

The RAT Generator can continuously supply 7,5 KVA.

The Main Battery is a 47 Amperehour Battery.

ELMS

All Airplane Electrical Power goes through the ELMS Panels for Distribution. The ELMS Panels contain the Load-Switching Devices that distribute this Power.

The ELMS Power Management Panels contain Electronic Units. These Control and Monitor the Load-Switching Devices in their related ELMS Panels. However, the ELMS Electronic Units (EEU) do not control all of the large Load-Switching Devices in the Power Panels. The GCU's, BPCU, and Backup Generator Converter directly control some of the large Load-Switching Devices.

Ground Power

Primary External Power automatically supplies Power to the Ground handling Buses. You can also use a Switch to connect Primary External Power to the Ground Service Bus. When you turn Primary External Power on at the Electrical Panel, the Power connects to the Right Main AC Bus. From there it supplies Power to the Rest of the Electrical System. If you need more Ground Power Capacity, connect the Secondary External Power. The Right Bus Tie Breaker (BTB) opens so that the Secondary External Power supplies Power to the left Side of the Electrical System while the Primary supplies to the Right Side.

Battery Switch

Connects the Hot Battery Bus to the Battery # 2 Bus.

APU Generator Switch

Arms the APU GCU to automatically control APU Generator Electrical Power.

Bus Tie Switches

Controls the Operation of its related BTB.

ISLN Amber Light shows BTB is open.

External Power Switches

Controls the Operation of its related External Power Contactor (EPC).

Generator Control Switches

Arms its GCU to automatically control IDG Electrical Power.

OFF is when the related Generator Circuit Breaker (GCB) is open.

Backup Generator Switches

Arms the Backup Generator Converter to control Backup Electrical Power.

Drive Disconnect Switches

Removes Engine Gearbox Power from the IDG.



Electrical Power

When you press the Switch, the two-piece IDG Input Shaft moves apart.
Drive Light Amber shows that the related IDG has Low Oil Pressure.

Standby Power Switch

Has these Positions:

- Off
- AUTO
- BAT (Momentary)

AUTO Position puts the Standby Electrical Power System under the ELMS Control.

BAT Position- with no AC Power on the Airplane, the Switch in Bat turns the Static Inverter on and makes it Power the Standby AC Bus. With AC Power on the Airplane, the Switch in Bat starts a DC / Standby Self Check Test.

Indication Synoptic Display

Is a simplified Schematic of the Electrical System.

Drive Status

Drive shows, when the IDG has Low Oil Pressure.

Indication Maintenance Page 1

Has Informations on these Items:

- AC Generation
- DC Generation
- Generator Oil Information
- Fly by Wire 8 FBW) Output
- Auto-Event Messages

Indication Maintenance Page 2

Shows which Buses are receiving Power.

An ON next to the name of the Bus means that it is receiving Power. An OFF means that it is not receiving Power.

Ground Handling Power

When you supply Power to the Primary External Power receptical, the BPCU energizes the Ground Handling Relay. This connects Primary External Power to the Ground Handling AC Bus. The Ground Handling TRU supplies DC Power to the Ground Handling DC Bus.

Secondary External Power cannot.

If both Primary External Power and the APU Generator are available, the BPCU selects Primary External Power for the Ground Handling AC Bus.

Ground Service Power

The BPCU selects the Power Source for the Ground Service Bus in this Order:

- Right Main AC Bus
- Primary External
- APU Generator

If the Right Main AC Bus has no Power, you can use the Ground Service Switch. When you push the Switch, the BPCU connects Primary External Power or APU Generator Power directly to the Ground Service Bus.

Primary External Power

When you push the Primary External Power Switch, you connect Primary External Power to the Main AC Buses. The BPCU closes the Primary EPC and the BTB's to connect the Power.

Secondary External Power

When you push the Secondary External Power Switch, you connect Secondary External Power to the Main AC Buses. The BPCU closes the Secondary EPC and the GCU's close the BTB to connect the Power. If Primary

Electrical Power

External Power was on the Right Main AC Bus, the Right GCU opens the Right BTB first to perform a Break-Power Transfer.

No Break-Power Transfer

When the AC System changes from an External Power Source to another Power Source, it does No Break-Power Transfers. The System momentarily connects the two Power Sources to one Bus, so there is no Interruption in Power.

The BPCU always does a Break-Power Transfer between Primary External Power and Secondary External Power.

Ground Service Switch

Arms the BPCU to connect either Primary External Power or the APU Generator directly to the Ground Service Bus.

BPCU

Controls External Power on the Airplane. It also controls Ground Handling and Ground Service Power.

Power Transfer Control

The BPCU controls Bus Transfer between Power Sources. A Reference Frequency Circuit in the BPCU permits No Break-Power Transfer (NBPT) between External, APU, and IDG Power Sources on the Ground. A NBPT is when two Power Sources momentarily parallel during a Transfer. The Power Transfer Circuit prevents any Paralleling in the Air and during Takeoff and Landing.

BPCU Power Sources

Primary External Power

Battery Bus # 2

Right DC Bus

The Secondary External Power Source does not supply Power to the BPCU. To use Secondary External Power, you must connect the Primary External Power or push the Battery Switch ON.

Ground Handling / Service Power

The BPCU controls the Power to the Ground Handling Bus and the Ground Service Bus. Ground Handling Power is available only on the Ground. Ground Service Power is available on the Ground and in Flight.

Primary External Power

When you apply Power to the Primary Power Receptacle, Power is available at the Primary EPC. With good Power Quality, the BPCU turns on the AVAIL Light in the Primary External Power Switch. When you push the Primary External Power Switch, the BPCU energizes the Primary EPC. This connects Primary External Power to the Right Main AC Bus. When the EPC closes, the BPCU turns OFF the AVAIL Light and turns ON the ON Light.

Secondary External Power

Works the same as Primary External Power, except the Secondary External Power connects to the AC TIE Bus through the Secondary EPC.

Electrical Power

Integrated Drive Generator (IDG)

Supplies Electrical Power to the Airplane. It is a Combination of a Constant Speed Drive and an AC Generator. The CSD turns the generator at a Constant Speed to make Constant Frequency Electrical Power.

The Disconnect Reset Ring lets you Reset the Drive Disconnect Mechanism. A Solenoid operates the Disconnect Mechanism. You pull on the Ring while the Engine is Shutdown to connect the Drive Shaft Halves.

The IDG can automatically Disconnect if the The IDG Oil gets to Hot. A Thermal Plug melts and operates the Disconnect Mechanism. If the IDG disconnects automatically with the Thermal Plug, the Reset Ring cannot connect the Drive Shaft Halves. The IDG must be Reseted at the Repair Shop.

The GCU and the Drive Disconnect Switch control the IDG. The GCU sends Information about the IDG to the ARINC 629 Busses. The EEC sends Oil Temperature and Oil Filter Data to the ARINC &") System Buses. This permits the AIMS to show EICAS Messages and the Maintenance Data.

Backup Generator

The Backup Generator is an Alternativ Power Source. It can supply 115 V AC, 400 Hz Electrical Power to the Transfer Buses.

The Backup Generator Converter sends Data from Backup Generator Components to the System ARINC 629 Buses. The EEC puts Oil Temperatute and Oil Filter Data on the System ARINC 629 Buses, this permits AIMS to show EICAS Messages and Maintenance Data.

APU Generator

Is a Secondary Source of Electrical Power for Airplane Systems. It can supply Electrical Power when the Airplane is on Ground or during Flight. It can supply 120 KVA of AC Power.

The APU GCU controls the APU Generator.

Generator Drive

The Gearbox of each Engine turns an IDG and an Backup Generator. The related GCU controls the IDG. The Backup Generator Converter controls the Backup Generators on both Engines.

IDG OPERATION

The GCU causes the Flight Deck Effects for the IDG.

If the IDG has Low Pressure during operation, the GCU turns ON the DRIVE Light and makes an EICAS Message.

BACKUP GENERATOR OPERATION

The Backup Generator Converter causes the Flight Deck Effects for the Backup Generator.

APU Power

The APU Generator supplies Power through the APB to the TIE Bus. Power goes from the TIE Bus, through the BTB's, to one or both Main AC Buses.

The APU Generator supplies Power through the GSSR to the Ground Service Bus. The APU Generator also supplies Power through the GHR to the Ground Handling Bus.

IDG Power

The Left IDG supplies Power to the Left Main AC Bus. The Right IDG supplies Power to the Right Main AC Bus. Power goes through the GCB's.

There is a GCU for each IDG. The Left and Right GCU's Control, Monitor and Protect the IDG Power System. Each GCU gets Inputs from a Generator Control (GEN CTRL) Switch and a Bus TIE Switch.

When the GEN CTRL Switch is In, the GCU automatically controls the GCB. When the Switch is Out, the GCU opens the GCB and trips the Field of the Generator.

When the Bus TIE Switch is In, the GCU automatically controls the BTB. When the Switch is Out, the GCU opens the BTB.



Electrical Power

Backup Generator Power

Only one Backup Generator supplies Power at a time. Normally, the Left Backup Generator supplies Power to the Left Transfer Bus and the Right Backup Generator supplies Power to the Right Transfer Bus. If the Left and Right Transfer Buses need Power, the Right Backup Generator supplies the Power if it is available.

Backup Generator Converter

Gets variable Frequency AC Power from both Backup Generators. It changes the Variable Frequency Power into 115 V, 400 Hz AC Power. The Converter supplies Power to one or both Transfer Buses.

Gets Cooling Air from the Forward Equipment Cooling supply fans. It also gets Cooling Air from the Supplement Cooling Fan.

ELMS

Has seven Panels that contain Components to distribute Electrical Power. The ELMS also Protects the Electrical Power system and Controls many Load- Switching Devices.

Main Backup Power goes to the Left, Right or Auxiliary Power Panels. These Power Panels supply Power to large Loads. They also supply Power to the Power Management Panels and the Ground Service / Handling Power Panel. The Power Management Panels and the Ground Service / Handling Power Panel supply Power to small Loads.

ELMS Electronic Unit (EEU) get Data from the other Electrical Power Control Units and Airplane Systems. This Data comes directly or from the ARINC 629 Buses. The EEU's use this Data to manage the Loads of the Electrical Power System.

Protects the Electrical Power System. It sheds (Disconnects) Electrical Loads to keep the Electrical Load Levels below the Power Supply Levels.

If there is a large Overload not due to a Power Source Loss, the ELMS sheds Loads in Groups like a Configuration Load Shed.

If an Overload is not large, the ELMS sheds individual Loads until the Electrical Load Level is below the available Power Supply Level.

When ELMS does a Load Shed, the Message LOAD SHD shows on the Electrical Power Synoptic Display below the THW UTILITY Bus Indication for the related Channel.

DC Generation

System changes AC Power from the Generators into DC Power. It supplies Power for DC Loads and to charge the Batteries. The Batteries are an Alternative Power Source for some Loads when the Generators do not operate.

Has these Subsystems:

- Transformer Rectifier Units (TRU's)
- Batteries
- Standby Power
- Towing Power
- Flight Controls DC Power (FCDC)

Standby Power supplies AC Power and DC Power to Important Systems when all normal AC Power is lost. The RAT Generator and the Main Battery are the Sources of Standby Power.

DC / Standby Self- Check

The DC Subsystem Card does a Check of the DC System. This is called a DC / Standby Self-Check. It does these Tests:

- Makes sure all DC / Standby System Relays operate correctly
- Makes sure the AC Standby Bus has Power (this does a Check of the Static Inverter)

A DC / Standby Self-Check can start either manually or automatically.

If the System passes the Test, no Message shows on the EICAS Display. If the System fails the Test, the Advisory Message ELEC STANDBY SYS shows.



Electrical Power

TRU

Four TRU's change 115 V AC Power into 28 V DC Power to supply the Main DC Busses. The TRU's normally get Power from the Transfer Buses. If the Transfer Busses have no Power, the RAT Generator supplies Power to the two Center TRU's.

Normally the Right TRU supplies Power to the Right DC Bus. and the Left TRU supplies Power to the Left DC Bus. If one TRU does not operate, the other TRU can supply Power to both through the DC TIE Relay.

Standby Power System

Operates when the normal Electrical Power Sources do not supply Power to the Left and Right Transfer Buses. Standby Power comes from either the RAT Generator or the Main Battery. ELMS controls the Standby System Relays. The Battery Switch and the Standby Power Switch send Control Signals to the ELMS.

RAT Generator

Supplies AC Power when the normal Power Sources are not available. The RAT Generator supplies Power to TRU C1 and TRU C2 for the Standby System Buses.

The RAT can Deploy manually and Automatically.

Electrical Power

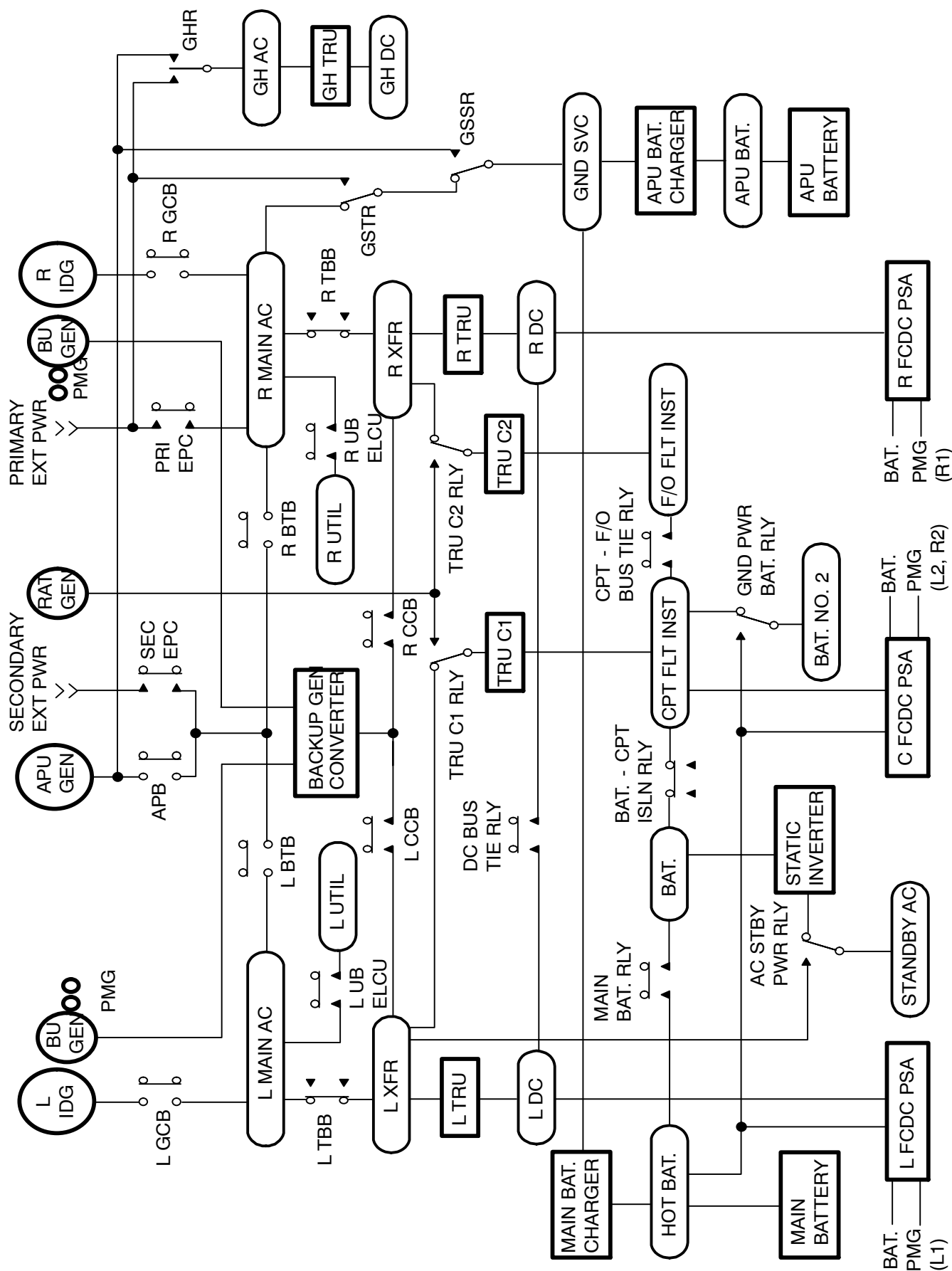


Figure 5 Electrical Power Schematic



ATA FLIGHT CONTROLS





Figure 6 Flight Controls



Flight Controls

Primary Flight Control System (PFCS)

Controls the Airplane Flight Attitude in Relation to the three Basic Axes:

- Longitudinal
- Lateral
- Vertical

ROLL CONTROL

- Uses the Ailerons, Flaperons and Spoilers to control the Airplane Attitude about the longitudinal Axis

PITCH CONTROL

- Uses the Horizontal Stabilizer and the Elevator to control the Airplane Attitude about the Lateral Axis

YAW CONTROL

- Uses the Rudder to control the Airplane Attitude about the Lateral Axis

SPEEDBRAKES

- The PFCS also includes the Speedbrakes. In Addition to Roll Control, the Spoilers also act as Speedbrakes i the Air and on Ground.

The Pilots or the Autopilot Commands the PFCS. The Pilots can override teh Autopilot.

MANUAL OPERATION

Position Transducers change the Pilots Manual Commands to analog electrical Signals. These Signals go to the four Actuator Control Electronics (ACE's). The ACE's change the Signals to digital Format and send them to the three Primary Flight Control Computers (PFC's). The PFC's calculate the Flight Control Commands based on Control Laws and Flight Envelope Protection Functions. The digital Command Signals from the PFC's go to the ACE's.

AUTOPILOT OPERATION

The PFC's receive Autopilot Commands from all three Autopilot Flight Director Computers (AFDC's). The PFC's use the Autopilot Commands in the same manner as the Pilots manual Commands. In Addition, the PFC's supply the Bakedrive Signals to the Bakedrive Actuators through the AFDC's. The Movement of the Flight Deck Controls supplies visual Indications for the Flight Crew.

PFCS MODES OF OPERATION (THREE MODES)

Normal Mode:

- Operates when the necessary Data are available for the PFC's and the ACE's. All the Control Laws, Protection Functions and the AFDC's operate

Secondary Mode:

- When the PFC's detects the loss of Important Air and Attitude Data, the PFC's operation changes to this Mode. The Autopilot cannot operate in this Mode.

Direct Mode:

- The PFC's are not used. The ACE's set the position of the Control Surface in direct response to Analog Pilot Control Inputs.

ACE

Is a Signal Converter and controls the Direct Mode

Operates in all three PFC's Modes. In NORMAL and in SECONDARY MODE the ACE Relays Input Signals from Airplane Sensors to the PFC and Command Output Signals from the PFC to the PCU's. In DIRECT MODE, the ACE processes the Input Signals with internal Hardware and sends Command Output Signals to the PCU's.



PFC (Primary Flight Computers)

Calculate Surface Commands for the Ailerons, Flapperons, Speedbrakes, Spoilers, Elevators, Rudder and Stabilizer.

- Load Software of the PFC through MAT
- Interchangeable
- Operates in two Modes:
 - In NORMAL MODE all Functions operate
 - In SECONDARY MODE when there is a loss of important Air and Attitude Sensor Data from the ADIRU and SAARU. The Secondary Mode is a degraded Mode in which only specified Functions of the PFC operate.
- At the End of each Flight, the PFC's do an Automatic PFC Self Test to find Component Failures and confirm Failures found in Flight
- Caution Message Flight Control Mode Indicates that the PFC is in Secondary Mode. Secondary Mode is an NO-GO Item
- Calculates Protection Functions for :
 - Bank Angle
 - Overspeed
 - Stall
 - Thrust Asymmetry Compensation
 - Overyaw

The BANK ANGLE PROTECTION supplies a Roll Command opposite to the Bank. The OVERSPEED PROTECTION supplies a Pitch Up Command when the Speed is more than the maximum. The STALL PROTECTION supplies a Pitch Down Command. The THRUST ASYMMETRY COMPENSATION (TAC) automatically controls the Rudder movement to make allowance for Asymmetrical Thrust from the Engines. The OVERYAW PROTECTION operates through the Wheel-Rudder-Cross-Tie-Function to decrease the Yaw Command. The Bank Angle and the Stall Protection supply more resistive Force to the Controls. The Pilots can override the Protection Functions when they move the Controls more than the Limit.

Flight Control Shutoff Valves

The SOV's for the Right and Left System can operate in the Air or on the Ground. The SOV's for the Center System can operate only on Ground.

Maintenance Page

There are three PFCS Maintenance Pages. Page one contains Data for the Control Inputs and Variables it is used to do Maintenance Functions such as Rigging or to do a check of the Discrete Inputs and Outputs of the PFCS Components. The second Page contains Surface Position Informations and Actuator Hydraulic Data. The third contains the Status of Analog Discretes, Normal Indications are White. Failure Indications are amber.

Aileron and Flaperon

Control the Flight Attitude of the Airplane about the Longitudinal Axis. They also increase the Wing Lift with the High Lift System during TakeOff, Approach and Landing.

The Flapperon are standart Inboard Ailerons which also operate as Flaps

Aileron Lockout

On the Ground and during Flight below Cruise Speed, the Ailerons and Flaperons are fully operational. At Cruise Speed, the Ailerons fair to the Wing Surface and Lock Out. The Flaperons supply Roll Control.

Aileron and Flaperon Droop

During Extension of the Flaps, the Ailerons and Flaperons Droop to increase the Lift of the Wing. When Drooped, the Ailerons and Flaperons are fully operational for Roll Control.



Flight Controls

Wheel Position Transducers

- Measure the Position of the Control Wheels. The Transducers send analog Electrical Signals to the ACE's
- When the Right and Left Shaft Assemblies rotate in response to a Control Wheel Command, the Control Wheel Position Transducers extend or retract
- Status Display Message „Control Wheel Transducer“ Indicates that one Position Transducer is defective. When two or more Transducer are defective, the Status Message „Flight Contrl Sys“ shows .

Wheel Force Transducer

- Measures the total Force from the Captain and First Officer to the Control Wheels
- Sends analog Electrical Signals to the ACE's. The PFC's use these Signals for the Bank Angle Protection Function
- The LVDT's measure the Spring Movement

Flaperon PCU

Move the Flaperons. Electrical Command Signals from the ACE's actuate the Flaperon PCU's. Each Flaperon has two PCU's.

During Adjustment of the Flaperon Surface it is necessary to adjust the Actuator Null LVDT. Remove the LVDT Access Cover to adjust the LVDT.

If both PCU's are in Bypass Mode, the Flaperon can move freely in both Directions.

In Flight up to a maximum of 10 Degrees.

When the Aircraft has no Power on the Ground, the Flaperon slowly moves down.

Aileron PCU

If both PCU's are in the Bypass Mode during Flight, the Aerodynamic Lift moves the Aileron about 15 Degrees Up from the Faired Position.

Loss of the Center and Left Hydraulic System during Ailerons are locked out, all PCU's stay in the Blocking/Damped Mode. This prevents Upfloat and Undesired Roll of the Airplane.

On the Ground, with no electrical or Hydraulic Power, the PCU's are in the Blocked/Damped Mode. The Aileron cannot move Up.

You adjust the Aileron PCU's on the Ground so the Aileron Control Surfaces are about 2 Degrees below the Wing Fixed Trailing Edge.

After installation of the Aileron or the Flaperon PCU, you do a MAT Test and adjust the Actuator Null LVDT to have the Control Surface at the Rig Position.

Spoiler and Speedbrake Control

In Roll Control, all Spoilers except 4 and 11 are Fly-By-Wire. Spoiler 4 and 11 receive mechanical Signals for Roll Control.

Symmetrical Spoiler Pairs Fair and Lock Out if one Actuator in the Pair fails. Spoiler 5 and 10 Fair and Lock Out as a Function of Altitude and Airspeed.

For Spoilers 4 and 11 Speedbrake Control is only available in Normal Mode. When the Pilot moves the Speedbrake Lever more than 54 Degrees, the PFC Commands the ACE to send an ON/OFF Electrical Signal to the rw Spoiler PCU's.

Without Hydraulic Pressure to the PCU, the closed Extension Check Valve prevents Extension of the PCU. This permits the Actuator to Retract.

NORMAL MODE

- In Roll Control, the PFC's command the Inboard Spoilers to a maximum of 20 Degrees and the Outboard Spoilers to a maximum of 45 Degrees.
- Spoilers 4 and 11 move to a maximum of 45 Degrees.
- The Spoiler Lockout Logic affects the Roll Commands of Spoiler 5 and 10. The PFC's use Computed Airspeed (CAS) and Altitude Data from the ADIRU's to calculate when to Lockout these Spoilers. Spoilers 5 and 10 Lockout at Cruise Speed.
- PFC's calculate Speedbrake Commands for all Spoilers, except 4 and 11.
- In Flight, the PFC's command the inboard Spoilers to a maximum of 20 Degrees and the outboard Spoilers to 45 Degrees, except for Spoilers 4,5,10 and 11. Spoilers 5 and 10 do not operate as Speedbrakes in Flight.



On the Ground all Spoilers except 4 and 11 move to a maximum of 60 Degrees.

Mechanical Speedbrake Logic affects Spoilers 4 and 11 when Speedbrake Lever command is greater than 54 Degrees, Spoilers 4 and 11 extend to 45 Degrees.

Rudder Control

A Rudder Tab increases the Effect of the Rudder. The Rudder Tab moves further in the same Direction as the Rudder .

During Flight, the Rudder Ratio Function reduces the Movement of the Rudder as the Airspeed increases.

A Gust Suppression Function reduces the Effects of Air Gust on the Vertical Stabilizer .

Thrust Asymmetry Compensation (TAC) Switch

Supplies a Discrete Signal to the C ACE. In AUTO the PFC's automatically control the Rudder Trim Actuator to make allowance for Asymmetric Thrust

Rotary Trim Selector and Manual Trim Cancel Switch

Supplies Signals, these Signals command the Rudder Trim Actuator move the Rudder Pedals and the Position Transducers.

Rudder Trim Control

Two Controls adjust the Trim of the Airplane about the vertical Axis (Rudder Trim Control and the Manual Trim Cancel switch) .

The Rudder Trim Control commands the Direction and rate of Rudder Trim. The Manual Trim Cancel Switch commands the Rudder to the Center Position and cancels any Rudder Trim Input by the Pilot. The Manual Trim Cancel Switch does not remove any Rudder Trim caused by TAC.

Modal Accelerometer

Measure the Lateral Acceleration of the aft Fuselage. They send an analog Signal to the ACE's.

Helps improve the Quality of Passenger Ride in the forward and aft Sections of the Cabin

Gust Suppression Pressure Transducers

Measure the Pressure Difference between both sides of the vertical Stabilizer.

Helps improve the Quality of Passenger Ride in the aft Portion of the Fuselage.

Rudder PCU

NORMAL MODE

When the ACE energizes the Bypass Solenoid, Hydraulic Pilot Pressure then moves the Mode Selector Valve to the normal Position. Under these Conditions, an electrical command to the EHSV results in the Actuator Extension or retraction.

BYPASS MODE

When the ACE De-energizes the Bypass Solenoid, the Damped Solenoid stays energized. This happens when there is a single Hydraulic or Electrical Failure on the PCU or its ACE. Under these Conditions, the Mode Selector Valve blocks Control Pressure from the EHSV to the Actuator Cylinder. It also connects together both sides of the Actuator. When the PCU is in Bypass Mode, the other two PCU's Backdrive it. These two PCU's then operate at full Hydraulic System Pressure.

DAMPED MODE

When the ACE's De-energizes the Bypass, Pressure Reducer and Damped Solenoids. This happens when the PCU has no Power or there is a double or tripple PCU OR ACE Failure. During Rudder Operation with a double Failure , the good PCU moves the Rudder very slowly. On the Ground with no Power on the PCU's, all three PCU's are in Damped Mode. The Rudder can move slowly when an outside Force pushes on it.

Flight Controls

Rudder Tab

It moves in the same Direction of the Rudder to increase its effect.

Has a maximum Movement of 27 Degrees in both Directions in Relation to the Rudder. For each Degree of Movement of the Rudder, the Rudder Tab also moves one Degree. At full Movement of the Rudder (27 Degrees), the Rudder Tab moves 27 Degrees in Relation of the Rudder. This results in a 54 Degrees Tab Movement in Relation to the Centerline of the Airplane. On Ground the Rudder Tab Control Rods deflect the Rudder Tab to the Left of the Airplane Centerline.

Rudder Ratio Changer

Reduces the Travel of the Rudder. This keeps the Effectiveness of the Rudder constant and reduces the Air Loads on the Rudder.

NORMAL MODE

The Control Laws in the PFC's reduce the Rudder Input command as the Computed Airspeed (CAS) increases. The Rudder Ratio Changer schedule is fixed.

SECONDARY MODE

The PFC's reduce the Rudder Input command by a fixed Ratio based on the Flaps and Slats Position. When the Flaps and Slats are not retracted, full Pedal Movement causes 27 Degrees of Rudder Movement under no Load. When the Flaps and Slats are Retracted, full Pedal Movement causes 10 Degrees of Rudder Movement under Load.

DIRECT MODE

Flaps and Slats not retracted, full Pedal Movement causes 23,5 Degrees of Rudder Movement under no Load. Flaps and Slats are retracted, full Pedal Movement causes 10 Degrees of Rudder Movement under no Load.

Thrust Asymmetry Compensation (TAC)

Helps control the Airplane during Asymmetrical Engine Thrust Conditions. The TAC Protection Function operates in the PFC's NORMAL MODE only. The Pilot can Disarm the TAC Function with the TAC Switch on the P5 Panel.

Elevator Control Protection Functions

Overspeed and Stall Protection Functions in the PFC's supply Flight Envelope Protection in both Manual and Autopilot Operation. The Overspeed Protection supplies a Pitch-Up Elevator Command. The Stall Protection supplies a Pitch-Down Elevator Command.

Elevator Feel

The Elevator Feel Unit supplies a Feel Force to the Control Columns. The Elevator Feel Actuator changes the Feel Force. The Feel at the Control Column increases with the amount of Column Movement and the Speed of the Airplane.

Column Breakout Mechanism

Makes it possible to control the Elevators if a Jam occurs in a Control Column, the Column Torque Tubes or an Elevator Feel Unit.

NORMAL MODE

The PFC calculates Elevator Feel Commands as a Function of Airspeed. As Airspeed increases, it commands the Actuator to Extend. This results in More or Less Resistance (Feel) to Movement of the Control Column.

SECONDARY MODE + DIRECT MODE

The PFC calculates Feel Commands as a Function of Flaps and Slats Positions. When the Flaps and Slats are not Retracted, a Low Feel Command is made.

Elevator Offload Function

Operates only in the Air

Commands to Determine when the Elevator is not at the Neutral Position for more than two seconds minimum.

Commands the Horizontal Stabilizer to move as a Function of Airspeed. The Movement of the Horizontal Stabilizer then causes the Elevator to move to the Neutral Position.



Elevator PCU**NORMAL MODE**

When the ACE energizes the Bypass Solenoid and at least one Coil of the Blocking Solenoid, the ACE energizes the Pressure Reducer Solenoid when there is no Failure of the ACE's or the PCU. The Actuator then operates with full Hydraulic System Pressure.

BYPASS MODE

When the ACE De-energizes the Bypass Solenoid and energizes one Coil of the Blocking Solenoid, this happens when there is a Failure on the PCU or the ACE in Control of the PCU.

BLOCKING MODE

When the ACE De-energizes the Bypass Solenoid and both Coils of the Blocking Solenoid. The ACE also De-energizes the Pressure Reducer Solenoid. This happens when the PCU has no Electrical or Hydraulic Power. Also, when there is a Failure of both adjacent PCU's or their ACE's and the Elevator is near the Failed Position. Under these Conditions, the Actuator cannot move. When both PCU's in Blocking Mode, they lock the Elevator in its Position.

Elevator Control**SPEED STABILITY FUNCTION**

Operates only in the Air. It does not Function during Autopilot Operation. The Speed Stability Function controls the Elevator to maintain the Trim Reference Speed. The Trim Reference Speed is the Speed last selected by the Pitch Trim Switches or the Alternate Pitch Trim Lever Switches.

STALL PROTECTION FUNCTION

Uses the Angle-Of-Attack from the ADIRU. It also uses the Computed Airspeed (CAS) and the Mach Number. Operates only in Air. Sends Signal to the Elevator for Pitch- Down Command. The Function also increases the Column Feel Force in the Column aft Direction.

OVERSPEED PROTECTION FUNCTION

Monitors the CAS and Mach Number. Sends a Signal to the Elevators for a Pitch-Up Command.

Stabilizer Control

The Elevator Off-Load Function automatically sets the Position of the Stabilizer during manual Flight or in Auto-flight. In this Mode, the PFC's monitor Elevator Deflection and transfer Pitch Changes to the Stabilizer. Once the Stabilizer goes to its commanded Position, the Elevator moves to Neutral. The Pilots command the Stabilizer to move with either the Pitch Trim Switches on the Control Wheels or the Alternate Pitch Trim Levers on the Control Stand. The guarded Cutout Switches on the Aisle Stand control Hydraulic Shutoff Valves on the Stabilizer Trim Control Modules (STCM's).

Stabilizer Assy

Moves to 15 Degrees:

- 4 Degrees Leading Edge Up (4 Degrees Airplane Nose Down Trim) from Neutral
- 11 Degrees Leading Edge Down (minus 11 Degrees Airplane Nose Up) from Neutral

Stabilizer Position Indication

Stabilizer Position Module RVDT's send Signals to ACE's. The ACE's to the three PFC's and to the two AIMS. The Flight Management Computing Function (FMCF 9 sends Airplane Weight and Center of Gravity for Green Band Computation to the AIMS. AIMS commands the Indicator to show both Stabilizer Position and Safe Takeoff Range.

High Lift Control

In the Primary Mode, Hydraulic Power moves the Flaps and Slats. In the Secondary Modes, Electrical Power moves the Flaps and Slats.



Flight Controls

Primary Mode Flap and Slat Sequence

During Extension from the Retracted Position, the Slats Extend to the Sealed Position while the Flaps stay Retracted. When the Slats are at the Sealed Position, the Flaps begin to Extend. When the Flaps are at the 20 Unit Position, the Flaps stop Moving. The Slats then Extend to the Gapped Position. When the Slats are in the Gapped Position, the Flaps move to the fully Extended Position. If the Slats are not at the Gapped Position when the Slats Drive Shutdown occurs, the Flaps cannot move more than the 20 Unit Position.

Secondary Mode Flap and Slat Sequence

During Extension, the Slats extend to the Gapped Position before the Flaps extend. When the Slats are at the Gapped Position, the Flaps extend to the Commanded Position.

Alternate Mode Flap and Slat Sequence

During Extension, the Flaps and Slats extend at the same time. During Retraction, the Flaps retract before the Slats. When the Flaps are fully Retracted, the Slats Retract.

Flap Primary Control Valve

Controls Hydraulic Power to the Hydraulic Motor. In the Primary Mode, this Valve controls the Direction and Speed of Movement of the Flap drive System. In the Secondary and Alternate Modes, this Valve prevents Hydraulic Power to the Hydraulic Motor.

Flap/Slat Priority Valve

Gives Priority of Hydraulic Power to the Primary Flight Controls over the Flaps and Slats. This Priority Valve makes sure that the Primary Flight Control PCU's receive sufficient Hydraulic Power when both Air Driven Pumps are not operating.

Flap Limit Switch

Limits the Position of the Flaps during Alternate Mode Operation. The Flap Limit Switch also prevents Retraction of the Slats in the Alternate Mode until the Flaps are fully Retracted.

No Back Brake

Helps prevent Flap retraction if there is a PDU or Torque Tube Failure.

Load Relief

Prevents damage to the Flaps and their support Structures from Large Aerodynamic Forces.

Limits the Position of the Flaps as a Function of Airspeed.

Operates only in the Primary Mode. It compares the Flap Lever Command Position to the Airspeed.

Is active if the Airspeed increases above the Load Relief Limit for more than one half second. Load Relief then Retracts the Flaps or prevents the Flaps from Extending to the Commanded Position.

Resets when the Airspeed decreases below a set value. Also resets when the Pilot moves the Flap Lever to or below the Flap Load Relief Position.

Flap Skew Detection System

Monitors the Position of the Flaps. The FSEU's stop the Primary and Secondary Mode Flap Operation if there is a Skew, an Asymmetry or a Secondary Mode Disagree Condition.

- SKEW CONDITION
 - If the inboard end of a Flap does not align with its outboard end.
- ASYMMETRY CONDITION
 - If the Left Flaps do not align with the Right
- SECONDARY MODE DISAGREE
 - If the Flaps do not move or move too slowly after a command to move in secondary mode

There is no Automatic Shutdown of the Alternate Mode if there is a Flap Skew, Asymmetry or Secondary Mode Disagree.



Slat Primary Control Valve

Controls Hydraulic Power to the Hydraulic Motor. In the Primary Mode, this Valve controls the Direction and Speed of Movement of the Slat Drive System. In the Secondary and Alternate Modes, this Valve prevents Hydraulic Power to the Hydraulic Motor.

Autoslat Priority Valve

Controls the Flow of Hydraulic Fluid to the Main Landing Gear System. This Valve gives Priority of Center Hydraulic System Power to the Slats during Autoslat Operation and to the Flaps and Slats during Landing Gear Operation.

No Back Brake Offset Gearbox

Help prevent Slat retraction if the PDU or a Torque Tube Fails.

Prevents Excessive Loads on the Pinion Gear if the Slat does not move freely.

Krueger Flap

Seals the Gap between the inboard Slat and the Engine Strut. This increases the Effect of the Slats.

Has two Positions: Retracted and Extended. It moves to the Extended Position when the Slats are in the Sealed or Gapped Position. It moves to the Retracted Position when the Slats are at the Up Position.

Autoslat Extension

Improves the Wing Stall Performance if the Airplane approaches a Stall Condition.

The WEU sends a Autoslat Request to the FSEU's if the Airplane approaches a Stall Condition.

Slat Skew Detection

Monitors the relative Position of all the Slats except for Slats 1 and 14.

Does not Monitor the outboard end of Slats 2 and 13 and the inboard end of Slats 6 and 9 for Skew. The FSEU's stop the Primary and Secondary Mode Slat Operation if there is a Skew, an Asymmetry or a Secondary Mode Disagree Condition.

Except for Slats 1 and 14, the Slats are in a Skew when the inboard end of one or more Slats is not aligned with its outboard end.

Asymmetry Condition is when the Slats on the Left Wing do not align with the Slats on the Right Wing.

Secondary Mode Disagree is when the Slats do not move or move too slowly after a command to move in Secondary Mode.

Flight Controls

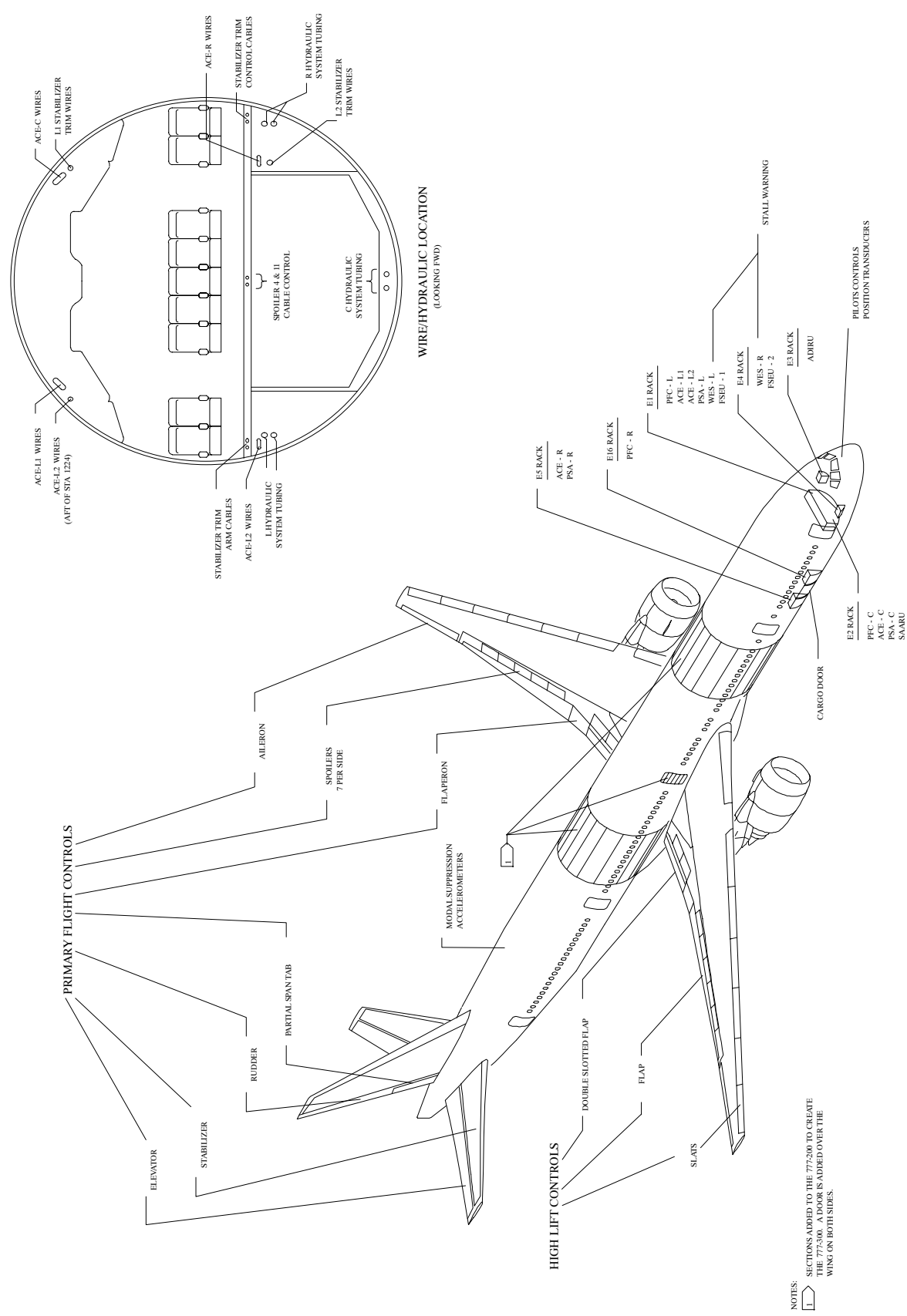


Figure 7 Flight Controls Schematic

Fuel

ATA FUEL

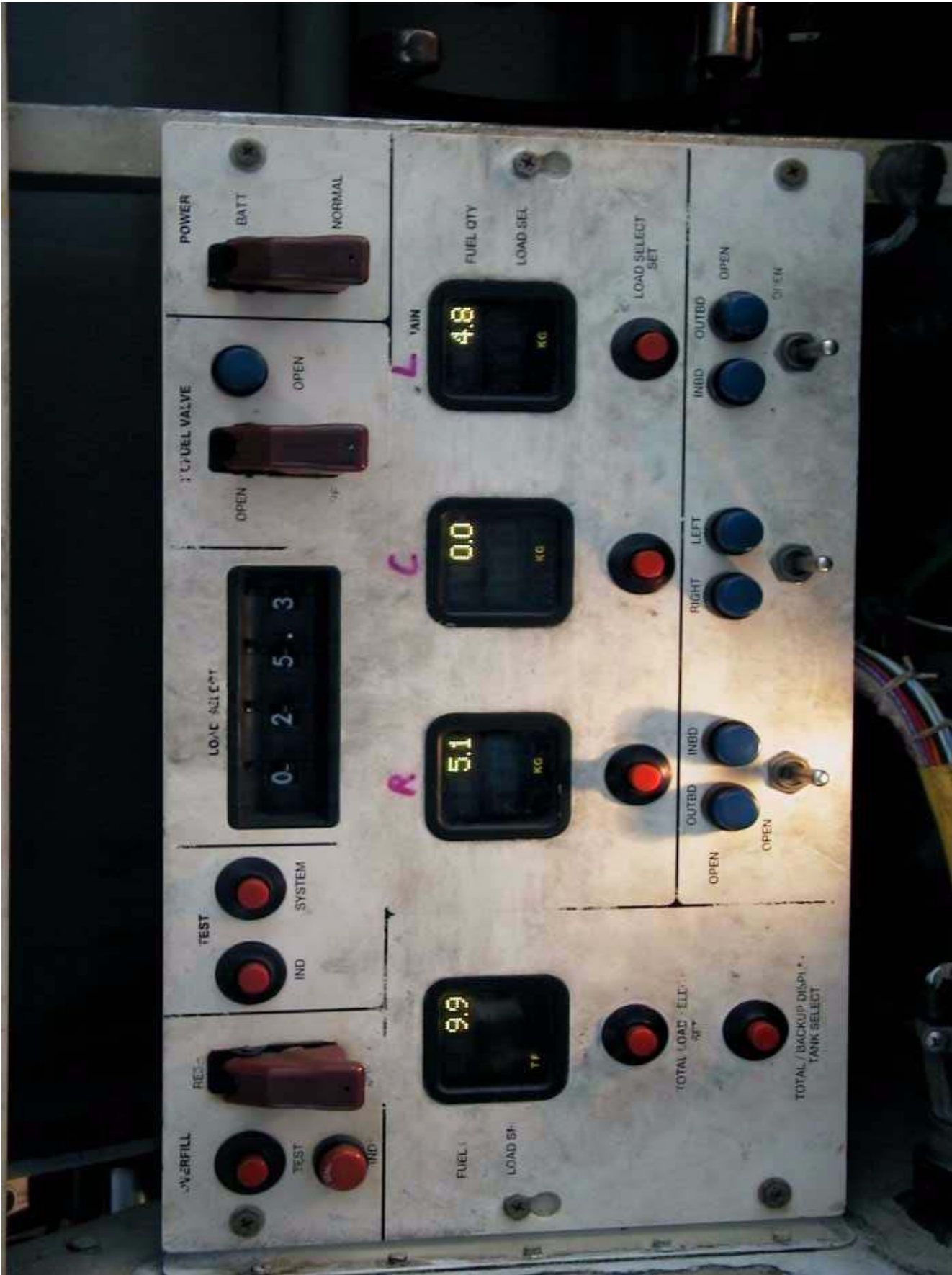


Figure 8 Fueling Panel



Fuel

Tank Vent System

Keeps the Pressure of the Fuel Tanks near the Pressure of the Outside Atmosphere. A large Pressure Difference can damage the Wing Structure.

Vent Channels and Vent Tubes keep the Pressure of all Fuel Tanks near the Pressure in the Surge Tanks. The Surge Tanks are open to Outside Air through the Vent Scoops. The Shape of the Vent Scoops keep positive Pressure inside the Surge Tanks during Flight.

When all the Fuel Level is higher than the outboard End of the Main Tank Vent Tube Channels, the Fuel Vent Float Valves closes to keep Fuel out of the Vent Channels. When the Fuel Level is below these Valves, the Floats open them.

The Pressure Relief Valve is normally closed, an open Pressure Relief Valve is a Symptom of a blocked Vent Scoop or Flame Arrestor.

Indication System

Has these Subsystems:

- Fuel Quantity Indication System
- Fuel Measuring Sticks
- Fuel Temperature Indication
- Fuel Pressure Indication

Fuel Quantity Indication System (FQIS)

Functions :

- Measures the Fuel Volume
- Calculates the Fuel Quantity
- Controls Refuel Operations
- Shows when there is Water in the Tanks

Fuel Weights go to the Integrated Refuel Panel (IRP) on ARINC 429. Fuel Weights, and FQIS Data and Fault Information go to the AIMS on the System ARINC 629 Buses.

Densitometers

Each Fuel Tank has one Densitometer. They use a Vibration Cylinder Transducer to measure the Fuel Density in each Tank.

Water Detectors

The Fuel Quantity Processor Unit (FQPU) uses Water Detector Signals to see if there is Water in the Tank Sump Area. Each Fuel Tank has one Water Detector. The Fuel Quantity Maintenance Page shows a Message when there is Water in the Fuel Tank.

Temperature Sensor

There is only one Fuel Temperature Sensor. It measure the Fuel Temperature in the left Main Tank. The Temperature Sensor is a Resistance-Type Sensor that fits inside a Sleeve.

Overfill Protection

There is a Surge Tank Float Switch in each Surge tank. If Fuel enters the Surge tank, the Surge Tank Float Switch sends a Signal through the IRP to the ELMS. This causes the ELMS to remove Power from all the Refuel Valves, so the Valves close.

Fuel Quantity Processor Unit (FQPU)

Does these Functions:

- Calculates the Fuel Weight for each Tank
- Calculates the total Fuel Weight
- Shows the Weights on the IPR Indicators
- Sends the Weights to the AIMS
- Causes the Refuel Valves to close
- Monitors the FQIS for Faults
- Sends Fault Data to the CMCS

Connects two isolated 28 V DC Power Sources at one time. The FQPU operates when one or both of the Sources have Power.

Power Sources:

- Captain's Flight Instrument Bus
- Right DC Bus
- Ground Handling Bus
- Hot Battery Bus

When a Refuel Station Door is open and the Ground handling Bus has Power, the FQPU gets Power from the Ground Handling Bus.

With the Battery Switch in Pos. BATT, the FQPU gets Power from the Hot Battery Bus.

Integrated Refuel Panel**OVERFILL TEST SWITCH**

Starts the Overfill Test. This causes the Overfill Protection to immediately close all the Refuel Valves. You do the Overfill Test during Refueling.

INDICATOR TEST SWITCH

During the Test, a Test Pattern shows in the Fuel Quantity Indicators and the Valve Position Indication Lights come on.

SYSTEM TEST SWITCH

During the Test all the Refuel Valves close, two at a time and the Refuel Valve Position Lights go Off.

Override / Jettison Pump

Supplies Fuel from the Center Tank to the Engine Feed Manifold. They also supply Fuel to the Refuel/Jettison Manifold during Fuel Jettison.

Center Tank Fuel Scavage Jet Pump

Take Fuel from the Low Points in the Center Tank and send it to the Main Tanks.

There is one Fuel Scavage Jet Pump in each side of the Center Tank.

Operates automatically when the Boost Pumps are on. They use Fuel from the Boost Pumps as Motive Fuel.

Boost Pump

Supplies Main Tank Fuel to the Engine Feed Manifold.

There are two Boost Pumps in each Main Tank.

Water Scavage Jet Pump

Takes Fluid from the Lowest Point in the Tanks and send it to the Pump Inlets. This prevents Water from collecting at the Bottom of the Tanks.

Operates automatically when the Fuel Pumps are on.



Fuel

Spar Valve Battery

Makes sure that the Fuel System always has Power to close these Shutoff Valves:

- Engine Fuel Spar Valve
- APU Fuel Shutoff Valve

Engine Fuel Feed

The normal Procedure for Engine Fuel Feed Operations is to supply Fuel from the Center Tank first. When the Center Tank is empty, you supply Fuel from the Main Tanks.

The Engines can also use Suction Feed from a Main Tank.

SUCTION FEED

Suction (Gravity) Feed occurs when all the Pumps on one side are off and the crossfeed Valves are closed. During Suction Feed, the Engines get Fuel through the Suction Bypass Valve. The Engines can only Suction Feed from the Main Tanks.

Left Center Override / Jettision Pump Control

If the APU Generator is the single Power Source, you can operate the left Override / Jettision Pump. You cannot operate the right Override / Jettision Pump if the APU Generator is the only Power Source.

If an IDG is the single Power Source, you can operate the related Override / Jettision Pump.

Fuel Synoptic Display

Is a simplified Schematic of the Fuel System. It shows the System Configuration for these Components:

- Override / Jettision Pumps
- Boost Pumps
- Spar Valves
- Crossfeed Valves

Also shows Fuel Quantity.

APU DC Fuel Pump

Operates automatically when the APU Selectors is in the ON Position and there is no Pressure in the left Engine Feed Manifold.

Supplies Fuel to the APU and to the Engine Feed Manifold.

It uses 28 V DC Power.

APU Fuel Shutoff Valve

Opens to permit Fuel to flow to the APU. Fuel comes from the left Engine Feed Manifold or from the DC Pump.

APU Isolation Valve

Opens to let Fuel from the APU DC Pump to the Engine Feed Manifold.

Is normally closed.

Operates automatically in Flight when there is no Engine Fuel Feed Pressure and the Engine has a Flame Out.

Fuel Jettision System

Dumps Fuel Overboard to reduce the Landing Weight.

Jettision Pumps

There are two Override / Jettision Pumps in the Center Tank and one Fuel Jettision Pump in each Main Tank.

Jettision Nozzle Valves

In the Air, the Nozzle Valves let Fuel in the Refuel / Jettision Manifold go Overboard.

On the Ground you cannot open the Nozzle Valves.

Defuel Valve

Connects the Engine Feed Manifold to the Refuel / Jettision Manifold.



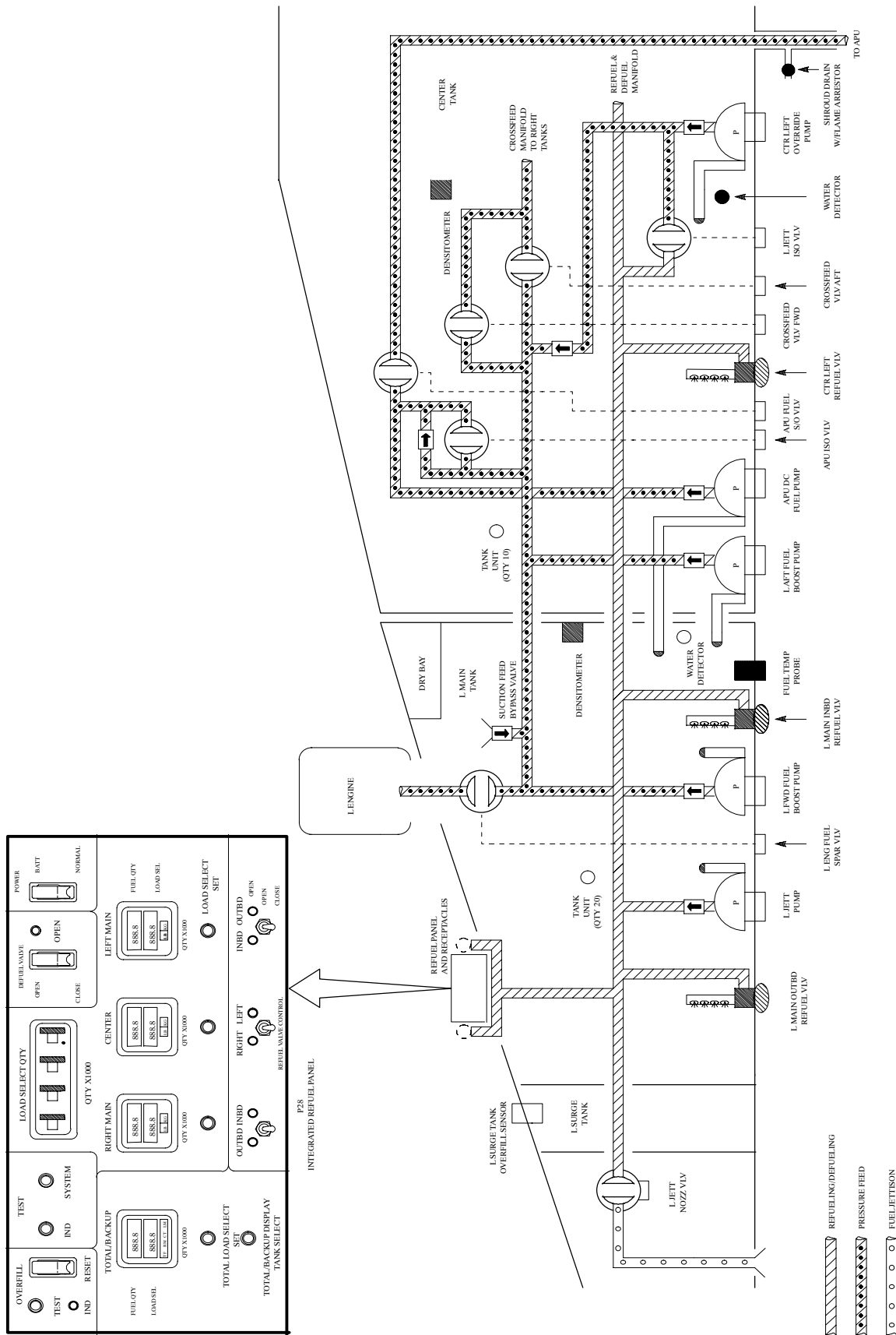


Figure 9 Fuel Schematic



ATA HYDRAULIC SYSTEM



Hy



Figure 10 Hydraulic System (ADP's)



Hydraulic System

Main Hydraulic System

Each System has one or more Primary and Demand Pumps. Primary Pumps normally operate continuously. Demand Pumps operate only when additional Power is necessary.

The Left Hydraulic System supplies Power for these Systems:

- Primary Flight Control system (PFCS)
- Left Thrust Reverser

The Right System supplies Power for these Systems:

- PFCS
- Right Thrust Reverser
- Normal Brake System

The Center System has two ACMP's, two ADP's are the Center system Demand Pumps. A Ram Air Turbine (RAT) supplies an Emergency Source of Power to the Flight Controls.

Also includes a center Hydraulic Isolation System (CHIS) for Reserve Brake and Steering Operation.

Supplies Hydraulic Power for these Systems :

- PFCS
- Alternate and reserve Brakes
- Normal and reserve Nose Gear Steering
- Landing Gear Actuation
- Main Gear Steering
- High Lift Control System

Four Hydraulic Interface Module (HYDIM) Cards are the Interface between the Hydraulic System and other Airplane Systems.

Receives and transmits Data Through the ASG Cards and the System ARINC 629 Buses

Also sends Data to the three Primary Flight Control Computers (PFC's) through the AIMS

HYDIM

Supplies Control, Indication and other Functions to the Hydraulic System.

HYDIM Left / Right / Center Left / Center Right are interchangeable, are in the P85 Left System Card File and the P84 Right System Card File.

- Controls these Functions :
- Demand Pump Auto Operation
- Reserve and NLG Isolation Valve Operation
- Landing Gear Auto-Off (MLG and NLG Selector/Bypass Valves)
- RAT Auto Deploy

Hydraulic System Reservoirs

Supplies Hydraulic Fluid under Pressure to the Hydraulic Pumps.

Pressurized by the Bleed Air System.

Has a Standpipe.

Left and Right / the EDP's get a Fluid supply from the Standpipe. A Port at the Bottom of the Reservoir supplies Fluid to the ACMP's.

Center / the Standpipe supplies the Fluid to ACMP 2, to both ADP's and to the RAT. ACMP 1 gets Fluid from the bottom of the Reservoir.

The Reservoir Pressure Relief Valve opens between 85 and 90 PSI.



Hydraulic System

Reservoir Pressurization Module and Shutoff Valve

Supplies Airplane Bleed Air to the Reservoirs.

The Shutoff Valves are simple manual Shutoff Valves.

A Reservoir Pressure Switch near each of the Reservoirs send Reservoir Pressure Low or Not-Low Signals to the HYDIM Cards.

Engine Driven Pump

Is the Primary Pump for the Left and Right Hydraulic System.

Output Pressure is nearly 3000 PSI.

A Depressurization Solenoid Valve blocks the Pump Output Flow when you turn Off the Pump.

Case Drain Hydraulic Flow cools and lubricates the EDP.

When the Depressurization Solenoid Valve is not energized, Pump Pressure Output goes to the Hydraulic System.

When you turn Off the Pump, The Depressurization Solenoid Valve gets Electrical Power. This permits Pressurized Hydraulic Fluid from the Pump output Line to move the Blocking Valve. This causes a Blockage and removes the Pressure from the EDP.

Can be Depressurized by the EDP switch or by the Engine Fire Switch.

HYDIM L monitors Left EDP, HYDIM R monitors Right EDP.

EDP Switch ON, the Depressurization Solenoid Valve is not energized, this permits the Pressure Output of the EDP to go to the Hydraulic System.

EDP SHUTOFF VALVE

Stops Hydraulic Supply from the Reservoir to the EDP when the Engine Fire Switch is in the Up Position (there is no Case Drain Flow).

Alternating Current Motor Pump (ACMP)

Are the Primary Pumps in the Center Hydraulic System and the Demand Pumps in the Left and Right Hydraulic System.

Case Drain Flow cools the Electric Motor, cools and lubricates the Pump.

Are rated at 2850 PSI.

Air Driven Pump (ADP)

Are the Demand Pumps for the Center Hydraulic System.

Each ADP is part of an ADP Assembly.

Has an Air Drive Unit (ADU).

The ADU contents:

- Turbine Gearbox Assembly (TGA)
- Modulating Shutoff Valve (MSOV)
- Air Driven Unit (ADU) Heater

Use Airplane Pneumatic Power to operate.

The MSOV's let Air flow to the Turbine of the TGA's

ADU Heaters are on the ADU's to prevent Ice formation.

Two ADP Logic Speed Control Units (LCSU) one for each ADP Assembly control the Pump Operation. The LCSU's supply Speed Control and Overspeed Protection to the TGA's.

Are the same as the Engine Driven Pumps.

ADP and EDP Pumps are interchangeable. When the Pump operates as an ADP Pump, the Depressurization Solenoid does not operate.

HYDIM CR controls ADP C1 in the Demand Mode. HYDIM CL controls the ADP C2 in the Demand Mode.

The HYDIM Cards do not control the ADP's in the Continuous Run (ON) Mode.



Hydraulic System

DEMAND MODE

Auto, the HYDIM Cards start one or both of the ADP's when the Center Hydraulic System must supply a large Hydraulic Flow Rate.

- Operates during :
 - Landing Gear Extension
 - Flap/Slat Operation
 - Low Pressure in the Center System or in both Center ACMP's
 - Touchdown
 - Air Mode, Flaps and Slats Not Up
 - Failure of the ADU Heaters on both ADP's and Groundspeed is more than 80 Knots (Turns On ADP C1).

Modulating Shutoff Valve

Is apneumatically operated Butterfly Valve.

Normally operates in full Open or full Closed.

An pneumatic Actuator Modulates the Valve during Secondary Speed Control.

ADU Heater

Keeps the Temperature of Parts of the MSOV and the TGA higher than the freezing Point. This prevents Ice Formation.

Operates Automatically

The HYDIM CL Card controls the Heaters for both ADU's.

Heater Elements connect in series. A Failure of a single Element causes the Failure of all the Elements in the Assembly.

ADP

NORMAL OPERATION

Signal comes from HYDIM Cards when the Selector is in the Auto Pos. or from the ADP Selector when the Selector is in the ON Pos. These Signals go to the LSCU. The LSCU energizes the Auto Run or Continuous Run Coil in the MSOV.

SPEED CONTROL

Has a Primary and a Secondary Speed Control Circuit.

The LSCU contains the Primary and Secondary Speed Control. The Primary Speed Control Circuit controls the pneumatic Actuator for the VIGV's.

The Secondary Speed Control controls the Position of the MSOV Butterfly Valve. The Secondary Speed Control tries to keep the Pump Speed higher than the Primary Speed Control. When the System operates on the Primary Speed Control, the Secondary Speed Control gets an underspeed Input and keeps the MSOV fully open.

RESERVE MODE

Lets the Turbine turn at higher Speed. This increases Pump Output for Autoslat operation when only one ADP can operate. The HYDIM Card commands Reserve Mode Operation for 8 seconds.

OVERSPEED PROTECTION

The Overspeed Shutdown System has a Latching Function that keeps the ADP OFF until it is Reset by the MAT Test.

Heatexchangers

For the Left System in the Left Tank (2000kg).

For the Right System in the Right Tank (2000kg).

For the Center System in the Right Tank (3000kg).

You can operate the Hydraulic System if Fuel goes below these Levels if you obey the Caution:

- Do not operate the Hydraulic Pumps after the Hydraulic Temperature Indication is more than 100 Degrees or after the Pump Fault Light comes on.



Hydraulic System

Reserve Isolation Valve and Nose Gear Isolation Valve

Supplies Engine Burst Protection to the Center Hydraulic System to prevent complete loss of Center System Fluid.

These Valves permit a Reserve Brake and Nose Gear Steering Operation if there is a Leak in the PFCS or MLG Hydraulic Lines. The Valves also permits PFCS and MLG Operation if there is a Leak in the NLG or Leading Edge Slat Hydraulic Lines.

Are Part of the Center Hydraulic Isolation System (CHIS).

The Reserve Isolation Valve isolates Brakes and Steering from the Center Hydraulic System.

The Nose Gear Isolation Valve controls ACMP C1 Output to Nose Gear Steering.

Hydraulic Accumulators

Absorb Pressure changes caused by Tail Flight Control PCU Operation.

Right and Center Hydraulic Systems each have a single Accumulator.

Left Hydraulic System uses two Accumulators.

They are on the aft Bulkhead of the Stabilizer Compartment.

Alternating Current Motor Pump (ACMP)

PRIMARY PUMP OPERATION

Signals from the Primary Pump Switches for the Center System ACMP's go directly to the ELMS. The HYDIM Cards do not control the Primary Pump Operation.

DEMAND PUMP OPERATION

Signals from the Demand Pump Selector for the Left and Right System ACMP's go to the HYDIM Cards and to the ELMS:

- Selector Switch in ON, Signal goes directly to the ELMS
- Selector AUTO, HYDIM Cards control the Pump operational Signal to the ELMS

Left Switch in AUTO, HYDIM Cards turn on the Left ACMP for these Conditions:

- Left Engine not running
- Touchdown
- Left EDP Pressure less than 2400 PSI

Right Switch in AUTO:

- Right Engine not running
- Altitude is less than 30 feet
- Right EDP Pressure less than 2400 PSI

Ram Air Turbine System (RAT)

Supplies an Emergency Source of Hydraulic Power to operate the Flight Controls. The RAT is also an Emergency Source of Electrical Power.

Extends automatically in Flight with a loss of Hydraulic Pressure in the three Hydraulic Systems.

ELMS extend the RAT for these Conditions:

- Airplane in Air Mode
- Left and Right Transfer Buses have lost Electrical Power

RAT Generator Heater System

Operates Automatically

Two Heater Elements in the Generator. Only one Element operates at a time.

HYDIM CL Card controls

If one Heater fails, select the other with RAT Heater Switch on the E6-2 Shelf

You can do a Test with a Ground Test Through the Mat



Hydraulic System

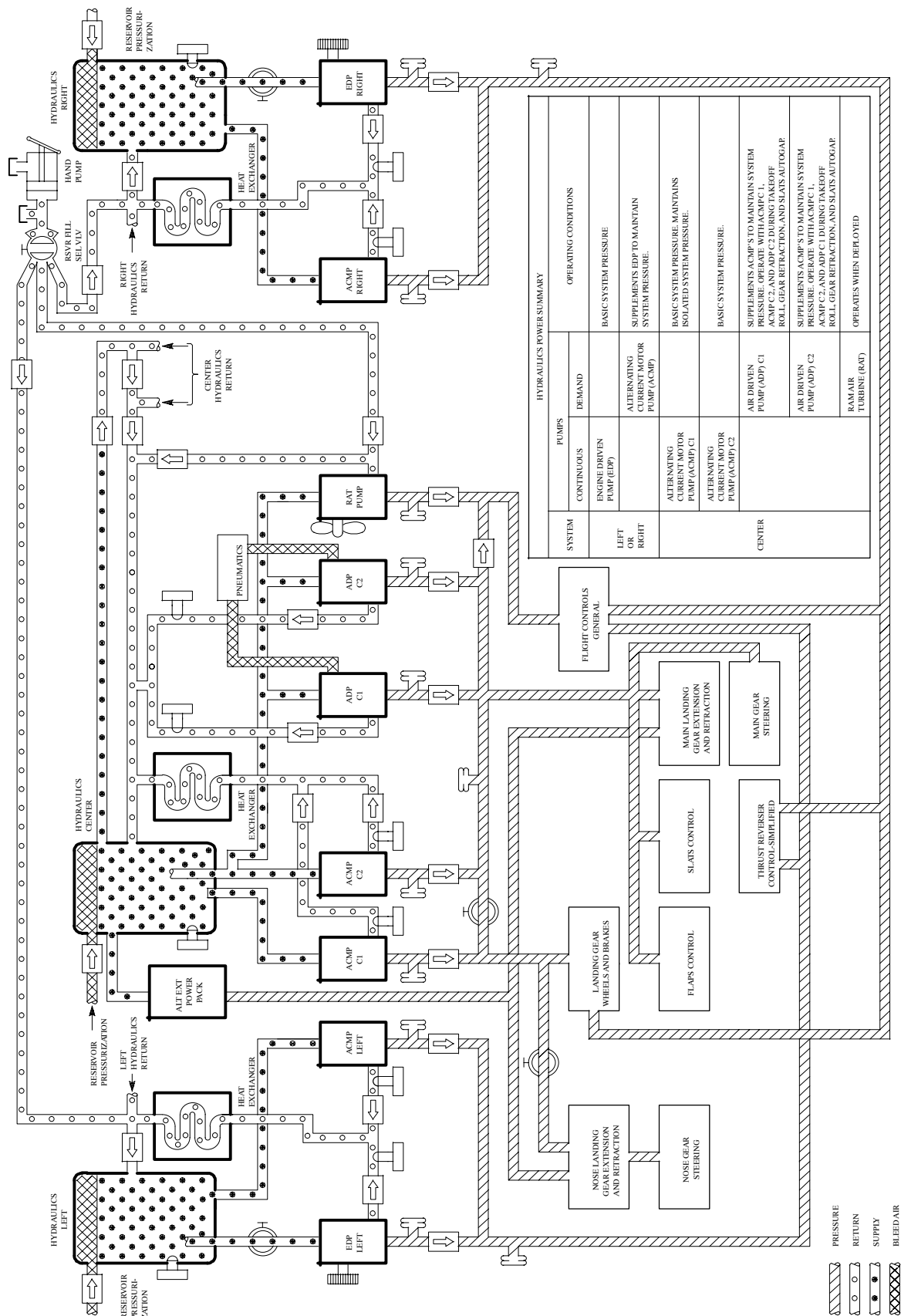


Figure 11 Hydraulic System Schematic



ATA LANDING GEAR



Figure 12 Landing Gear



Landing Gear

Landing Gear Control System

Controls the Extension and Retraction of the Main and Nose Gear.

- When the Airplane is on Ground, a Landing Gear Lever Lock Solenoid locks the Landing Gear Lever in the Down Position. A Solenoid releases the Lock when the Airplane is in Air.
- AUTO-OFF Relais in ELMS remove the Gear-Up Signal ten seconds after the Landing Gear retracts. This removes the Pressure from the Landing Gear Components.

Landing Gear Lever Control Module

Sends Signals to the Landing Gear Selector/Bypass Valve to extend and Retract the Landing Gear.

- The Lever has seven internal Switches. Four of these Switches control Power and Ground to the Down Solenoids in the NLG and MLG Selector/Bypass Valves. Two Switches go to the ELMS to control Power to the UP Solenoids in the NLG and MLG Selector/Bypass Valves. One Switch resets the Gear Door Release/Safety Valve Modules after an Alternate Gear Extension or Ground Door Operation.

Landing Gear Selector/Bypass Valve

OFF POSITION

- In this Position, the Landing Gear is not Pressurized.

EXTENSION

- Hydraulic Pressure and Spring Force move the Selector Valve to the Down Position, this permits Hydraulic Pressure to go to the Landing Gear Down Lines.

RETRACTION

- Hydraulic Pressure and Spring Force move the Selector Valve to the UP Position, this permits Hydraulic Pressure to go to the Gear UP Lines.

BYPASS VALVE

- Has a NORMAL and a BYPASS Position.
- During normal Landing Gear Operation, the Bypass Valves are in the Normal Position.
- If the Selector Valve is in the UP or OFF Positions, or if there is no Pressure in the Center Hydraulic System, Alternate Extend Pressure moves the Bypass Valve to Bypass. This makes sure to permit the Alternate Extension System Extends the Gear. This prevents a Selector Valve stuck in the UP Position.
- Normal System Gear Extend Pressure resets the Bypass Valves to Normal.

MLG Door Operated Sequence Valve

Controls Hydraulic Flow to the Main Gear Uplock Actuator and to the MLG Retract Actuator.

- Is a two Position Valve (Door Open and Door Not Open).
- A mechanical Linkage from the Landing Gear Door operates the Sequence Valve.

Uplock Operated Sequence Valve

Controls Main Gear Door Close Operation

- Is a two Position Sequence Valve (Locked or Unlocked).
- A mechanical Linkage from the Uplock Mechanism moves the Sequence Valve.

MLG Drag Brace Operated Sequence Valve

Controls MLG Door Close Operation during Landing Gear Extension

- Has two Positions (Gear Down and Gear Not Down).
- A Linkage from the Upper Drag Brace Spindle moves the Valve

Landing Gear

MLG Truck Position Actuator

- Moves the Main Landing Gear Truck to 13 Degrees (Tilt) when the Airplane is in the Air and the Landing Gear is Down and Locked.
- Moves the Truck to 5 Degrees (Stow) during a Gear Retraction. The Gear stays in this Position during Flight.

MLG Door Priority/Relief Valve

Limits the Pressure to the MLG Door Actuator during Gear Retraction. This makes sure sufficient Pressure goes to the Truck Positioner Actuator to move the Truck to the Stow Position before the Gear enters the Wheel Well.

MLG Extension-Retract Sequence

START POSITION

- MLG Down and Locked
- MLG Door Closed and Locked
- MLG Truck Position Actuator Tilt
- MLG Drag Brace Operated Sequence Valve Down
- MLG Uplock Operated Sequence Valve Unlocked
- MLG Door Operated Sequence Valve not Open

FINAL POSITION

MLG Up and Locked

- MLG Door Closed and Locked
- MLG Truck Position Actuator Stow
- MLG Drag Brace Operated Sequence Valve Not Down
- MLG Uplock Operated Sequence Valve Locked
- MLG Door Operated Sequence Valve Not Open

NLG Locking Mechanism and NLG Lock Actuator

- Holds the NLG in the Extended or the Retracted Position.
- The NLG Lock Actuator unlocks the NLG Locking Mechanism at the Start or an Extension or Retraction. It also locks the Mechanism when the NLG is fully Extended or Retracted.
- Uses Overcenter Locking to lock the NLG

NLG Operated Sequence Valve

Makes sure that the Doors moves only if the NLG is in the Retracted or Extended Position. It makes sure that the Doors do not move if the NLG is in transit.

NLG Door Operated Sequence Valve

Controls the Hydraulic Flow to the NLG Lock and Retract Actuators. This makes sure the NLG Extends or Retracts only when the NLG Doors are open.

- Is a two Position Valve (Open or Closed)

Landing Gear Unsafe Lights

Come on when a Landing Gear Door is Open and the Safety Valve in the Landing Gear Door Release/Safety Valve Module is in the Normal Position.

Air/Ground Rigging/Calibration

After you replace a Load Sensor, the new Sensor must be Calibrated to the Airplane. You Calibrate all four Load Sensors if you replace the two WOW Cards. You can Calibrate each WOW Load Sensor with the Air/Ground Rigging/Calibration Function on the MAT. This Function is in the PSEU and Air/Ground Rigging Function in the Other Function Menu.

The Ground Test Enable Switch must be in the Enable Position to do this Function.



Landing Gear

Nose Gear Steering System

- Rudder Pedals Inputs turn the Nose Gear up to 7 Degrees in each Direction.
- Steering Tiller Inputs turn the Nose Gear up to 70 Degrees in each Direction.

NLG Steering Centering and Rudder Interconnect Mechanism

- Connects the Rudder Pedals to the Upper Cable Loop. It also moves the Steering System to the Neutral Position when there are no Inputs.
- Permits the Tiller to move the Upper Cable Loop without moving the Rudder Pedals. It also permits the Rudder Pedals to move the Upper Cable Loop.

NLG Steering Pivot Link and NLG Steering Centering Mechanism

- The Pivot Link connects the Upper Cable loop to the Lower.
- NLG Steering Centering Mechanism locks the NLG Steering System in the Centered Position during Gear Retraction.

Antiskid/Autobrake system

- Automatically controls Brake Metered Pressure .
- The Antiskid System monitors Wheel Speed Deceleration and controls Brake Pressure to prevent Skid Conditions. It also releases one third of the Brakes during Taxi to extend the brake Service Life.
- The Autobrake System automatically supplies Metered Brake Pressure to stop the Airplane during Landing or during a Rejected TakeOff.

Antiskid Modules

The normal Antiskid Module controls Brake Pressure for six Wheels independently. The Alternate Module controls two Wheels independently and two sets of paired Wheels with the other two Antiskid Valves.

Autobrake Shuttle

Select the highest of Autobrake or Normal Brake Metered Pressure and send it to the Brakes.

Hydroplane/Touchdown Protection

Operates only on the aft Wheels. This Mode protects against Hydroplaning and also prevents locked aft Wheels during Touchdown.

Oxygen

ATA OXYGEN





Figure 13 Oxygen



Oxygen

Crew Oxygen System

The Cylinder(s) supplies Oxygen through the SOV, Pressure Regulator and Supply Line to the Masks in the Flight Deck. The Supply Line Pressure Regulator regulates the Bottle Pressure to 70 PSI. The Dluiter/Demand Regulator/Mask supplies the Flow and Pressure that the Crew needs.

Pressure Transducer

Tells the Airplane Information Managment System (AIMS) the Pressure in the Oxygen Cylinder when the SOV is open.

Thermal Compensator

Absorbs the Heat that the Pressurized Oxygen causes when it fills an Unpressurized Line.

Chemical Oxygen Generator

Supply Oxygen for the Passengers and Flight Attendants.

Contains Iron and Sodium Chlorate.

Overboard Discharge Indicator

Shows when Overpressure causes an Ocygen release from the Flight Crew Oxygen Cylinder(s) or from the optional Passenger Gaseouos Oxygen System.

Oxygen

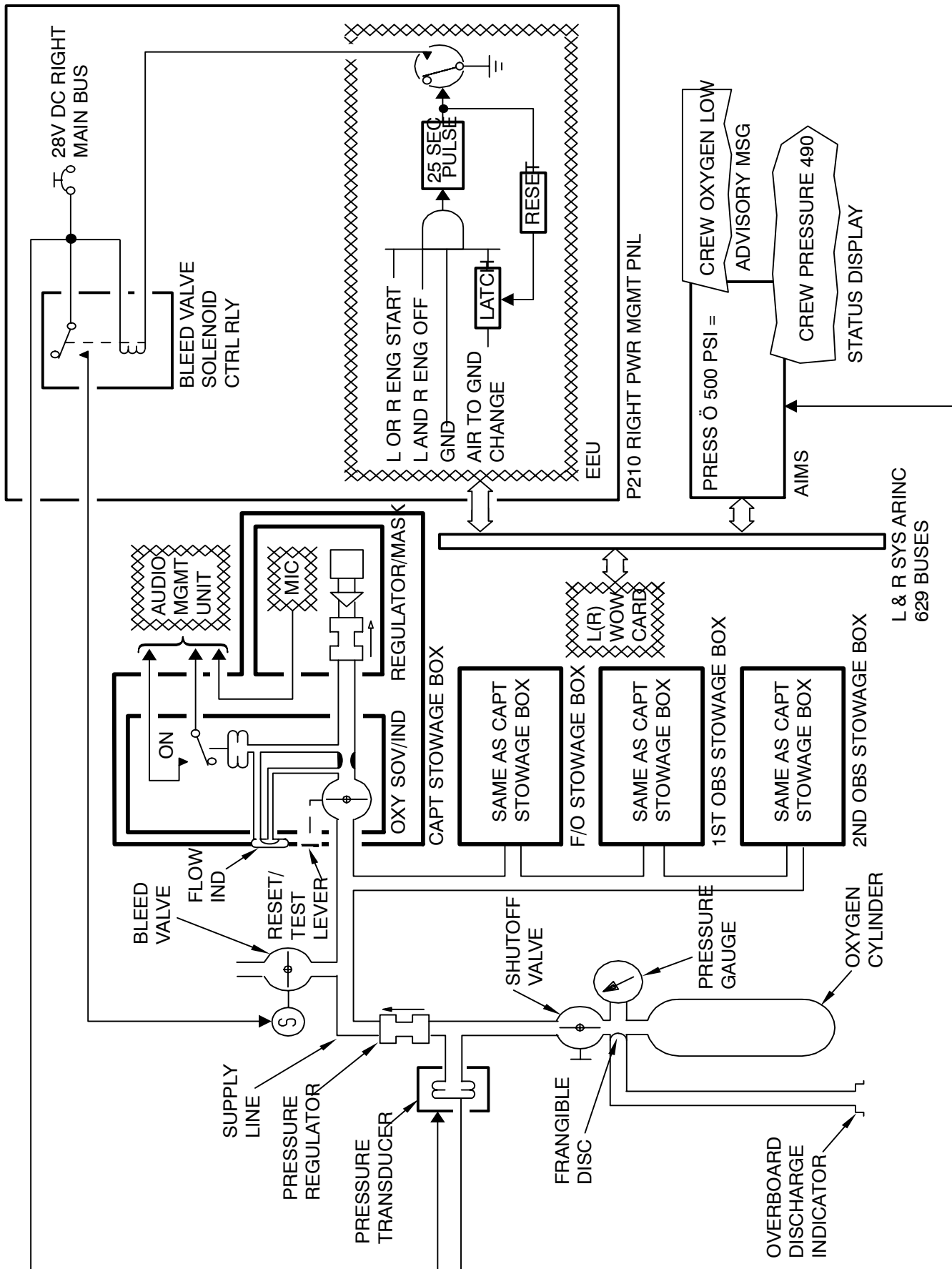


Figure 14 Crew Oxygen Schematic



Water & Waste

ATA WATER & WASTE





Figure 15 Waste Tank



Water & Waste

Water Fill

Set the Quantity Preselect Switch to OFF/RESET Position, if it is not . Set the Quantity. The Fill Handle will move automatically to the open Position. When the Tanks are full, the Handle moves to closed. Set the Quantity Selector Switch to OFF/RESET.

Water Drain

Put the Isolation Drain Valve into the Drain Position. The Isolation Valve opens. Open the Distribution Drain Shutoff Valves. Pull the Drain Valve Handle.

Isolation Drain Valve

Lets you isolate the Overhead Distribution Lines that supply Water to the Forward Lavatories and Galleys. It also permits you to drain the Forward Part of the Overhead Distribution Line Overboard.

Lavatory Water Supply SOV

Lets you control the flow of Water into the Lavatory.
Is above the Sink and behind the Mirror.

Water Cooling

For Drinking.

Operates when the Water Temperature is above than 10 Degrees C.

If an Overheat Condition occurs, the Overheat Switch opens and the Overheat Warning Light comes on. Push the manual Reset Button on the Cover of the Cooler to Reset the Overheat Switch.

Water Heating

An Overheat Switch stops the Operation if the Temperature is more than 77 Degrees C.

A Light on the outside of the Heater comes on when Power is available to the Heater. It goes off if :

- Power is not available
- Power Switch is Off
- Overheat Switch is open.

Water Quantity

Preselect Switch sends Quantity Information to the Water Quantity Summation Unit. The Unit causes to Open the Preselect Overflow Valve. The Valve backdrives the Fill Valve Handle to open. When the Quantity is equal to the Preselect Quantity, the Summation Unit causes to close the Valve. The Tank Fill Handle will move in.

Water Quantity Transmitter

To adjust, Fill the Tanks to Full. Then Drain them. The inner Surface of the Tank must be wet. Do not use the Preselect System to Fill the Tank.

Water Quantity Summation Unit

Gets Signals from the Water Quantity Transmitters.

Gives a Water Quantity Signal to the Water Quantity Gages and the CMS.

Water Tank Pressurization

Comes from the Pneumatic System or from a Compressor. The Air Compressor supplies Pressure to the Tanks when the Pressure from the Pneumatic System is not sufficient.

Air Compressor

Starts when the Tank Pressure is less than 35 PSIG, stops when the Tank Pressure is 45 PSIG.

Water & Waste

Waste System Vacuum Blower

Causes a Pressure Difference.

Operates if the Airplane is below 16000 feet and the Flush Switch is selected.

The Barometric Switch de-energizes the Vacuum Blower above 16000 feet.

Lavatory Flush Control

When you push the Flush Switch, the Flush Control Module starts a Flush Cycle that continuous for 15 seconds.

Sets the Sequence of Operation for the Blower, the Rinse Valve and the Flush Valve.

The Maintenance Switch on the Module causes the Flush Valve to open, also to operate a Vacuum Blower for 10 seconds. Goes back to normal when you push the Flush Switch again.

Waste Tank Point Level Sensor

Sends a Signal to the LCM when the Waste Tank is Full.

Six Sensors, two for each Waste Tank.

Waste Tank Continuous Level Sensor

Calculates the Amount of Waste in the Tanks. This Data is only for Indications that shows on the Cabin Area Control Panels (CACP) and Cabin System Control Panel (CSCP).

There is one Sensor for each Waste Tank.

Use the LCM to do an Zero Adjustment when you install a new Continuous Level Sensor.

Test the Sensor with the LCM or with an All Test through the Cabin Management System (CMS).

Logic Control Module

Does not let the Vacuum Waste System operate for the Lavatories connected to a Waste Tank that is full.

One for each Tank.

Has a BITE for Itself, the Point Level Sensors and the Continuous Level Sensor.

Tank Full Light turns on if :

- The two Point Level Sensors detect the Tank is Full
- The two Point Level Sensors Fail
- One Point Level Sensor Fails or is fouled and the other Sensor detects the Tank is Full
- The Continuous Level Sensor detects the Tank almost Full.

The Ground Service Bus or the Left Main Bus must have Power for the LCM to operate.



Water & Waste

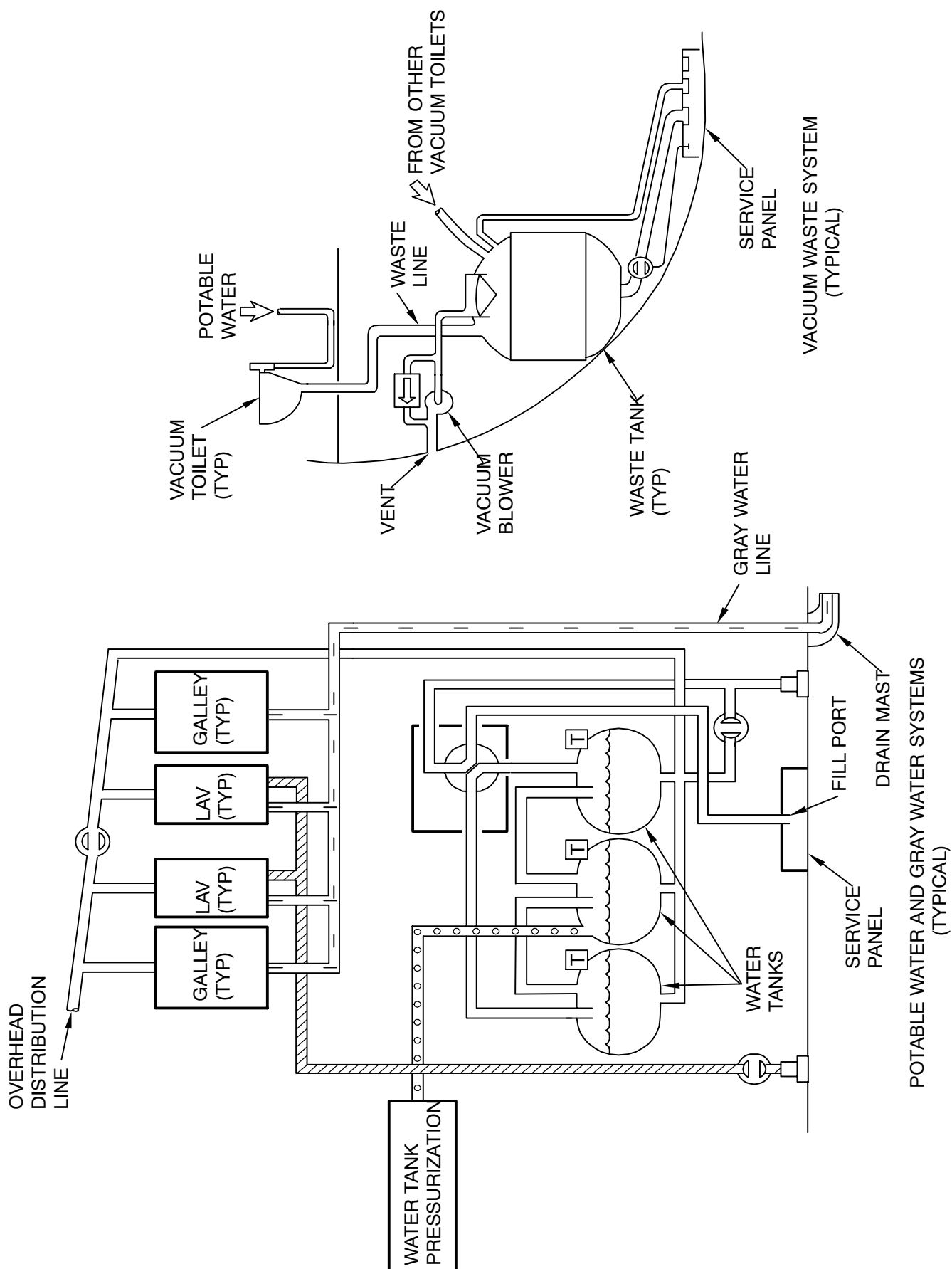


Figure 16 Water & Waste Schematic



ATA AUXILIARY POWER UNIT

Auxiliary Power Unit



Figure 17 APU



Auxiliary Power Unit

Protective Shutdowns

Low Oil Pressure, loss of Oil Pressure Input or High Oil Temperature will cause the APUC to do a Protective Shutdown when the APU is in the Unattended Mode.

Fuel System

Contains the APU Fuel Control and other Fuel System Components.

Contains the Fuel Pumps and some Internal Pressure Regulating Valves.

Supplies Pressurized and Metered Fuel for Combustion and to operate the IGV and SCV Actuators.

Ignition System

APUC controls the Ignition System.

Start System:

- Two Starter Motors. One Pneumatic and one Electric. They are on the Front of the APU.
- The APUC controls both Start Systems and automatically selects between the Starters.

The APUC turns on the Ignitor Plugs at 7 Percent APU RPM during APU Stat. The APUC turns the Plugs Off at 50 Percent APU RPM.

The APUC also turns the Ignitor Plugs On if the APU RPM goes below 95 Percent RPM during APU Operation (SPEED DROOP).

Starter System

You can try three APU Starts in a 60 Minute Period with the Electrical Starter Motor.

There is no Limit to the number of APU Starts you may try with the Air Turbine Starter.

Pneumatic Start

The APUC energizes the Solenoid Valve on the ATSCV. This opens the Starter Control Valve and Pressure Regulated Air flows to the Air Starter and turns the APU.

At seven percent RPM the APUC energizes the Ignition Unit. The Ignition turns OFF at 50% RPM.

At 55 % RPM the APUC removes Power from the ATSCV Solenoid Valve to Shutoff the Air Turbine Starter.

Electric Start

The APUC sends a Signal to ELMS. This supplies 28 V DC Power to the Electric Starter. At 49 % RPM the APUC removes Power from the Electric Starter.

Autostart

The APU will Start Automatically for these Conditions:

- Airplane is in Air
- Power removed from both Transfer Buses

The ELMS contains the APU Autostart Logic and sends the Start Signal to the APUC.

The Ram Air Turbine will Automatically Extend during an APU Autostart

Inlet Guide Vanes (IGV's)

Control the Air Flow to the Load Compressor and thus control APU Air Output.

Inlet Guide Vane Actuator

Uses High Pressure Fuel to operate the IGV.

APUC controls.

An internal LVDT sends Actuator Position to the APUC.



Auxiliary Power Unit

APU Check Valve

Prevents Pneumatic System Flow from turning the APU Load Compressor into Reverse.

Is springloaded Closed and opened by Airflow from the Load Compressor.

Surge Control Valve

Releases Pneumatic Pressure from the Load Compressor. This keeps a minimum Flow of Air through the Load Compressor to prevent Compressor Surge.

The APUC controls a torque Motor on the Seervo Valve. This Motor controls High Pressure Fuel from the APU Fuel System to open or close the Surge Control Valve.

Pressure Sensors

Inlet Pressure Sensor (P2) measures Ambient Pressure of the Load Compressor.

Total Pressure Sensor (PT) measures Load Compressor Discharge Pressure.

A Differential Pressure sensor (DP) measures the difference between the Total Pressure and the Static Pressure in the Diffuser (Differential Pressure Equals Total Pressure minus Static Pressure).

The APUC uses PT and DP to calculate Load Compressor Airflow to operate the Surge Control Valve.

EGT Indicating System

Supplies APU Exhaust Gas Temperature Data for Flight Deck Indication and APU Control.

Four Probes Grouped in two Rakes.

Loss of Input from one Rake does not cause the loss of EGT Indication. Loss of Input from both Rakes causes loss of Indication. EGT Overtemperature or loss of EGT from both Rakes causes an APU Protective Shutdown in the Unattended Mode.

APU EGT shows on the MFD Status Display and the APU Maintenance Page.

Data Memory Module

Keeps this Data in Nonvolatile Memory:

- APU Serial Number
- APU Operating Hours
- Number of APU Starts
- Start Data
- Shutdown Data
- Pneumatic system Operating Mode
- APU Turbine Life Used
- APU Health Data

The APUC reads the DMM Memory during the APU Start Sequence and transmits updated Information to the DMM during APU Shutdown.

APU Generator

Is a secondary source of Electrical Power for the Airplane System. It can supply 120 kva of AC Electrical Power when the Airplane is on the Ground or during Flight.

APU Maintenance Switch

Supplies Power to the APUC when the APU Selector is OFF. This permits the APUC to show APU Indications on the Status or Maintenance Page Formats.

Auxiliary Power Unit

APU Control System

Uses an APU Controller in these eight Operating Modes:

- Starting or Ignition
- Surge Control
- Fuel Metering
- Inlet Guide Vane (IGV) Control
- Data Storage
- Protective Shutdown
- BITE / Fault Reporting
- APU Indication

APU Controller

The APUC operates in these eight Operating Modes:

- Test Mode (APUC doing Power Up Test)
- IDLE Mode (APUC powered and APU is not On)
- Start / Air Mode (APU is doing an Air Start)
- Start / Electric Mode (APU is doing an Electric Start)
- Onspeed Mode (APU RPM is more than 95 %)
- Coldown Mode (API is in the Coldown Mode)
- Shutdown Mode (APU RPM is less than 15 % during APU Shutdown)
- AUTO Shutdown Mode (the APUC is doing an APU Protective Shutdown)

The APUC is on the E7 Rack above the aft Galley

Speed Sensors

Two Speed Sensors measure APU Shaft Speed and supply the Data to the APUC for Control and Display Functions.

The APUC selects the higher of the two Signals for Control and Display Functions.

APU Engine RPM shows on the Status Display and the Maintenance Page.

Inlet Temperature Sensor

Supplies Inlet Air Temperature Data (T2) . The APUC uses this Data for these Functions:

- Fuel Control
- IGV Control
- SCV Control
- Turbine Inlet Temperature Calculation

APU Oil Heater System

Uses 115 V AC Electric Resistive Heaters to heat the Gearbox and Midframe Bearings.

Operates continuously when the Ground service Bus has Power.

APU Oil Indicating System

Supplies APU Oil Temperature, Pressure and Quantity Data for APU Flight Deck Display and APU Control Functions.

Components:

- Oil Pressure Sensor
- Low Oil Pressure Switch
- Oil Temperature Sensor
- Oil Quantity / Sump Temperature Sensor

Data shows on Status and Maintenance Page.



Auxiliary Power Unit

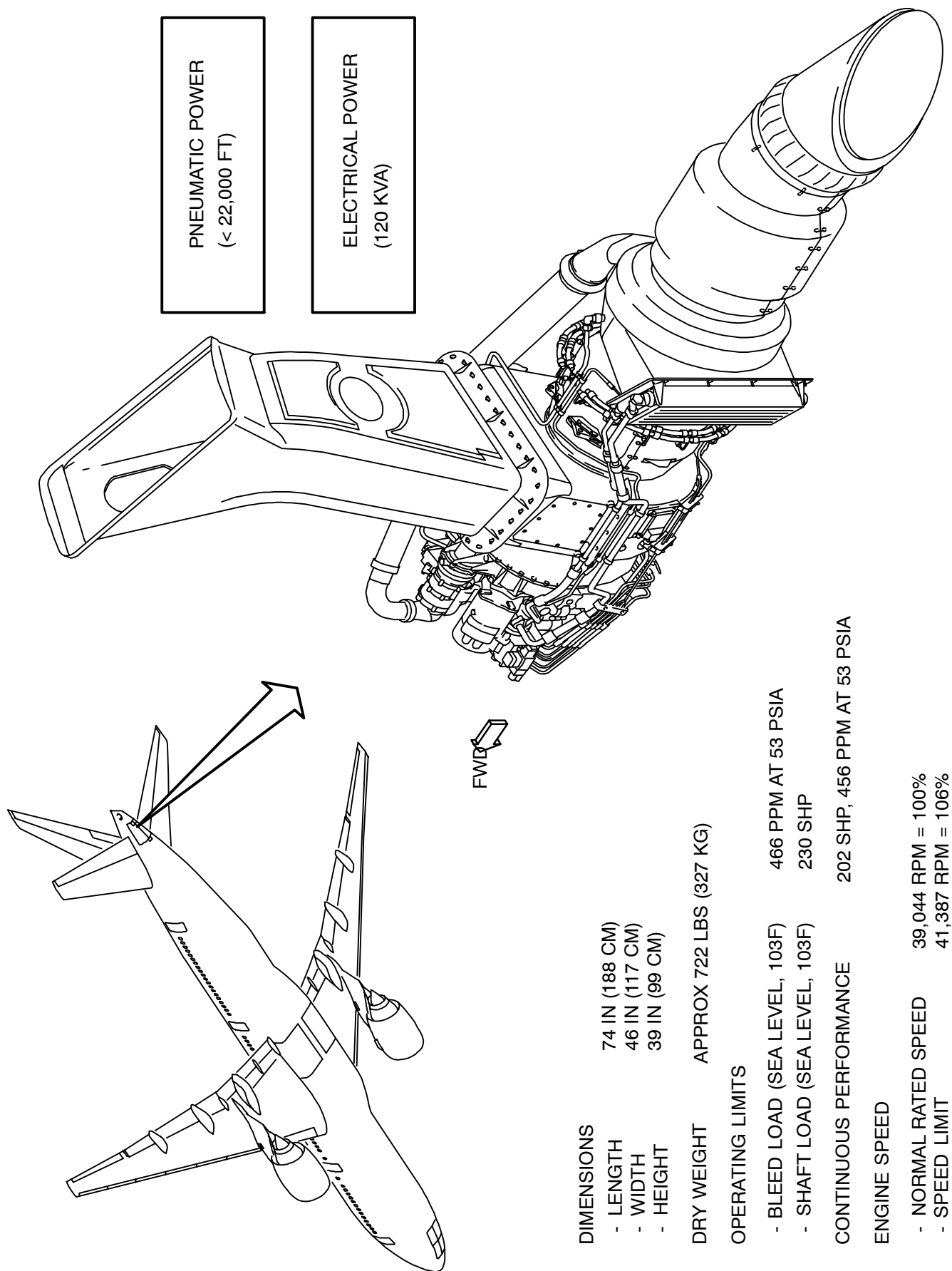


Figure 18 APU General



ATA DOORS

Doors



Figure 19 Entry Door



Programming Mechanism Chain

Has these Functions :

Correctly align the Door to the Airplane, as the Door Opens and Closes.

Lets the Door Emergency Power Assist System (EPAS) open the Door in Emergencies.

Vent Door Mechanism

Releases Pressurization to prevent Damage when the Passenger Door Opens.

Will not let the Passenger Entry Door Unlatch if Differential Pressurization is above 0,21 PSI.

Info ! Do a check of the Vent Door Mechanism if you cannot move the Door Handle to the close Position when you try to close the Door.

Flight Lock Mechanism

Locks the Door Latch Mechanism closed when the Airplane Airspeed is 80 Kts or more. ADIRU and SAARU supply the Airspeed Signal.

Emergency Power Assist System (EPAS)

Supplies mechanical Power to open the Passenger Entry Door in Emergencies.

A Safety Switch on the Battery Packs lets you stop the EPAS Operation when you do Door Maintenance. You cannot close the Hinge Cover when the Switch is in the Safe Position.

A Test Switch and a red Indicator Light on the bottom of the Battery let you do a Test of the Battery.

External Door Operation

Pull the Handle outboard. This will move the Mode Select Handle to the Disarm Position. Turn the Handle. The Vent Door should open as you start to turn the Handle. The External Handle will stay in the extended Position while the Door is open.

Internal Door Open Operation

Move the Mode Select Lever to the Disarm Position. The Yellow Indicator Flags should not be visible.

Cargo Handling System Reset

Manually put all Components affected to the Load Position. Set the System Control to Containers. Set The system Power to OFF and then back to ON. Use the Stop/Lock - Lock/Unlock Switch to move the center Stop/Locks from lock to load. The System is now Reseted.

If you manually lower a lateral Guide, you must manually release it before it will operate electrically.

Doors

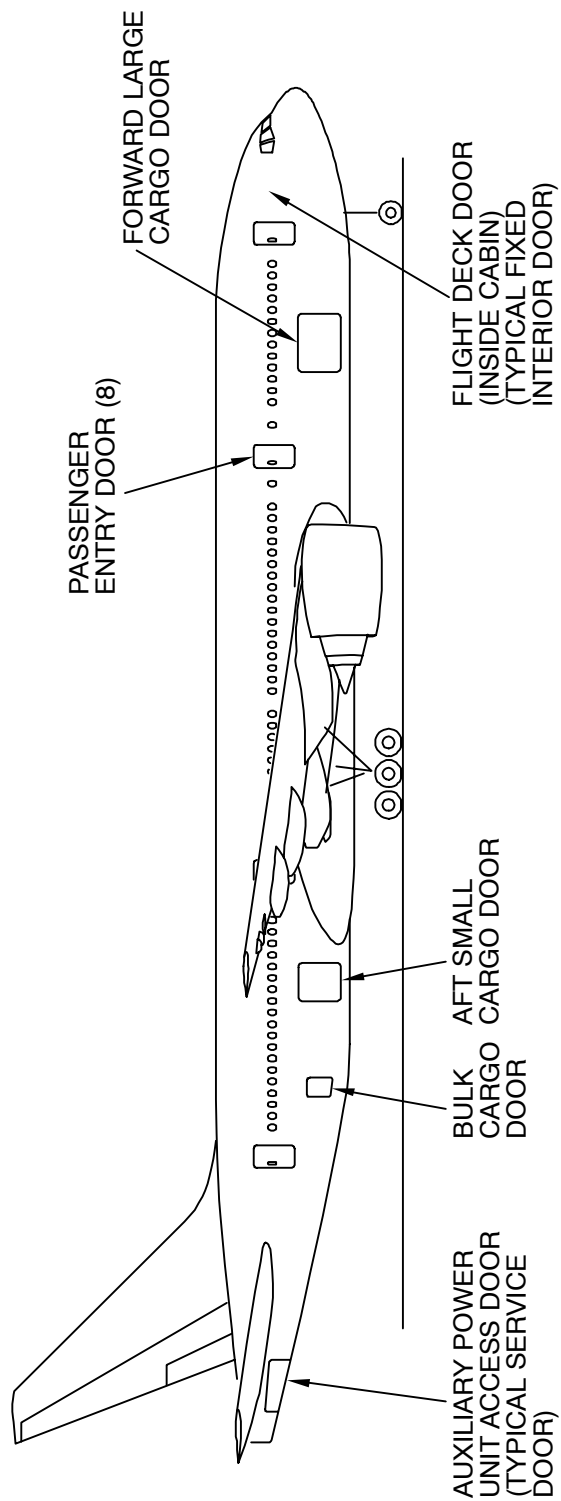


Figure 20 Doors General



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