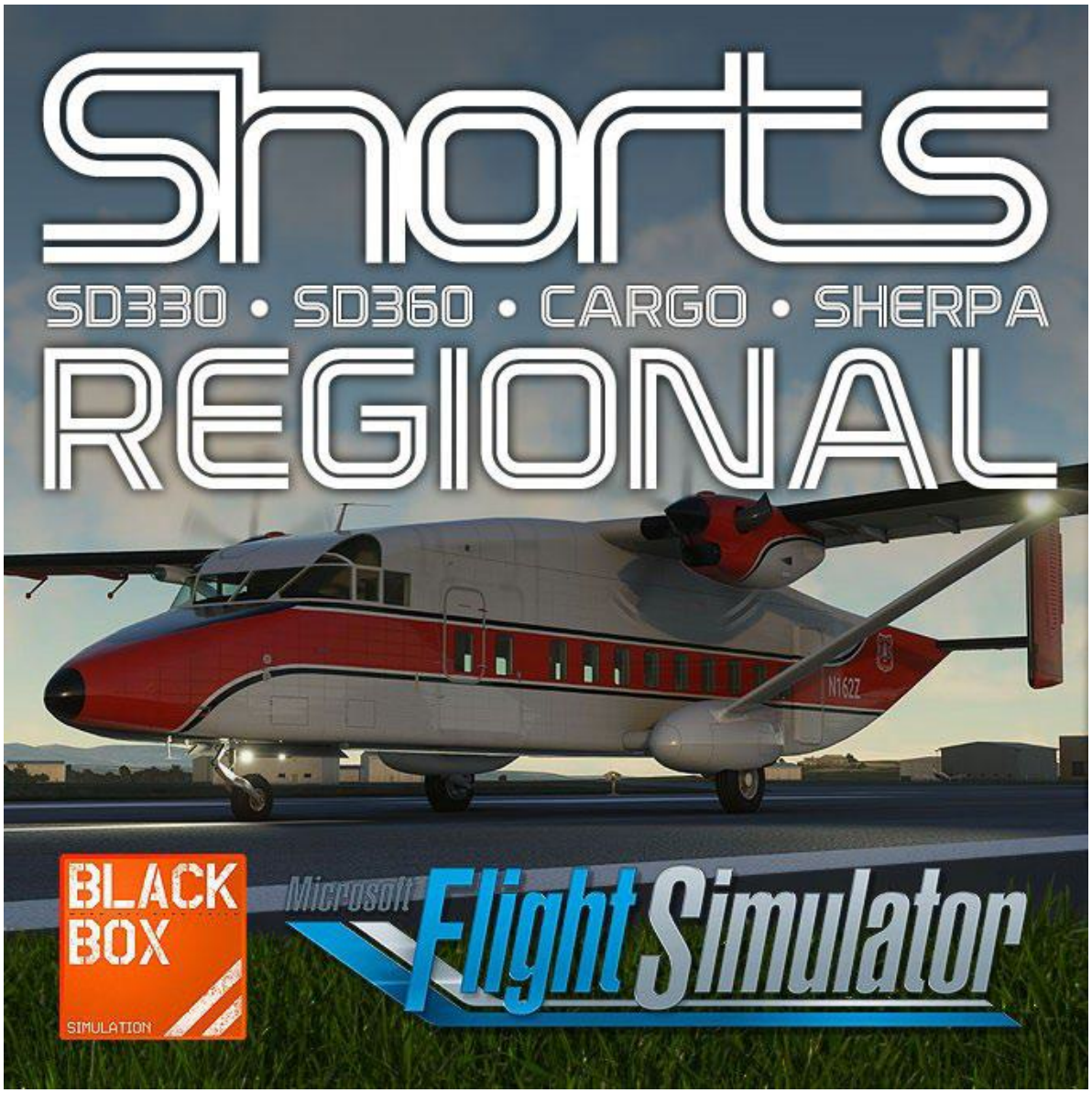


www.blackboxsimulation.com

CONTENTS

CHAPTER THREE

lighting

CHAPTER FOUR

Master Warning System

CHAPTER FIVE

Fuel System

CHAPTER SIX

Powerplant

CHAPTER SEVEN
Fire Protection

CHAPTER EIGHT
Ice and Rain Protection

CHAPTER NINE
Air Conditioning

CHAPTER TEN
Hydraulic Power Systems

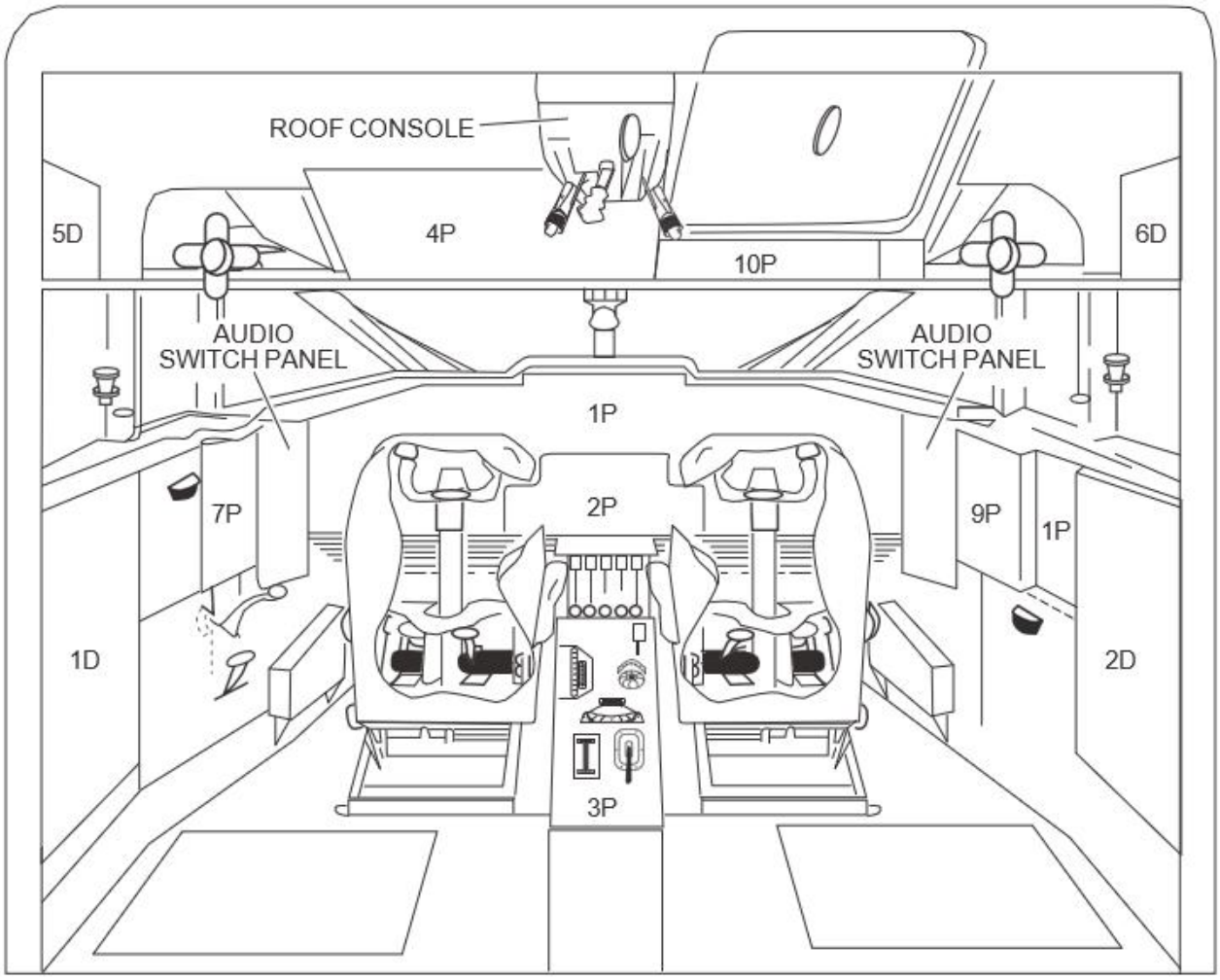
CHAPTER ELEVEN

Flight Controls

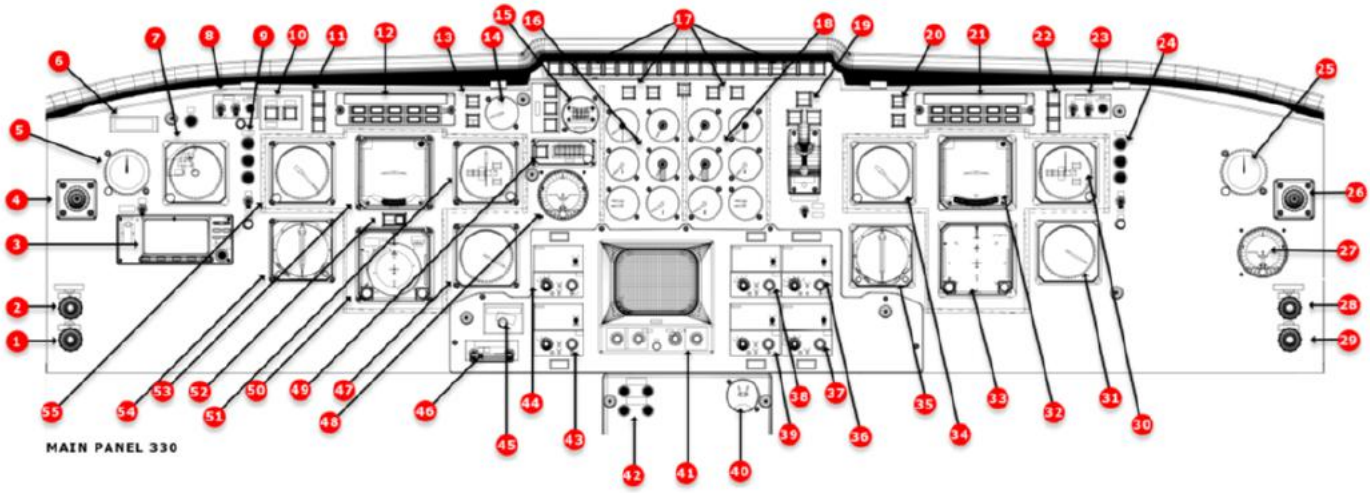
CHAPTER TWELVE

Avionics

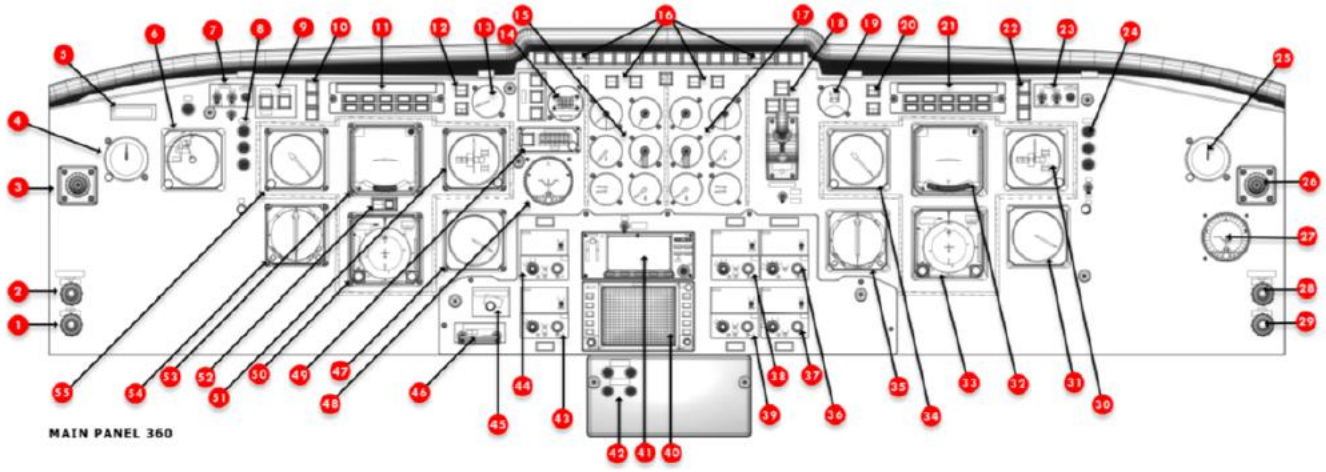
COCKPIT LAYOUT DIAGRAMS



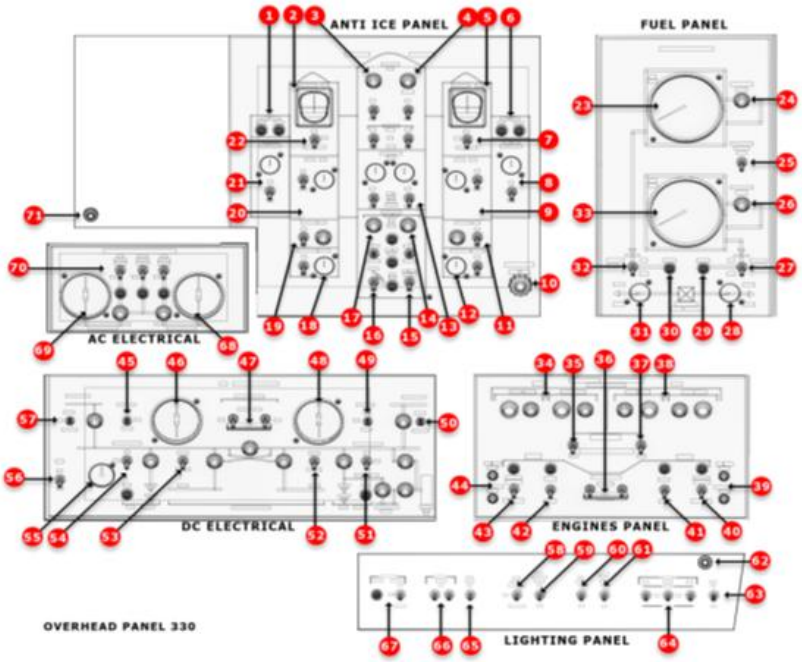
PANEL IDENTIFICATION	DESCRIPTION/FUNCTION	PANEL IDENTIFICATION	DESCRIPTION/FUNCTION
1P	Main Instrument Panel	9P	AIR CONDITIONING Services
2P	Avionics Panel	10P	LIGHTS
3P	Center Console	11P	DOORS Position Indication
4P	ELECTRICS		and SYSTEMS TEST
	ANTI-ICING	1D	AC & DC DISTRIBUTION (left)
	FUEL and	2D	AC & DC DISTRIBUTION (right)
	ENGINE Services	5D	Avionics C/B Panel (left)
7P	HYDRAULIC Services	6D	Avionics C/B Panel (right)



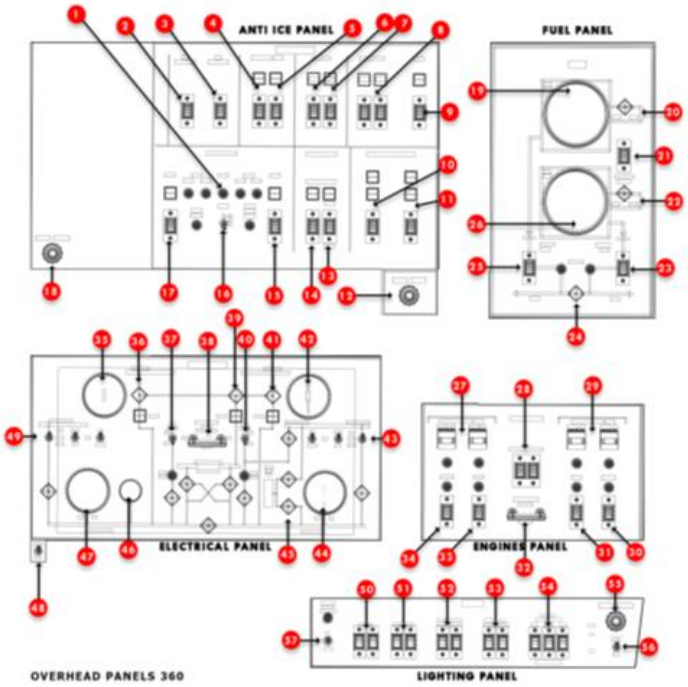
1.	Captains Panel Lights Damper	15.	Fuel Totalizer	29.	1st officers Panel Lights Damper	43.	NAV 1 Controller
2.	Captains Instrument Light Damper	16.	Left Hand Engine Indicators	30.	1st officers Altimeter	44.	COM 1 VHF Controller
3.	Garmin GPS 400	17.	Centralized Warning Panel	31.	1st officers Vertical Speed Indicator	45.	Avionics Dimmer Switch
4.	Captains Gasper Vent	18.	Right Hand Engine Indicators	32.	1st officers Flight Director ADI	46.	Avionics Master Switch
5.	Captains Stopwatch	19.	Landing Gear Indicators	33.	1st officers Horizontal Situation Indicator	47.	Captains Vertical Speed Indicator
6.	Tail Number	20.	1st Officers Autopilot Annunciator/Transfer	34.	1st officers Airspeed Indicator	48.	Captains Standby Attitude Gyro
7.	Radar Altimeter	21.	1st Officers Flight Director Mode/Annunciator	35.	1st officers Radio Magnetic Indicator	49.	Assigned Altitude Indicator
8.	Captains Wiper Controls	22.	1st Officers Ground Proximity Warning Indicator	36.	Transponder Controller	50.	Captains Horizontal Situation Indicator
9.	Captains Marker Beacon Lights	23.	1st Officers Wiper Controls	37.	ADF 1 Controller	51.	Captains Altimeter
10.	Ground Proximity Warning System	24.	1st officers Marker Beacon Lights	38.	COM 2 VHF Controller	52.	NAV/GPS Switch
11.	Captains Ground Proximity Warning Indicator	25.	1st Officers Stopwatch	39.	NAV 2 Controller	53.	Captains Flight Director ADI
12.	Captains Flight Director Mode/Annunciator	26.	1st Officers Gasper Vent	40.	Flap Indicators	54.	Captains Vertical Speed Indicator
13.	Captains Autopilot Annunciator/Transfer	27.	1st Officers Standby Attitude Gyro	41.	Weather Radar	55.	Captains Airspeed Indicator
14.	Outside Air Temperature Indicator	28.	1st officers Instrument Light Damper	42.	Reverse/Fine Pitch Indicators		



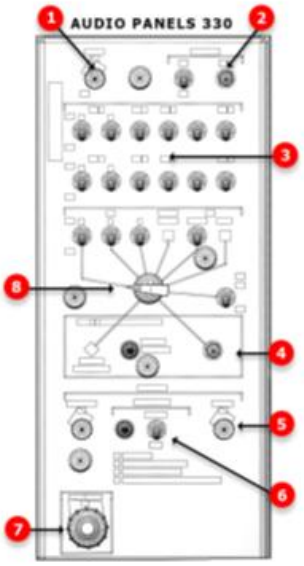
1.	Captains Panel Lights Dimmer	15.	Left Hand Engine Indicators	29.	1st officers Panel Lights Dimmer	43.	NAV 1 Controller
2.	Captains Instrument Light Dimmer	16.	Centralized Warning Panel	30.	1st officers Altimeter	44.	COM 1 VHF Controller
3.	Captains Gasper Vent	17.	Right Hand Engine Indicators	31.	1st officers Vertical Speed Indicator	45.	Avionics Dimmer Switch
4.	Captains Stopwatch	18.	Landing Gear Indicators	32.	1st officers Flight Director ADI	46.	Avionics Master Switch
5.	Tail Number	19.	Flap Indicator	33.	1st officers Horizontal Situation Indicator	47.	Captains Vertical Speed Indicator
6.	Radar Altimeter	20.	1st Officers Autopilot Annunciator/Transfer	34.	1st officers Airspeed Indicator	48.	Captains Standby Attitude Gyro
7.	Captains Wiper Controls	21.	1st Officers Flight Director Mode/Annunciator	35.	1st officers Radio Magnetic Indicator	49.	Assigned Altitude Indicator
8.	Captains Marker Beacon Lights	22.	1st Officers Ground Proximity Warning Indicator	36.	Transponder Controller	50.	Captains Horizontal Situation Indicator
9.	Ground Proximity Warning System	23.	1st Officers Wiper Controls	37.	ADF 1 Controller	51.	Captains Altimeter
10.	Captains Ground Proximity Warning Indicator	24.	1st officers Marker Beacon Lights	38.	COM 2 VHF Controller	52.	NAV/GPS Switch
11.	Captains Flight Director Mode/Annunciator	25.	1st Officers Stopwatch	39.	NAV 2 Controller	53.	Captains Flight Director ADI
12.	Captains Autopilot Annunciator/Transfer	26.	1st Officers Gasper Vent	40.	Weather Radar	54.	Captains Radio Magnetic Indicator
13.	Outside Air Temperature Indicator	27.	1st Officers Standby Attitude Gyro	41.	Garmin GPS400	55.	Captains Airspeed Indicator
14.	Fuel Totalizer	28.	1st officers Instrument Light Dimmer	42.	Reverse/Fine Pitch Indicators		



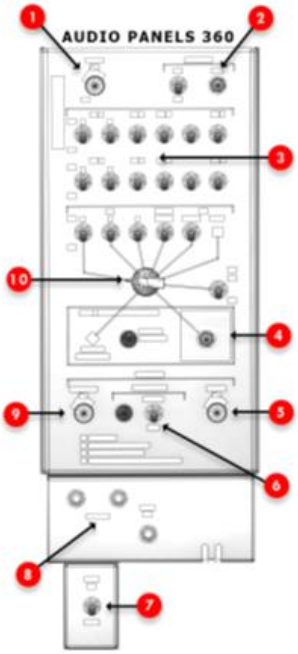
1	Left Hand Wing boot indicators	19	Left Hand Anti Ice Vane Control	37	ENG 2 Reserve Power Switch	55	Battery Voltmeter		
2	Left Hand Propeller Heater Ammeter	20	Left Hand Stall Wing Vane Heater Control	38	End 2 Fire Extinguisher Controls	56	Captains Fan Switch		
3	Captains Windscreen Heater Switch	21	Left Hand Stall Wing Vane Heater Control	39	Eng 2 Governor L.B.A Test Indicators	57	Left Shedding Bus Switch		
4	1st Officers Windscreen Heater Switch	22	Left Hand Emergency Propeller Heater	40	Eng 2 Ignition Switch	58	NAV Lights Switch		
5	Right Hand Propeller Heater Ammeter	23	FWD Fuel Tank Totalizer	41	Eng 2 Start Switch	59	Anti-Collision Beacon Switch		
6	Right Hand Wing boot indicators	24	FWD Fuel Tank Levelling Valve Indicator	42	Eng 1 Start Switch	60	No Smoking Sign Switch		
7	Right Hand Emergency Propeller Heater Switch	25	Levelling Valve Switch	43	Eng 1 Ignition Switch	61	Fasten Seat Belts Sign Switch		
8	Right Hand Stall Wing Vane Heater Control	26	AFT Fuel Tank Levelling Valve Indicator	44	Eng 1 Governor L.B.A Test Indicators	62	1st Officers Flood Light Adjuster		
9	Right Hand Stall Wing Vane Heater Control	27	AFT Booster Pump Switch	45	Left Generator Switch	63	1st Officers Fan Switch		
10	Panel Light Adjuster	28	Eng 2 Fuel Temp Gauge	46	Left DC Volt/Ammeter	64	Flood Light Switches		
11	Right Hand Anti Ice Vane Control	29	Eng 2 Fuel Filter Indicator	47	Internal/External Power Switch	65	Taxi Light Switch		
12	Right Hand Component Heater	30	Eng 1 Fuel Filter Indicator	48	Right DC Volt/Ammeter	66	Landing Light Switch		
13	Right Hand Pitot Heater Switch	31	Eng 1 Fuel Temp Gauge	49	Right Generator Switch	67	Emergency Light Switch		
14	Right Hand Duct Low Pressure Indicator	32	FWD Booster Pump Switch	50	Right Shedding Bus Switch	68	Right AC Bus Volt/Ammeter		
15	Ice Spot Light Switch	33	AFD Fuel Tank Totalizer	51	Right Battery Switch	69	Left AC Bus Volt/Ammeter		
16	De-Icer Timer Switch	34	End 1 Fire Extinguisher Controls	52	Right ESS Service Bus Switch	70	AC Control Switches		
17	Left Hand Duct Low Pressure Indicator	35	ENG 1 Reserve Power Switch	53	Left ESS Service Bus Switch	71	Captains Flood Light Adjuster		
18	Left Hand Component Heater	36	Start Master Switch	54	Left Battery Switch				



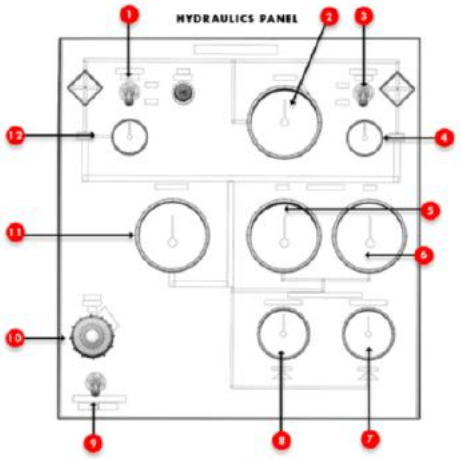
1	Wing And Tail Anti Ice Indicators	19	FWD Fuel Tank Totalizer	37	Left Battery Switch	55	Battery Voltmeter
2	Ice Spot Light Switch	20	FWD Fuel Tank Levelling Valve Indicator	38	Internal/External Power Switch	56	1st Officers Flood Light Adjuster
3	Ice Detector Switch	21	Levelling Valve Switch	39	Standby Inverter Controls		
4	No1 Inertial Separator Switch	22	AFT Fuel Tank Levelling Valve Indicator	40	Right Battery Switch		
5	No2 Inertial Separator Switch	23	AFT Booster Pump Switch	41	Right AC Bus Indicator		
6	No1 Anti Ice Switch	24	Fuel Clog Cross feed Indicator	42	Right DC Volt/Ammeter		
7	No2 Anti Ice Switch	25	FWD Booster Pump Switch	43	Right Shedding Bus Switch		
8	Propeller Anti Ace Selector	26	AFT Fuel Tank Totalizer	44	Right DC Volt/Ammeter		
9	Engine Anti Ice Switch	27	End 1 Fire Extinguisher Controls	45	External DC Power Indicator		
10	Left Pitot Static Controls	28	ENG Reserve Power Switches	46	Tail Battery Voltmeter		
11	Right Pitot Static Controls	29	End 2 Fire Extinguisher Controls	47	Left DC Volt/Ammeter		
12	Panel Light Dimmer	30	Eng 2 Ignition Switch	48	Captains Fan Switch		
13	1st Officer Windshield De-Ice Switch	31	Eng 2 Start Switch	49	Left Shedding Bus Switch		
14	Captains Windshield De-Ice Switch	32	Start Master Switch	50	Landing Light Switches		
15	No2 Engine Air Bleed Switch	33	Eng 1 Start Switch	51	Taxi/Nav Light Switches		
16	De-Icer Timer Switch	34	Eng 1 Ignition Switch	52	Anti-Col/Beacon Switches		
17	No1 Engine Air Bleed Switch	35	Left AC Bus Volt/Ammeter	53	Seat Belts/No Smoking Lights		
18	Captains Flood Light Dimmer	36	Left AC Bus Indicator	54	Emergency Light Switches		



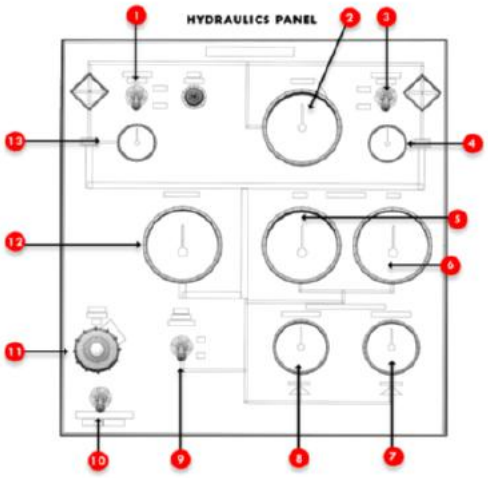
1 Speaker Volume
2 Attendant Call Button
3 Channel Audo Switches
4 Emergency Battery Discharge
5 Avionics Volume
6 Standby Radio Switch
7 Side Panel Light Adjuster
8 Audio Selector



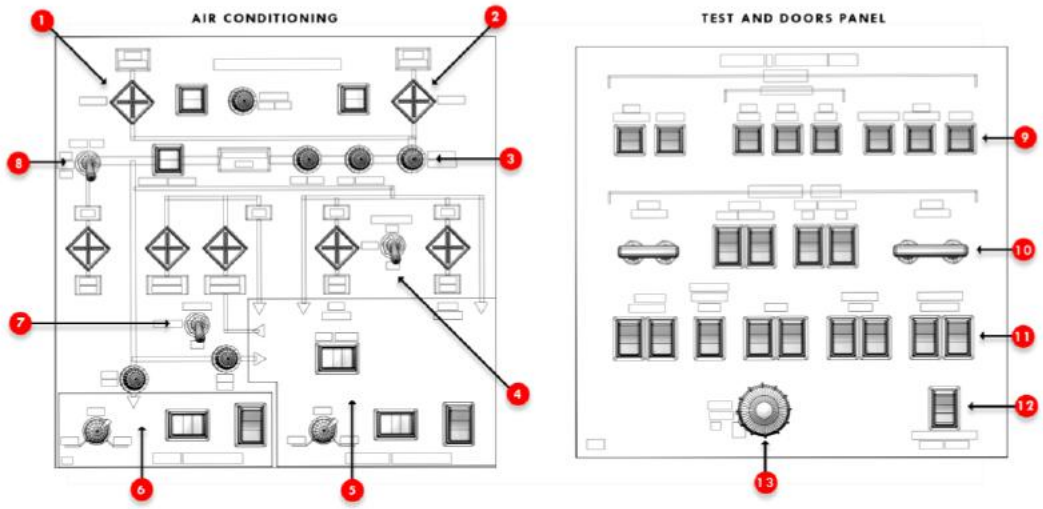
1 Speaker Volume
2 Attendant Call Button
3 Channel Audio Switches
4 Emergency Battery Discharge
5 Avionics Volume
6 Standby Radio Switch
7 Boom Mic/Mask Toggle Switch
8 Headset and Mic sockets
9 Interphone Volume
10 Audio Selector



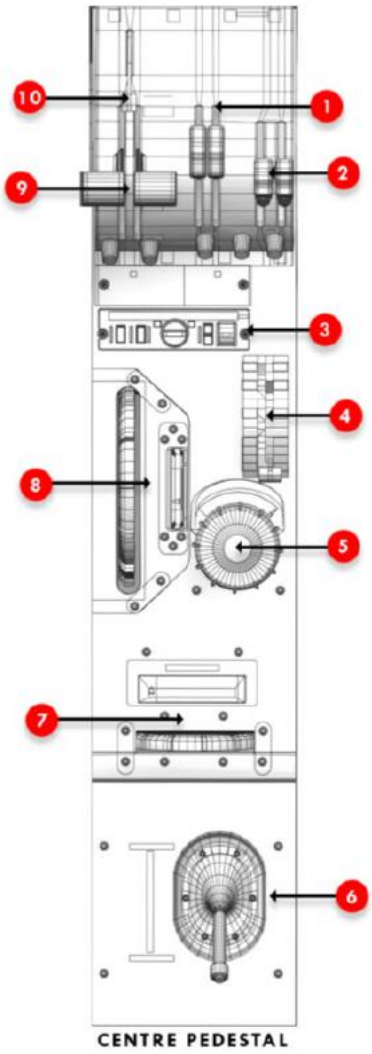
1. Left Pump Inlet Valve Switch
2. Hydraulic Reservoir Contents
3. Right Pump Inlet Valve Switch
4. Right Hydraulic Pump Temp
5. Left Brake Pressure
6. Right Brake Pressure
7. Left Emergency Brake Pressure
8. Right Emergency Brake Pressure
9. Circuit Breaker Light
10. Panel Dimmer Switch
11. Nose Wheel Steering Pressure
12. Left Hydraulic Pump Temp



1. Left Pump Inlet Valve Switch
2. Hydraulic Reservoir Contents
3. Right Pump Inlet Valve Switch
4. Right Hydraulic Pump Temp
5. Left Brake Pressure
6. Right Brake Pressure
7. Left Emergency Brake Pressure
8. Right Emergency Brake Pressure
9. Nose Wheel Steering Switch
10. Circuit Breaker Light
11. Panel Dimmer Switch
12. Nose Wheel Steering Pressure
13. Left Hydraulic Pump Temp

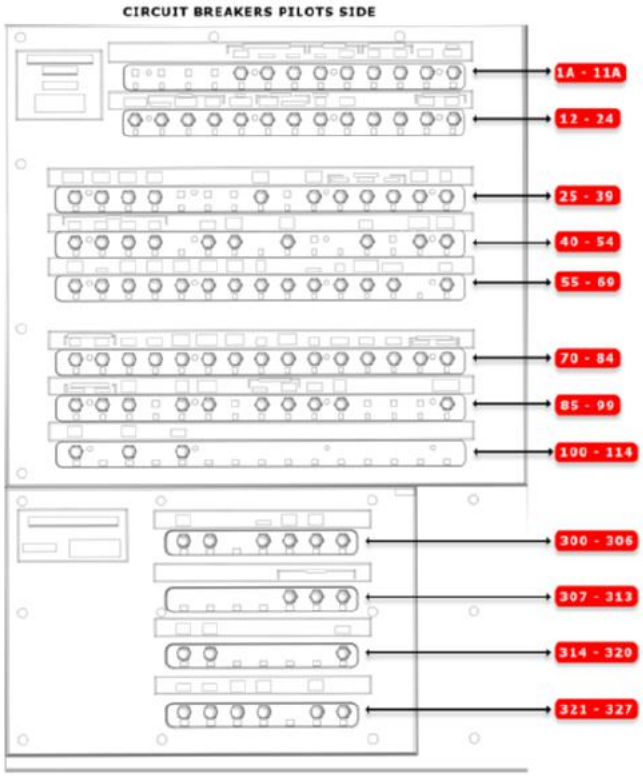


1.	Left Engine AC Indicator	**8**	Main Fan Selector	**12**	Circuit Breaker Light Selector
2.	Right Engine AC Indicator	**7**	Ground Air Recirculation Switch	**13**	Panel Lights Dimmer
3.	Low Duct Pressure Indicator	**9**	Door Indicators		
4.	Gasper Fans Controller	**10**	Auto Feather/Smoke/Light/Fire Test Switches		
5.	Passenger Compartment AC Control	**11**	Stall/O`Speed/LBA/Power /Governor Test switches		



1 Propeller
2 Hydraulic Reservoir Contents
3 Engine Condition
4 Flap Selector
5 Rudder Trim
6 Control Lock
7 Aileron Trim
8 Elevator Trim
9 Throttle
10 Air Ground Lever

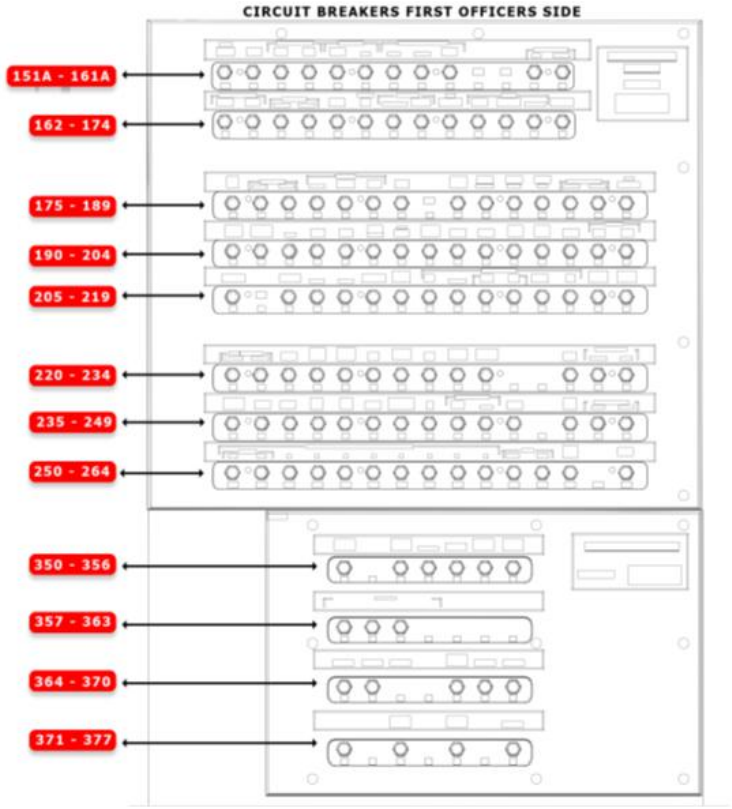
CIRCUIT BREAKER DIAGRAMS



1A	Unused	**12**	DC Transfer	**25**	Right Inverter Indication	**40**	Lights - Roof Panels
1	Unused	**13**	Fuel - Contents	**26**	Doors Warning	**41**	Lights - Side Panels
2	Unused	**14**	Fuel - Filter Warning	**27**	High Speed Warning	**42**	Lights - Flight Director
3	Unused	**15**	Fuel - Flow Meter	**28**	Stall Wing Stick Shaker	**43**	Lights - 1D Panel
4	Gen -Trip/Reset	**16**	Low Fuel/Oil Pressure	**29**	Unused	**44**	Unused
5	Gen - Services	**17**	Eng Fire - Warn/Test	**30**	Unused	**45**	Smoke Detector FWD
6	Gen - Field	**18**	Eng Fire - Extinguish	**31**	Unused	**46**	Right Rain Repellant
7	Prop - Heat	**19**	Pitch Ind & LBA Stop	**32**	Flight data Recorder	**47**	Unused
8	Prop - heat Control	**20**	Auto Feather	**33**	Unused	**48**	Left Gyro Compass
9	Eng Fire - Left Shot 1	**21**	Unused	**34**	Nose Wheel Steering	**49**	Unused
10	Eng Fire - Right Shot 2	**22**	Unused	**35**	Hyds - Press Wings	**50**	Unused
11	Eng - Ignition	**23**	Eng Air Int - Heat Control	**36**	Hyds - Contents	**51**	Propeller Tachometer
11A	Eng - Air Intake Heater	**24**	Eng Air Int - Anti-Ice Vane	**37**	hyds - Control	**52**	Unused
				38	Landing Gear Warning	**53**	Essential Services Bus Bar Indication
				39	Windshield Wiper	**54**	Hydraulic Pressure Indication

55	Outside Air Temparature	**70**	Flight Comp Emergency Lights - Left Flood	**85**	Windshield Heaing - Control	**100**	Hydraulic Fluid Overheat
56	Inter Turbine Temperature	**71**	Flight Comp Emergency Lights - Centre Flood	**86**	Windshield Heaing - Heater	**101**	Unused
57	Flight Director No1 HIS	**72**	Console Flood	**87**	Boot Valve Heater	**102**	Oil Temp Pressure
58	No1 Flight Director	**73**	Landing Light	**88**	Unused	**103**	Unused
59	Warning Light Test	**74**	Landing/Taxi Light Control	**89**	Ice Spotlight	**104**	Reserve Power
60	Overspeed Governor Test	**75**	1st Pilots Fam and Map Light	**90**	Air Conditioning Control	**105**	Unused
61	Tail Battery Charge	**76**	Avionic Busbar Control	**91**	Unused	**106**	Unused
62	Anti Icing Vane	**77**	Hydraulic Temp	**92**	Stall Warning - Heater	**107**	Unused
63	Unused	**78**	Engine Fuel Blow Down	**93**	Stall Warning - Horn and Heater	**108**	Unused
64	Audio	**79**	Ferry Fuel	**94**	Pneumatic De-Icing	**109**	Unused
65	No1 VHF	**80**	Right Taxi Light	**95**	Air Intake Indication	**110**	Unused
66	Passenger Emergency Light Supply	**81**	Low Fuel FWD	**96**	Unused	**111**	Unused
67	ELT Indication	**82**	Prop Synch	**97**	Unused	**112**	Unused
68	Unused	**83**	Left Inverter - Supply	**98**	Unused	**113**	Unused
69	Battery Indication	**84**	Left Inverter - Control	**99**	Shedding Busbar Indication	**114**	Unused

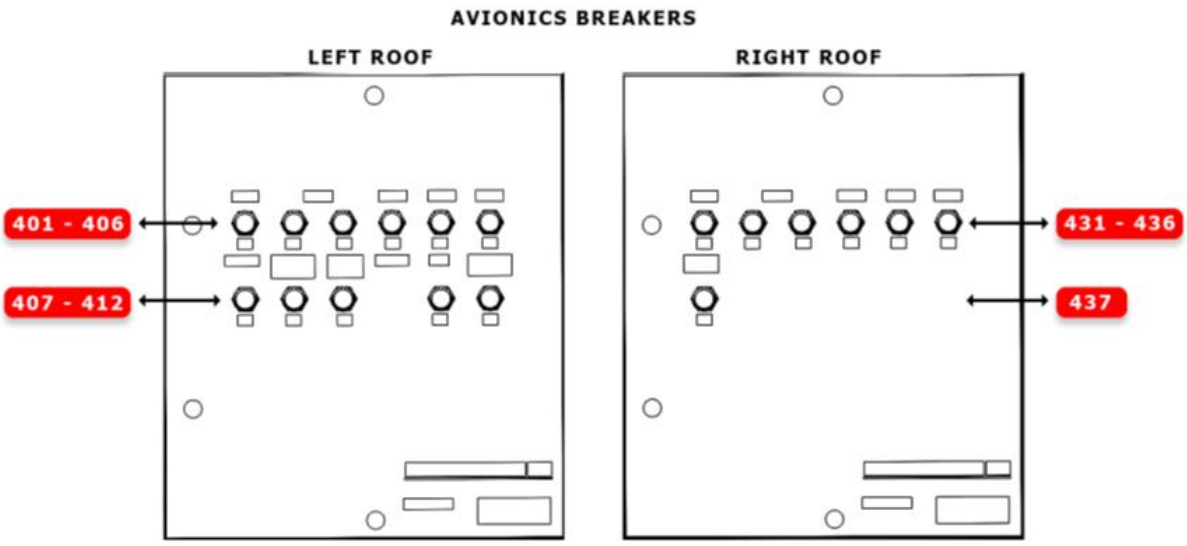
300	Flight Director Display	**307**	Unused	**314**	Ground Proximity Warning	**321**	Panel Lights
301	Unused	**308**	Unused	**315**	Flight Data Recorder	**322**	Weather Radar
302	Unused	**309**	Unused	**316**	Unused	**323**	Standby Altitude Gyro No2
303	Torque	**310**	Unused	**317**	Unused	**324**	Flight Director V/Gyro
304	Flight Director Display	**311**	Panel Lights	**318**	Unused	**325**	Unused
305	Normal Supply NAV 1	**312**	Panel Lights	**319**	Unused	**326**	Volt Frequency Meter
306	Unused	**313**	Panel Lights	**320**	Booster Pump	**327**	Unused



219	Battery Indication	**234**	Right Inverter - Control	**249**	Busbar Shed Indication	**264**	Exit Signs - FWD
218	Unused	**233**	Right Inverter - Supply	**248**	Strobes	**263**	Exit Signs - AFT
217	Right Flood Lights	**232**	Low Fuel Aft	**247**	Reserve Power	**262**	Passenger Emergency Lighting - B1
216	VHF 2	**231**	FWD Floor Lighting	**246**	Left Rain Repellent	**261**	Passenger Emergency Lighting - A1
215	Audio	**230**	Overspeed Governor Test	**245**	Air Intake Indication	**260**	Passenger Emergency Lighting - A3
214	Boarding Lights	**229**	Anti-Icing Vane	**244**	Pneumatic De-Icing	**259**	Passenger Emergency Lighting - A5
213	Baggage Compartment Lights	**228**	Engine Fuel Blown Down	**243**	Passenger Emergency Lights Control	**258**	Passenger Emergency Lighting - A7
212	Air Conditioning - Main Fan	**227**	Hydraulic Temperature	**242**	Ground Services Indication	**257**	Passenger Emergency Lighting - A9
211	Air Conditioning - Control	**226**	Avionic Bus Bar Control	**241**	Stall Warning - Horn And Heater	**256**	Passenger Emergency Lighting - A11
210	Gasper Fan	**225**	2nd Pilots Fan & Map Light	**240**	Stall Warning - Heater	**255**	Passenger Emergency Lighting - B12
209	Boost Valve	**224**	Unused	**239**	Briefing Signs	**254**	Refuel - Contents
208	Air Conditioning - Ground/Circulation Valve	**223**	Unused	**238**	Unused	**253**	Refuel - Control
207	Air Conditioning - Circulation Valve	**222**	Ferry Fuel	**237**	Boot Valve Heaters	**252**	Oil Temp Pressure
206	Anti Collision Lights	**221**	Landing Light - Heater	**236**	Windshield Heating - Heater	**251**	Unused
205	Passenger Compartment Bus Bar	**220**	Landing Light - Control	**235**	Windshield Heating - Control	**250**	Nav Lights

161A Eng - Air Intake Heater	**174** Eng - Heat Control	**189** Wind Shield Wiper	**204** Hydraulic Pressure Indication
161 Eng - Ignition	**173** Eng - Anti-Ice Vane	**188** Landing Gear - Control	**203** Essential Services Bus Bar Indication
160 Eng Fire - Left Shot 2	**172** Pito Static - Heaters	**187** Landing Gear - Indication	**202** Inter Turbine Temperature
159 Eng Fire - Right Shot 1	**171** Pito Static - Warning	**186** Hyds - Control	**201** Propeller Tachometer
158 Prop - Heat Control	**170** Auto Feather	**185** Hyds - Flap Acc Solenoid	**200** Crew Call
157 Prop - Heat	**169** Pitch Ind & LBA Stop	**184** Hyds - Press Wing	**199** Voice Recorder Control
156 Gen - Field	**168** Eng Fire - Extinguish	**183** Flap Indicator	**198** Right Gyro Compass
155 Gen - Services	**167** Eng Fire - Warning/Test	**182** Unused	**197** Fuel Cross Feed Selected Indication
154 Gen - Trip/Reset	**166** Low Fuel & Oil Pressure	**181** Stall Wing Stick Shaker	**196** Air Conditioning Indication
153 Unused	**165** Fuel - Flow Meter	**180** Ice Detector Indication	**195** Smoke Detector Aft
152 Unused	**164** Fuel - Filter Warning	**179** Flight Director No2 HIS	**194** Lighting Flight Director No2
151 Ground Supply - Indication	**163** Fuel - Contents	**178** Flight Director No2	**193** Warning Lights Test
151A Ground Supply - Control	**162** DC Transfer	**177** Standby Inverter - Indication	**192** Control Locking
		176 Standby Inverter - Supply	**191** Lighting - Side Panel
		175 Left Inverter Indication	**190** Lighting - 2D Panel

356 Emergency Supply NAV 1	**363** Panel Lights	**370** Booster Pump	**377** Unused
355 Unused	**362** Panel Lights	**369** Flight Director Vertical Gyro	**376** Unused
354 Flight Director No2	**361** Panel Lights	**368** Unused	**375** Volt Frequency Meter
353 Torque	**360** Unused	**367** Unused	**374** Unused
352 Panel Lights	**359** Unused	**366** Pilots Console Lighting	**373** Pilot 1 Altitude Gyro
351 Flight Data Recorder	**358** Unused	**365** Voice Recorder	**372** Unused
350 Flight Director Alt Director Indicator	**357** Unused	**364** Ice Detector	**371** Panel Lights



401 COM 1	**407** CPWS	**431** COM 1	**437** No 2 XPDR/Alt
402 Audio 1	**408** No 1 XPDR/Alt	**432** Audio 2	
403 Audio 1	**409** Radar Alt	**433** Audio 2	
404 NAV 1		**434** NAV 2	
405 ADF 1	**411** HD	**435** ADF 2	
406 DME 1	**412** Weather Radar	**436** DME 2	

QUICK VIEW SHORTCUTS

Left CTL+0 – Lighting Panel

330

360

Left CTL+1 - Captains Main Panel

330

360

Left CTL+2 - Engine Gauges

Generic

Left CTL+3 - GPS (+ Weather Radar SD3-60)

330

360

Left CTL+4 - Electrical Panel

330

360

Left CTL+5 - Overhead Panel

330

360

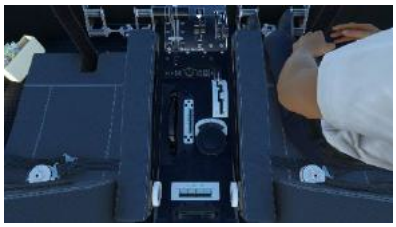
Left CTL+6 - Engine Control Panel

330

360

Left CTL+7 - Centre Console

330



360

Left CTL+8 - First Officers Side Panel

330

360

Left CTL+9 - Captains Side Panel

330

360

AIRCRAFT GENERAL

INTRODUCTION

This manual provides a description of the major systems of the Shorts SD3-30/60 aircraft.
The information contained herein is intended only as an instructional aid. This material does not supersede, nor is it meant to substitute for, any of the manufacturer's maintenance or operating manuals.

GENERAL

The Shorts SD3-30/60 is a twin-engine, unpressurised, turboprop land plane having a strut braced/cantilevered high wing monoplane configuration and a retractable tricycle landing gear. Power is provided by two turboprop engines, each driving a Hartzell five-bladed propeller whose pitch is hydraulically controlled.
The engines are manufactured by Pratt and Whitney Aircraft of Canada Ltd.
Propeller synchronization, reverse pitch, and auto-feathering are provided.

The airplane is controlled by conventional ailerons, elevators, and rudder and is certificated for two-pilot operations with the provisions for a third crew member.

It has a designed life cycle of 40,000 hours.

The aircraft is designed for the transportation of passengers and/or cargo on short-to-medium routes day or night in IFR and/or icing conditions.

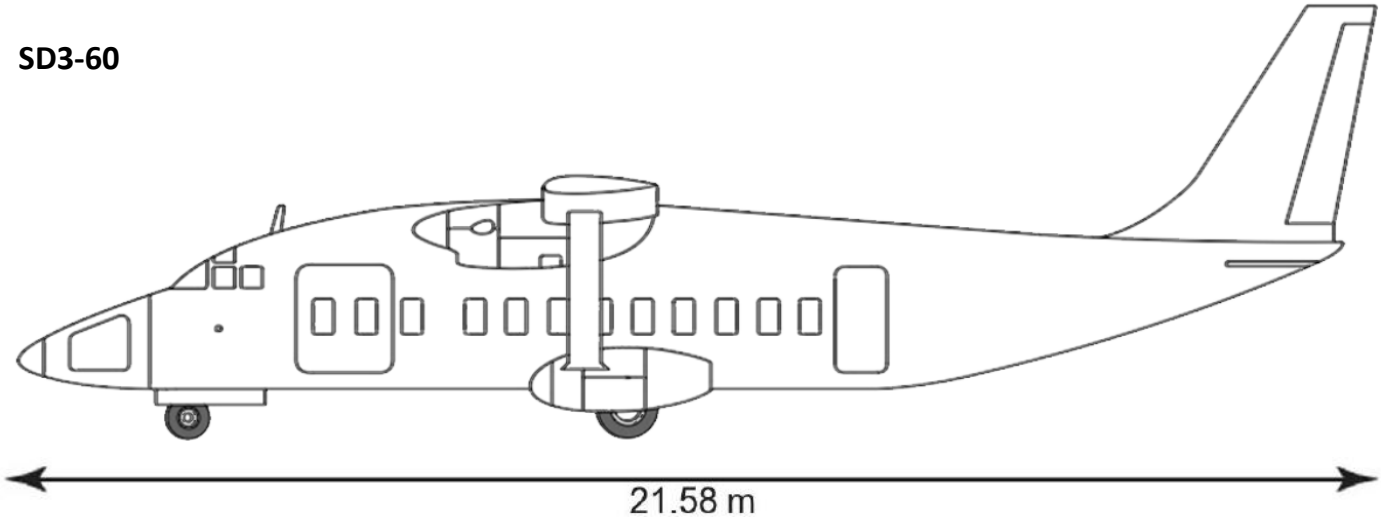
The aircraft can be configured for up to 36 passengers or cargo only.

STRUCTURE

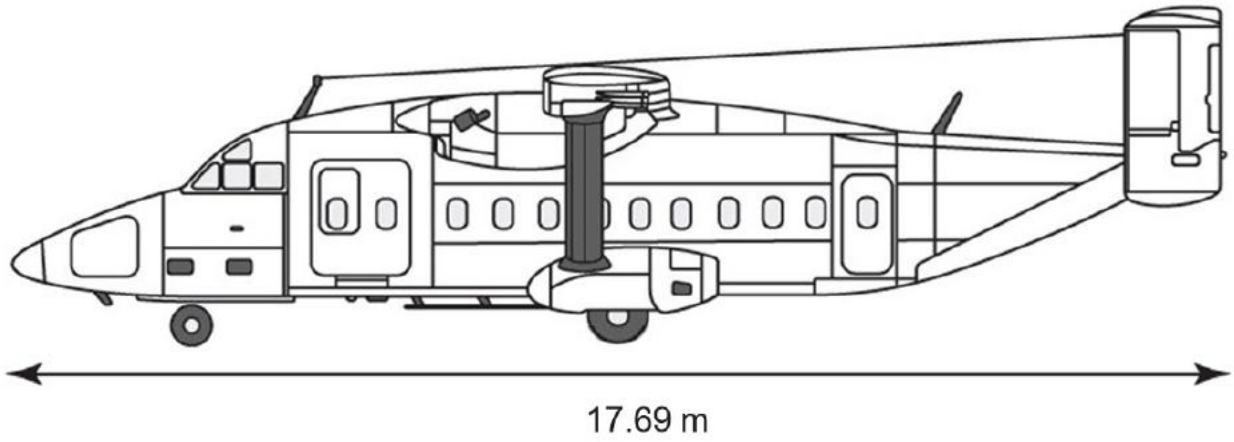
GENERAL

The fuselage is essentially a box-like structure with conventional frames supporting double skin panels in which the smooth outer skin is bonded to a corrugated inner skin. The aircraft is unpressurised.

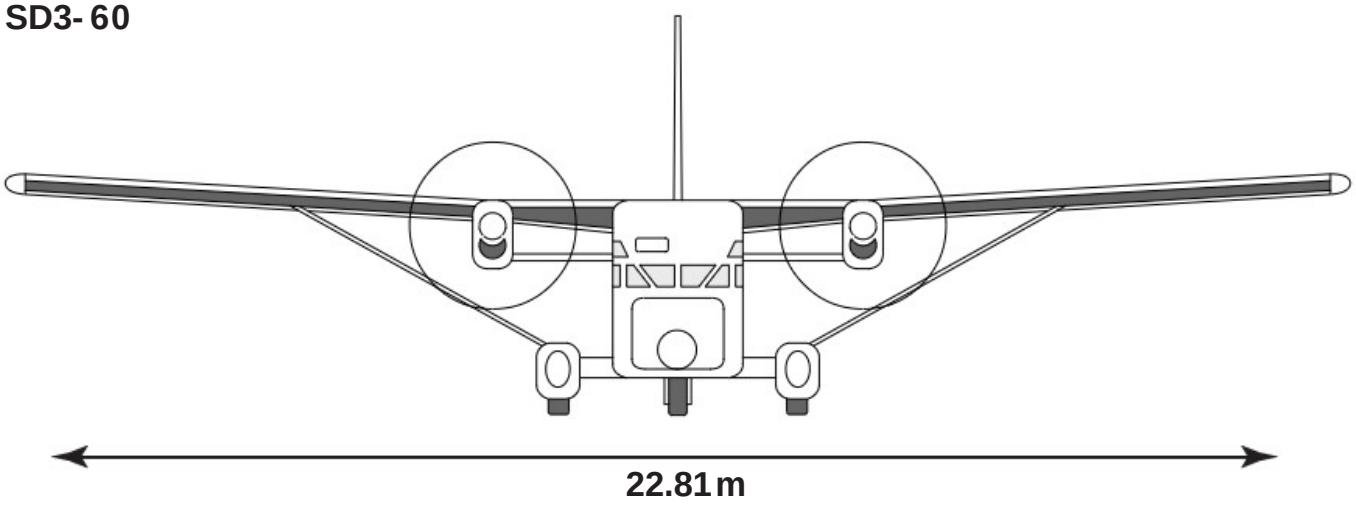
SD3-60



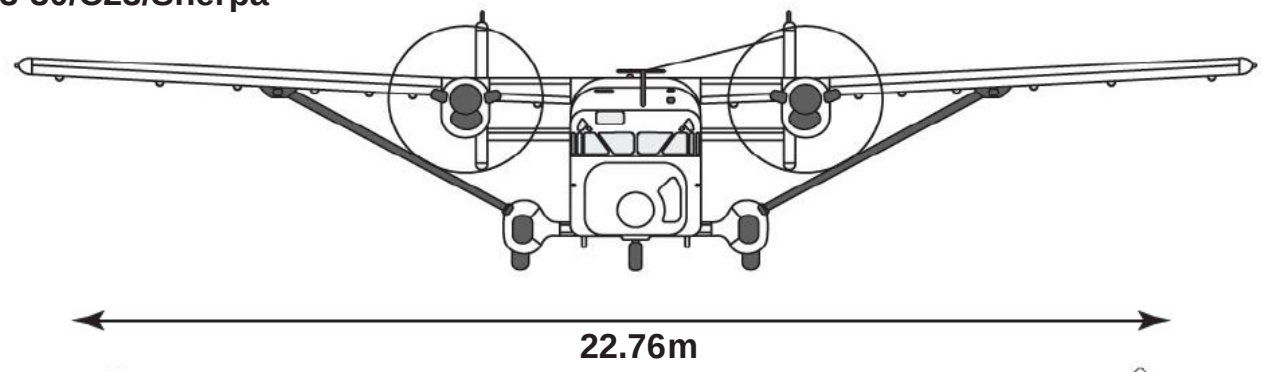
SD3-30/C23/Sherpa



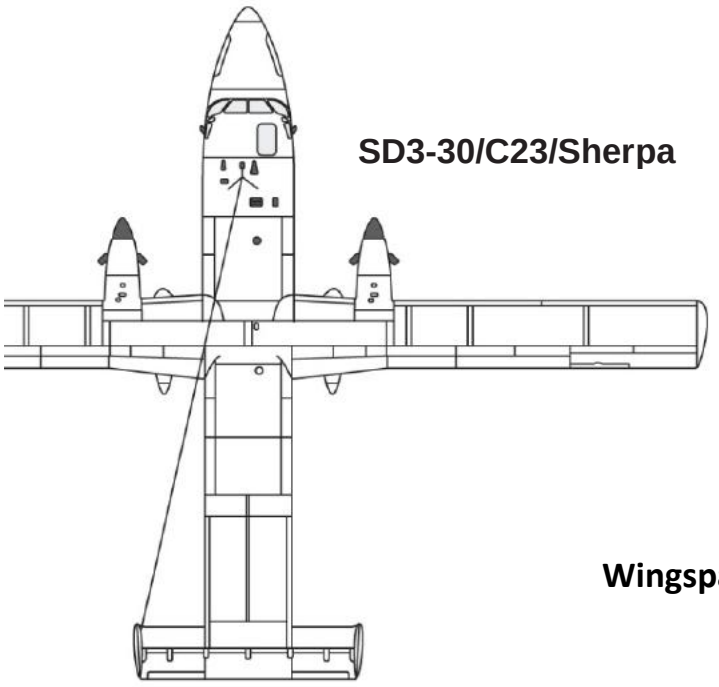
SD3- 60



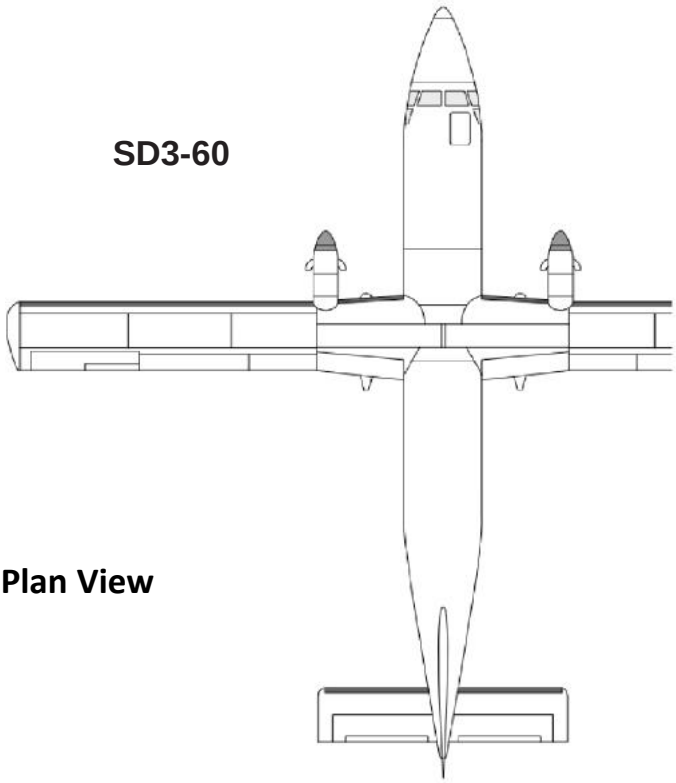
SD3-30/C23/Sherpa



SD3-30/C23/Sherpa



SD3-60



Wingspan and Plan View

ELECTRICAL POWER SYSTEMS

INTRODUCTION

This chapter covers the AC and DC electrical power distribution systems installed on the Shorts SD3-30/60 airplane. The DC system consists of two starter generators, one on each engine, which distributes electricity through 10 DC bus bars. AC power is developed through two primary inverters with one additional inverter for backup. The AC power is distributed through 6 AC bus bars. Two main batteries and one tail battery provide power for emergencies, engine starts, and limited ground operations. The tail battery provides power to assist during a battery start and provides a backup source of power for the emergency lighting system.

GENERAL

The electrical system is designed to provide a full supply of regulated AC and DC power for operating the airplane systems. The system consists of two engine-driven starter generator, three inverters, 16 bus bars for power distribution, three 24-volt batteries, indicators, and relays. An external power supply may be connected to the aircraft for engine starting, ground servicing, or maintenance.
Controls are located in the overhead panel 4P (CTL+4)

The system is designed to preclude a total loss of electrical power because of a single fault in any part of the system. Provisions for bus bar coupling, load shedding, and alternate power distribution for the DC essential ser-vices bus bars are designed into the system.

DC POWER SYSTEM

DC BUSES AND DISTRIBUTION

The distribution system for DC power consists of ten bus bars, electrical indicators (EIs), and two combination volt and ampere meters.
The bus bars are:

- Left and right main DC bus bar.
- Left and right battery bus bar
- Left and right essential services bus bar
- Left and right shedding bus bar
- Ground service bus bar
- Tail battery bus bar

Circuit breakers are located in panels 1D, 2D, 5D, and 6D. (CTL+8 & CTL+9)

BATTERIES

The aircraft has two Saft 24-volt, nickel-cadmium batteries having a capacity of 36 ampere-hours at one hour rate. Each battery is connected to its respective main bus bar through an ON–OFF switch located on the 4P panel. The batteries must be on, and main busbars coupled for engine start.

A third battery, rated at 24-volt 2.5 ampere-hours, is fitted in the rear fuselage. This battery primarily supplies emergency power through the Tail Battery bus bar for emergency cabin lighting. It also provides power during battery starts and can be used for ignition during windmill starting. The two main batteries are respectively connected to the right and left Battery bus bars. These bus bars supply power to engine fire extinguishers, battery indicators, and certain lighting circuits. The tail battery is permanently connected to the Tail battery bus bar.
Illumination of each O/HEAT EI on panel 4P is an indication of an overheat condition for each main battery. Further increases in battery temperature results in an isolation between the battery and the main DC bus bar provided the associated generator is online. Subsequent cooling will reconnect the battery to the bus bar. Should the associated generator fall off the line, the overheat circuitry is overridden and the battery is reconnected provided the ELECTRICAL MASTER switch is selected to INTERNAL. The tail battery is not protected by an overheat circuit.
The engine start sequence requires both batteries to be connected to their respective main DC bus bars and the bus bars are coupled (coupling is indicated by the EI). Interlocking re-lays that allow the engine start sequence to occur are only energized when these conditions are met. Failure to energize the relays inhibits the engine start sequence.

Battery charging occurs during normal operations and is registered as part of the total load indicated on the DC volt/ampere meter on panel 4P. The main batteries cannot be charged from an external source while they are installed in the aircraft. They must be removed to be charged externally. The tail battery is charged from the left main DC bus bar if the left generator is online. If the left generator fails, the Generator Fail Slave relay will disconnect the tail battery charging relay and the left load shedding contactor if the shed bus switch is in the normal or override position. The tail battery is then subsequently inhibited from charging even though the EMGY or O-RIDE position may be selected using the shedding bus bar switch.

STARTER-GENERATORS

Two Lear Siegler starter-generators, one for each engine, provide DC power for all systems. Automatic features for voltage regulation, reverse current flow, ground fault, and starter terminations circuits are incorporated into the system.

Two combined volt/ammeters provide generator information through the main DC bus bars. The tail battery voltmeter reads tail battery voltage when the ELECTRICAL MASTER switch is in INTERNAL, and the left generator is off.

Electrical indicators complete a symbolic circuit diagram on panel 4P showing system condition.

EXTERNAL DC POWER

A 28-volt DC external supply may be connected to the aircraft for engine starting or ground servicing. Connection is made through a plug on the right side of the aircraft.

Power is available to the ground service bus bar as depicted by the EI on panel 4P.

Upon selection of EXTERNAL on the ELECTRICAL MASTER switch, power is now available to the right main DC bus bar and simultaneously to the left main DC bus through the coupling contactor when external is selected. This also connects the left and right essential services bus bars to their respective DC bus. The right and left shedding bus bars are shed because of a failed generator condition (GENS offline); however, this is overridden by selecting EMGY (Emergency) with the shedding bus bar switch.

AC POWER SYSTEM

INVERTERS

Three inverters are installed in the aircraft, designated left, right, and Standby. The left and right inverters supply 5-, 26-, and 115-volt 400-Hz AC power to associated bus bars. The standby inverter automatically takes over from a failed inverter.
Inverters are capable of being selected on or off by the push-button switch on panel 4P.
An illuminated OFF (amber) appears in the switch if the inverter has been selected on and it fails. An OFF also appears when the inverter is de-selected (i.e., off).

POWERING OF INVERTERS AND OPERATIONS

The left and right inverters receive DC power from their respective main DC bus bars. The standby inverter receives its DC power from the right essential DC bus. Once the inverter switches are selected on, they are energized and are producing 5-, 26-, and 115-volt 400-Hz AC power.
Normally the left and right inverters supply power to their respective left and right AC bus bars, however the standby inverter will automatically assume the load of one failed inverter. Should a second inverter fail, the associated bus bar from the failed inverter is no longer powered.
A failed indication, OFF, is displayed on panel 4P for the failed inverter and the electrical indicators (EIs) show the new power distribution.
The inverter is normally connected to its appropriate bus bar after its output has exceeded more than 50 volts. If the output falls below 90 volts, the inverter is isolated (an OFF EI is illuminated) from the bus bar. The inverter can be reset by selecting the appropriate switch/indicator on panel 4P to OFF and then back to ON.

CONTROLS AND INDICATORS

All controls for selection and management of AC and DC electricity are through the electrical section of panel 4P.

AC controls are limited to the three-inverter switch/indicators. AC and DC indications of selection and/or faults are displayed by the Electrical Indicators (EIs).

Lighting system control is provided by 5-amp circuits on the left and right main DC bus bars with circuit protection located on distribution panel 1D and 2D.

Lighting system indication is provided by 5-amp circuits on the left and right essential service bus bars with circuit protection located on distribution panel 1D and 2D.

The one exception to the indica-tors being on panel 4P is the red GENerator failure warning annunciators on the Central Warning Panel (CWP), 1P.

The controls include the following:

Electrical master switch:

- INTERNAL— Aircraft batteries
- OFF—Off
- EXTERNAL—Ground supply

Essential Services NORMAL—TRANSFER switch:

- NORMAL—Essential services bus bars are connected to their respective Main DC bus bar.
- TRANSFER—The selected essential services bus bar is connected to the opposite main DC bus bar.

Generator switches:

a. ON—OFF—COUPLE

- ON—Selects generators on.
- OFF—Selects generators off.
- COUPLE—Couples the main DC busbars together (only one switch, left or right, is necessary).

b. TRIP—RESET

- RESET—Reset capability for an automatically or manually tripped generator.
- TRIP—Manual deselection of the generator from the bus bar (switch is spring-loaded to the OFF position)

Battery switch

- ON—Selects battery to main DC bus bar.
- OFF—Deselects battery from main DC bus bar.

Shedding bus bar switch:

- NORM—Normal connection of the shed-ding bus bar and the main DC bus bar.
- O'RIDE — Overrides the normal shed-ding function (i.e., loss of an on-side generator). Bus bar will now shed with subsequent loss of opposite generator.
- EMGY—Directly connects the shed-ding bus bar to the Main DC bus bar (will not shed).

Inverter Switch/Indicator:

- ON—Selects inverter on.
- OFF—Deselects inverter (Off is illuminated).

NOTE

An illuminated OFF with the inverter selected on indicates a failed inverter.

BUS BAR DISTRIBUTION

DC BUS BARS

Ground Bus Bar

- Navigation lights
- Domestic service (coffee pot/stereo)
- Anti-collision lights
- Gasper boost air valves and fans
- Air conditioning main fan and ram air control
- Air conditioning recirculation fan and ground air intake valve
- Baggage compartment light
- Passenger compartment briefing signs.
- Passenger compartment emergency lights
- Fuel content and levelling valves
- Galley/toilet step light

Battery Bus Bars

- Engine fire extinguishers
- Flight compartment right floodlight (R)
- Passenger compartment emergency lighting
- Reading and emergency lights (L)

Essential Service Bus Bars

- Fire warning
- Hydraulic control
- Landing gear control and indication
- Engine instruments
- Rain repellent system
- Low blade angle stop and propeller pitch indication.
- Heading indicator (pilot) (L ESS)
- Heading indicator (copilot) (R ESS)
- Standby inverter (R ESS)
- Windshield wipers
- Flight directors
- Stall warning heaters

Shedding Bus Bars

- Pitot tube and static vent heaters
- Windshield heating
- Anti-collision beacon (L)

Main DC Bus Bars

- Landing lights
- Left inverter (L Main)
- Flight compartment left and centre flood lights (L Main)
- Nav 1 (L Main)
- VHF comm (L Main)
- Right inverter (R Main)
- Nav 2 (R main)
- VHF comm 2 (R Main)
- Engine intake anti-icing
- Propeller de-icing
- Weather RADAR (L Main)

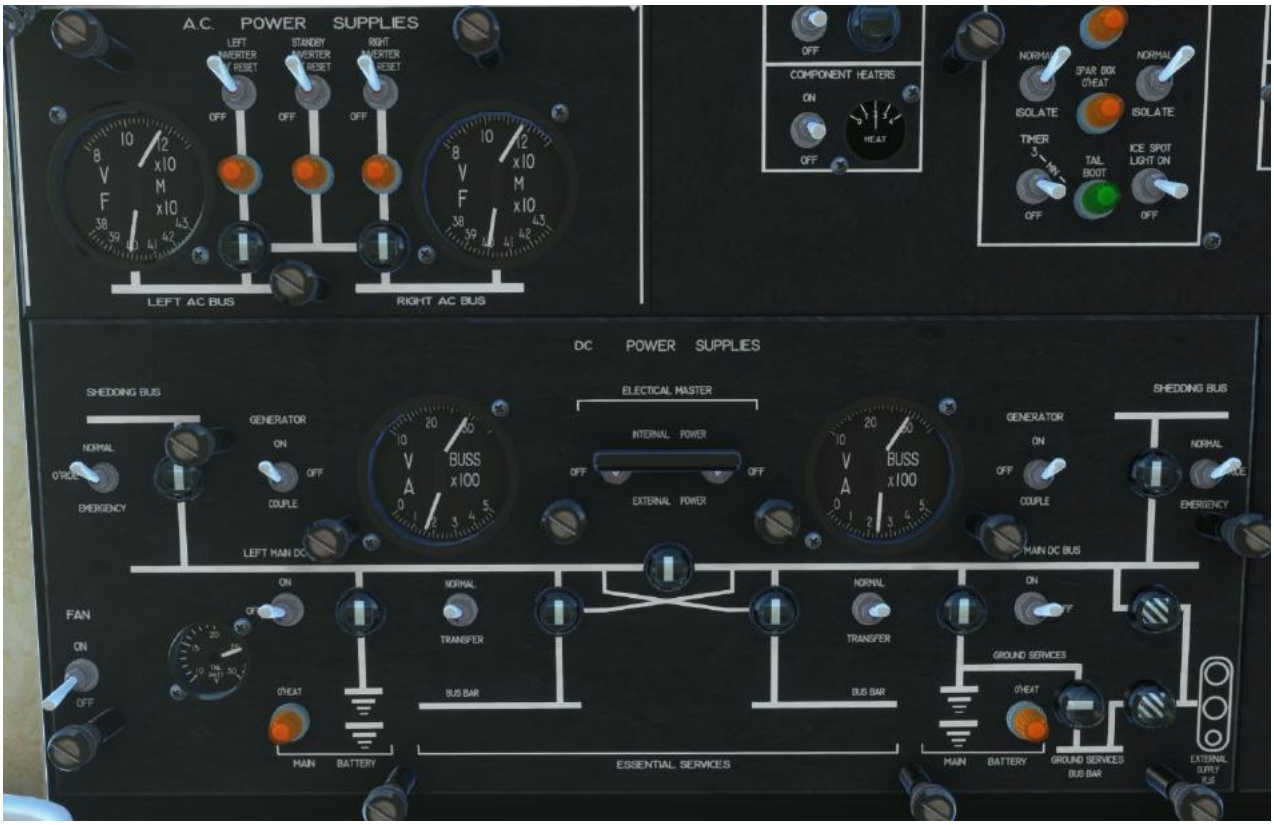
Tail Battery bus bar

- Passenger compartment emergency lighting

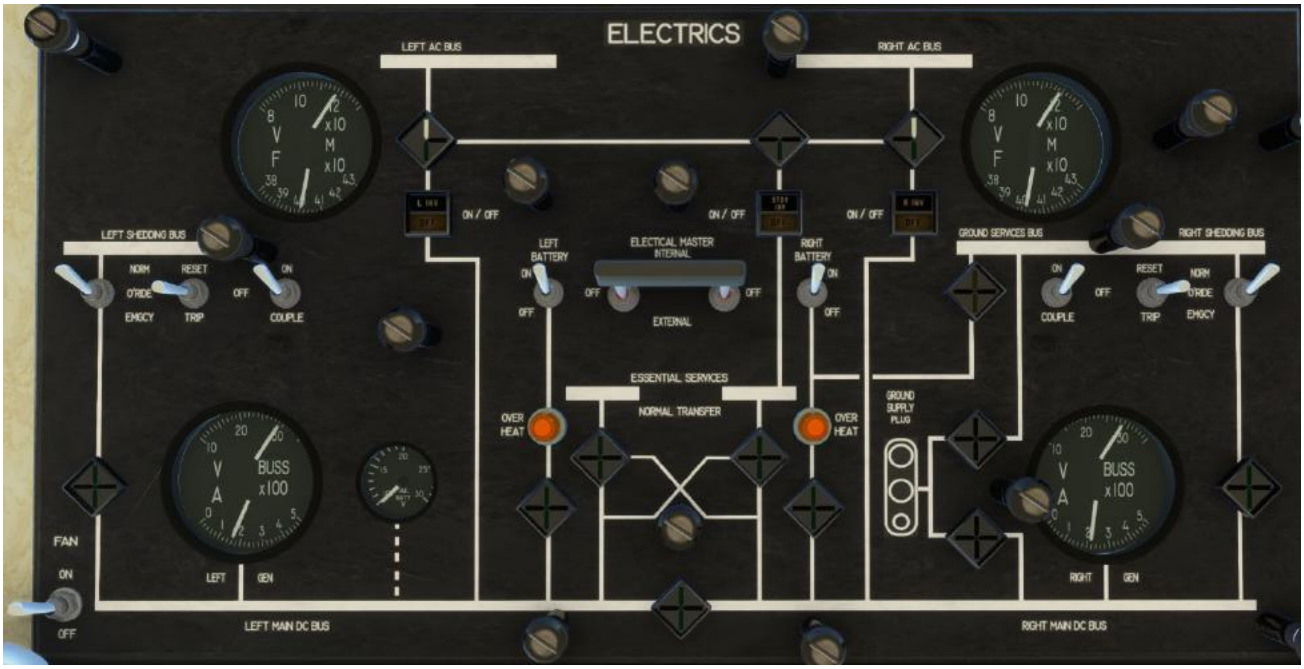
AC BUS BARS

Flight Directors

- Standby artificial horizon (pilot) (L)
- Standby artificial horizon (copilot) (R)



360 Electrical (4P)



330 Electrical (4P)

LIGHTING

INTRODUCTION

This chapter covers the aircraft's exterior and interior lighting. The lights include the cockpit instruments, passenger, anticollision, landing, taxi, and emergency lights. This chapter also covers baggage compartments, lavatory, and wing inspection lights.

GENERAL

Cockpit lighting is used for general area illumination and for all flight instruments. The instruments are generally illuminated internally whereas the switches are illuminated both internally and by post lights. Light emitting diode (LED) displays are used by the navigation, communication, DME, and transponder controllers and by the electrical indicators (EIs). And mechanical "Dolls Eye" indicators in the SD3-330. For direct illumination, map lights and floodlights are provided. Cabin lighting consists of indirect fluorescent tubes for the seating area, lavatory, and entrances.

Exterior lighting consists of landing, taxi, navigation, strobes (on 360) , and wing inspection lights.

INTERIOR LIGHTING

PANEL LIGHTS

The pilots control their lights by the switches and dials on the overhead panel, the main instrument panel, and the individual brightness knobs on certain equipment.
The instruments and indicators located in the instrument panel are illuminated internally or by post lights. The post lights provide general illumination of placards, switches, and nomenclature.

The lighting for the roof panels, 4P and 10P, and the magnetic wet compass is controlled by the dimmer knob located on panel 4P. The roof panels use 40 pillar lights, and the compass is internally lit.

The lighting for the main instrument panel (and avionics panel) is operated by four PANEL LIGHTS dimmer controls. The pilot and copilot each have two separate controls on panel 1P.
The controls are:

- FLT SYSTEM— (left and right) Controls the respective flight director and HSI. Power comes from the 28-VDC essential service bus bar.
- GENERAL— (left and right) Controls the 115-AC transformer that is required for internally lighted units on panel 1P and the pillar posts on panels 1P, 2P, and 5P. The left dimmer controls the lighting for the engine instruments. The right dimmer controls the lighting for the radio panel, 2P.

The AVIONICS LIGHTS rheostat controls lighting for the avionics equipment.

The side panel 1D is illuminated by a utility light that is controlled by a three-position switch just aft of panel 7P. The three positions are BRIGHT–OFF–DIM.

The side panel 2D is illuminated by a floodlight that is also controlled by a three-position switch located on panel 11P.

The remaining panels, 7P, 9P, 11P, and both pilots' audio panels are illuminated by pillar lights that are controlled by two dimmer switches on panels 7P and 11P.

CONSOLE LIGHTING

The lighting for the centre console is controlled by the CONSOLE LIGHTING rheostat located in the roof panel above Pilots right shoulder

MAP LIGHTS

Each pilot has a utility light that is fitted on the flight compartment roof, panels 4P and 10P. The lights can be used for the pilot's map, etc.
There is also a utility light located adjacent to panel 1D, used primarily for illumination of distribution panels 1D and 5D. The switch has dimmer control built in.

A warning light on the CWP, and on the 11P panel is illuminated if ANY door is not properly closed.

EXTERIOR LIGHTING

LANDING LIGHTS

The aircraft has two landing lights, housed in the wing fairing at the top of each wing strut.
Each light is powered respectively by the left and right main DC bus bars.
Two switches, LANDING LIGHTS ON–OFF, on panel 10P (CTL+0), provide control.

TAXI LIGHTS

The aircraft (serial numbers 3601 to 3660) may be equipped with one or two taxi lights. Aircraft prior to mod 7556 has one light on the left nose landing gear door, mounted on the internal side. After mod 7556, an additional light is mounted in a similar position on the right door. Aircraft after 3660 have the two taxi lights.
The light(s) is controlled by one switch, TAXILIGHT ON–OFF, on panel 10P.

NAVIGATION AND STROBE LIGHTS

Three navigational/strobe lights are mounted on each wing tip and the tail. The navigation lights are the standardized steady illumination green for the right wing, red for the left wing, and white for the tail.
The navigation lights are controlled by the NAV ON–OFF switch and the strobes by the ANTI-COLLISION STROBE ON–OFF switch, both on panel 10P.
Electrical power comes from the right ground service bus bar for the navigation lights and the right shedding bus bar for the strobes.

Note
Strobes not fitted to SD3-30 Aircraft

ANTICOLLISION LIGHTS

The aircraft is equipped with an anticollision light on the top of the fuselage and an optional light mounted underneath the fuselage.
The light(s) is controlled by the ANTICOLLISION BEACON ON–OFF switch on panel 10P.
Electrical power comes from the ground service bus bar.

WING INSPECTION LIGHTS

The wing inspection light functions as an ice spotlight for the leading edge of the left wing.
Aircraft with mod 7167 are provided with an additional light for the right side.
The lights are controlled by the ICE SPOTLIGHT ON–OFF switch on panel 4P. (CTL+5)

330 Lights Panel (10P)

360 Lights Panel (10P)

MASTER WARNING SYSTEM

INTRODUCTION

The master warning system consists of the Central Warning Panel (CWP), caution lights, electrical indicators (EIs), and the warning horn. The system provides a visual and/or audible indication of system status and directs the pilot's attention to any problem areas.

GENERAL

The master warning system is designed to alert the pilots to any serious system malfunction or conditions that need corrective action. The warning and caution indicators are arranged in the cockpit as illustrated in the section designated CENTRAL WARNING PANEL.
Warnings that require immediate crew action illuminate in red (WARNING). Indications of less urgency are illuminated in amber (CAUTIONS). EIs are green when showing a normal or ON condition. Abnormal or OFF conditions are indicated by an amber EI. White and blue illuminations are also used to show valve or switch positions.

CENTRAL WARNING PANEL

The CWP provides immediate notification to both pilots of most warnings and cautions. The Annunciator section of this manual shows all the warning and caution indicators. Table 4-1 provides a description of all the warnings, Table 4-2 the cautions, and Table 4-3 provides information on some of the system EIs.

A TEST "BRT"DIM switch on panel 11P provides selection of two levels of light intensity on all annunciators except the red, which are always bright. The TEST position checks the integrity of all the indicating modules on panel 1P and other warning/indicator lamps in the flight compartment. The anti-icing systems do not test with the central warning system lighting switch. Each anti-icing system is tested separately with switches located on the anti-icing panel.

Central Warning Panel (1P)

CWP DESCRIPTION TABLES

Table 4-1. WARNING DESCRIPTIONS

RED INDICATOR	LOCATION	CAUSE FOR ILLUMINATION
FIRE L or R	CWP	Engine Fire Warning
GEN L or R	CWP	Generator is not Operating or Main Bus Bar Less than 26 Volts
CONTROL LOCKS	CWP	Flight Controls Not Fully Unlocked
DOORS	CWP	Exterior Door Open (Cargo, passenger or emergency)

Table 4-2. CAUTION DESCRIPTIONS

AMBER INDICATOR	LOCATION	CAUSE FOR ILLUMINATION
FUEL L or R	CWP	Low Fuel Pressure
LOW FUEL AFT or FWD	CWP	Low Fuel Quantity 295 or 330 POUNDS
ICE	CWP	Accumulation of Ice on the Ice Detector
HYD L or R	CWP	Low Hydraulic Pressure, 1500 +100/–0 psi
PITOT L or R	CWP	Power Failure or Not Turned ON
OIL L or R	CWP	Low Oil Pressure
FIRE FAULT L or R	CWP	Fault detected in the Fire Loop
SMOKE FWD	CWP	Smoke Detected in the FWD Baggage Compartment
SMOKE AFT	CWP	Smoke Detected in the AFT Baggage Compartment
BLEED/or A'COND	CWP	High Temperature, High Pressure, Low Pressure, Flight or Passenger Compartment Overheat (Air Conditioning System) High or Low Pressure (Anti-Ice System)

Table 4-3. ADVISORY AND ELECTRIC INDICATOR (EI) DESCRIPTIONS

AMBER INDICATOR	LOCATION	CAUSE FOR ILLUMINATION
FUEL X (white)	CWP	Fuel Cross feed Handle Selected to the Open Position

WARNING HORNS

STALL WARNING

Early detection of a stall is provided by a stall warning horn, light, and stick shakers. The horn and light unit is located on the right side of the flight compartment roof and the stick shakers are on each control column.

GEAR WARNING

The warning horn is used to alert the pilots that the gear is not down when attempting to land. The warning horn sounds if all three gear are not down and locked when either one or both power levers are retarded to approximately flight idle or the flaps selected greater than 15°down. The horn can be silenced by positioning the L'GEAR HORN switch to CANCEL. This is effective only if the horn is functioning because of power lever positioning. The horn cannot be silenced if flaps are selected greater than 15°.

The horn sounds continuously for unsafe gear and sounds intermittently for high airspeed.

The horn is located on the left side of the flight compartment roof.

GPWS WARNING

The GPWS System is INOP at this time

FUEL SYSTEM

INTRODUCTION

The aircrafts fuel system provides for storage and distribution of 576 gallons of fuel. The fuel system consists of tanks, venting components, indicating devices, distribution and transfer network, and refuelling/defueling capabilities.

This chapter covers the operation of the fuel system up to the engine-driven fuel pumps. At that point fuel system operation becomes a function of the engine. Reference Chapter 7, “Powerplant,” for addition information.

GENERAL

The fuel storage system consists of two box-shaped tanks that are located on top of the fuselage centre section. Crossflow and levelling valves provide for fuel trans-fer and balancing.

Fuel is gravity fed to two collector tanks each housing an AC-powered boost pump.

The forward fuel tank, under normal operations, feeds the left engine and the aft fuel tank feeds the right engine.

FUEL DISTRIBUTION SYSTEM

GENERAL

The fuel is gravity fed to the collector tank on the right side of the fuselage. Nonreturn lines prevent fuel from back flowing during changes in flight attitude. 115-volt AC-powered booster pumps in the collector tanks force fuel through a filter, a non-return valve, and then through Low Pressure (LP) valves. The normally closed cross feed valve separates the forward and aft fuel system. This valve is opened during fuel balancing and for engine/fuel malfunctions.

FUEL BOOST PUMPS

The two boost pumps located in the collector tanks are AC powered. Control is by means of two ON/OFF switches located in the fuel section of panel 4P.

LOW PRESSURE (LP) VALVES

Two mechanical LP valves are installed to interrupt fuel flow to an engine if the condition becomes necessary. The controls for the valves are located in the roof console (overhead panel) and may be safety wired in the open position.

CROSSFEED VALVE

The cross-feed valve allows for uninterrupted fuel flow to either engine from either tank. Normal operation is for the forward tank to feed the left engine and the aft tank to feed the right engine. If necessary to correct for any fuel im-balance or malfunction, the valve can be opened. Fuel balance can be restored by opening the cross-feed valve and selecting the booster pump on the low tank to OFF. The white FUEL X annunciator on the CWP, and a horizontal amber cross feed EI on the fuel panel 4P illuminates any time the cross-feed lever is selected open. When the cross-feed lever is selected closed, the FUEL X annunciator extinguishes and the cross-feed EI on the fuel panel 4P changes from horizontal amber to vertical green.

FUEL LEVELING VALVES

Two levelling valves are used for levelling fuel within each tank (between cells one and two, and three and four) and for gravity refuelling. The Levelling valve provides a connection between each cell within its respective tank.
The valves are selected open/closed on either panel 4P or 8P panels.

NOTE
The valves do not level fuel between the two tanks.

FUEL FILTERS

The fuel filters are a cleanable, 70-micron barrier. A pressure-controlled by-pass valve redirects the flow should the filter become clogged. Indication of fuel bypassing the filter is provided by the FILTERS warning light (amber) in the fuel section of panel 4P.

FUEL INDICATING SYSTEM

FUEL QUANTITY INDICATING SYSTEM

The fuel indicating system consist of two sets of two gages, one set on panel 4P and the other on the refuel/defuel panel, 8P. Each gage measures one tank (forward or aft) by summing the capacitance of six probes in parallel. A constant capacitance (fuel measurement) is obtained regard-less of changes in pitch and fuel movement.
Power comes from the Essential Services bus bars or from the Ground Service bus bars if the Essential Services bus bars are not energized.

FUEL TOTALIZER

A fuel totalizer is installed on panel 1P below the Central Warning Panel. The totalizer is initially set with the total fuel reading from the fuel gages. Once the engine fuel flow indicators begin operating, the totalizer starts counting down. This provides another independent source for fuel computation. Input is from the fuel flow transducer.

FUEL FLOW

Fuel flow can be monitored by two engine flow indicators mounted on the engine display panel, 1P. Each indicator measures from 0 to 800 pounds per hour of fuel flow. Flow information is also used by the totalizer for an estimated fuel quantity.

LOW FUEL WARNING SYSTEM

Two low-level fibre-optic sensors, one in the forward tank and one in the aft tank provide information to two electrical indicators in the flight compartment. The low-level warning is activated when fuel is 330 pounds or less in the forward tank and 295 pounds or less in the aft tank. The warning, LOW FUEL FWD or LOW FUEL AFT is indicated on the CWP, panel 1P. Electrical power comes from the Left and Right essential services bus bars.

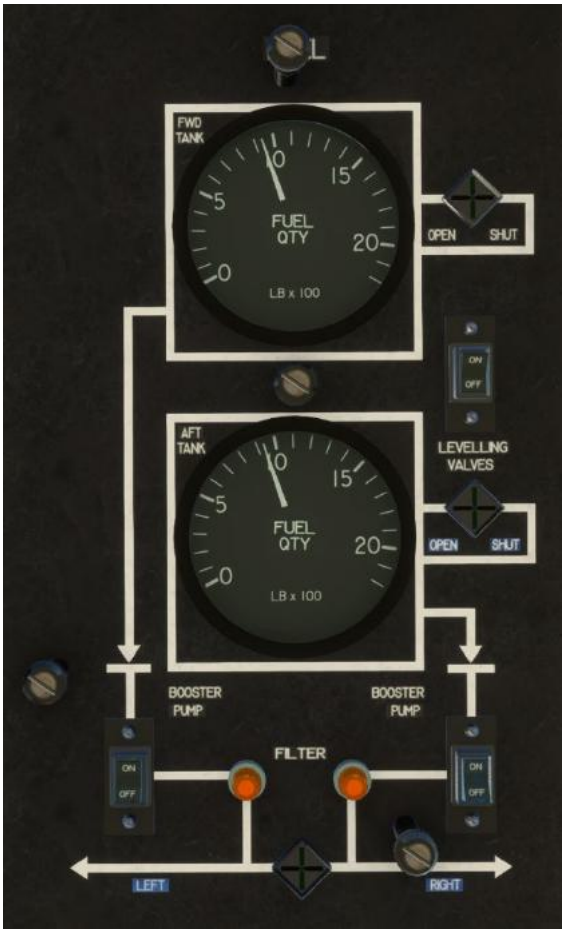
FUEL PRESSURE

Fuel pressure from the boost pumps to the engine driven pumps is maintained by the booster pumps (approximately 8 to 10 PSI). In the event of pump failure, low fuel pressure is detected by the 2 PSI low pressure switch which illuminates the FUEL L or FUEL R annunciator on the CWP.

Fuel pressure switches are located downstream of the LP valves.

330 Fuel Panel

(4P)



360 Fuel Panel

POWERPLANT

INTRODUCTION

The Shorts SD3-60 series airplane can be equipped with several different PT6A turbo-prop engines. This chapter covers the Pratt and Whitney turboprop engine, model PT6A-65AR. The Airplane Flight Manual and/or Pilot Operating Handbook must be referenced for information about the other engines.

Note

Please note SD3-30 aircraft are fitted with the PT6A-45R engine but both are very similar in power and operation

GENERAL

Two wing-mounted turboprop engines, Pratt and Whitney model PT6A-65AR with five-bladed propellers, provide power for the Shorts SD3-60 aircraft. Each engine is approximately 1,424 shaft horsepower (shp) at reserve take-off power.

BETA GOVERNING

In the Beta governing mode, blade angles can-not be decreased sufficiently when the POWER levers are set between FLIGHT IDLE to full REVERSE. Beta governing allows pitch/blade angle to be directly controlled by the pilot through the POWER lever when operating at these power settings.

LOW BLADE ANGLE SECONDARY STOP

Blade angle is restricted from decreasing below (12.5°) when in the propeller governing mode and the Ground/Air lever set at air. If this stop fails, a secondary stop (8.5°) pre-vents the blade angle from decreasing any lower.

Indications that the secondary stop is operating in flight is provided to the pilot by the FINE PITCH (blue) lights on panel 2P cycling on and off.

During reverse operation (in the Beta governing mode), the REVERSE PITCH (green) lights are illuminated as well as the FINE PITCH (blue) lights.

Blade pitch indications are only provided by the two types of lights, FINE PITCH and REVERSE PITCH.

A low blade angle check is performed on the first flight of the day by pressing and holding the LBA test switches on panel 11P. The ground/air lever is set for ground.

1Move power levers slowly into the ground range and the FINE PITCH lights should cycle on and off with fluctuating PRPM.

FEATHERING

The propellers can be feathered by selecting the PROP lever fully aft to the FEATHER position (Figure 7-10). Oil pressure in the propeller hub dumps to the sump allowing the springs and counterweights to drive the propeller to the feathered position.

CAUTION

POWER levers must not be below FLIGHT IDLE when feathering the propeller.

AUTO FEATHERING

This system provides automatic feathering of the propeller due to engine failure. For the automatic system to work, both power levers must be set above approximately 88% Ng (power lever angle) prior to an engine failure (determined by a substantial loss of torque i.e., down to 500 lb-ft). The system is independent of the normal feathering controls.

Auto feathering action for each engine is identical and is initiated by a solenoid valve on the propeller overspeed governor.

Once the auto feather system has been activated on a failing engine, the system automatically disables the feature on the good engine.

Two auto feathering test switches are located on panel 11P for checking the system.

AUTO FEATHER INDICATION

Two indicators on panel 1P show the armed conditions of each engine.
Appropriate indications for the following conditions are:

- Power levers position below 88% Ng—both indicators out.
- POWER levers position at or above 88%Ng (engines normal)—AUTOFEATHER ARM captions are illuminated.
- POWER levers position at or above 88%Ng (one engine failed)—both indicators out.

OVERSPEED GOVERNOR

Propeller overspeed protection is provided by the centrifugal action of conventional flyweights located inside the overspeed governor. As PRMP increases over the maximum allowed, the flyweights change position opening a valve for the release of propeller oil pressure back to the sump. This effectively increases the blade angle and reduces the PRPM.
The propeller overspeed governor comes into operation when propeller speeds reach approximately 1,750 PRPM (3% in excess of maximum setting).
The system is tested by holding the OVER-SPEED GOVERNOR LEFT/RIGHT TEST switch in the test position after establishing a near maximum propeller speed (1,620 PRPM). The PRPM should drop to 1,565 ± 30.

PROPELLER SYNCHRONIZATION

An electronic synchronizer sets the left engine to match the right engine's speed. Propeller speeds are measured by the overspeed governors and then compared. Speed differences are corrected by trimming the slave engine (left) propeller governor to match the master (right) engine. The system will correct for a maxi-mum mismatch of approximately 100 PRPM.
Once synchronization has been initiated, the system should hold if both PROP levers are moved together.
Synchronization is not used for take-off and landing and is selected only after both engines have been manually matched.

INDICATION AND CONTROL

The system is activated by pressing a switch/indicator on the main instrument panel, 1P. The switch/indicator is identified by a (white) PROP SYNC indication on the top half of the switch. The bottom half of the switch indicates (green) SYNC on a black background when the SYNC system is activated.
The (green) SYNC indication is extinguished, and the bottom half of the switch becomes black when the system is deactivated.

PROPELLER SPEED INDICATION

Propeller speed is measured by a tach generator on each engine's reduction gearbox. Indications for each engine are displayed by a pointer for analogue readings and a 4-digit digital display for finer reading (On SD3-60 only). The indicators are located on the main instrument panel, 1P.

POWERPLANT CONTROL

GENERAL

Powerplant (engine and propeller) control is achieved by means of a power lever, a propeller lever, and a fuel lever for each engine plus one ground/air lever. The levers are mounted in a quadrant on the centre console.

POWER LEVERS

The power levers set the gas generator speed point (Ng). When in the ground range (Beta range) the power levers control the propeller governor's beta valve to permit direct selection of the propeller blade angle between in-flight fine pitch (in-flight Beta) and full reverse.
The power levers move from take-off position (full forward) to reverse (full aft). They are designed to prevent inadvertent power selections below FLIGHT IDLE when in flight, and below GROUND FINE into reverse when operating in the ground range. They also limit forward power lever movement when the flight controls are locked.

GROUND/AIR LEVER

The ground/air lever is a two-position lever that prevents unintentional selection below FLIGHT IDLE.
The air mode of the ground/air lever is automatically reengaged by advancing the POWER levers. Power levels from FLIGHT IDLE to max take-off are now available. When the ground mode is selected, power levels from full reverse to max take-off are available. The secondary low blade angle stop is inhibited when the ground mode is selected.

REVERSE THRUST STOP

The reverse thrust stop lever prevents inadvertent selection of the power levers below GROUND FINE. To select reverse, the stops must first be lifted by their finger tabs.

PROPELLER LEVER

The PROP lever is used to select the propeller rpm and provide a means of feathering the propeller. To select the feather position, in-creased back pressure must be applied on the lever to pass a spring detent. The feather position dumps propeller oil to the sump allowing the springs and counterweights to feather the propeller blades.

NOTE

The propeller may be feathered with the engine operating (POWER lever set at FLIGHT IDLE).

WARNING

POWER levers must not be selected below FLIGHT IDLE when feathering the propeller.

Allowable propeller speeds are:

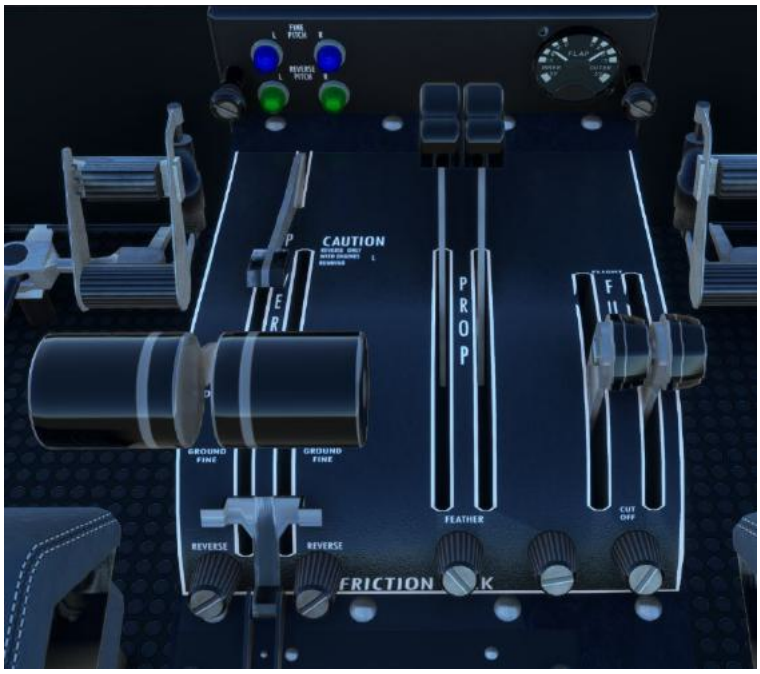
- Ground operations:
    - Propeller feathered only.... 0 to 400
    - Taxi ..... 900 to 1,170
    - Power checks ..... 1,400 to 1,700
    - Take-off ..... 1,675 +25 –0
- Flight operations:
    - All flight operations 1,200 to1,700
    - Up to 150 kts IAS ..... 1,700 prpm
    - Above 150 kts IAS ..... 1,450 prpm

FUEL LEVER

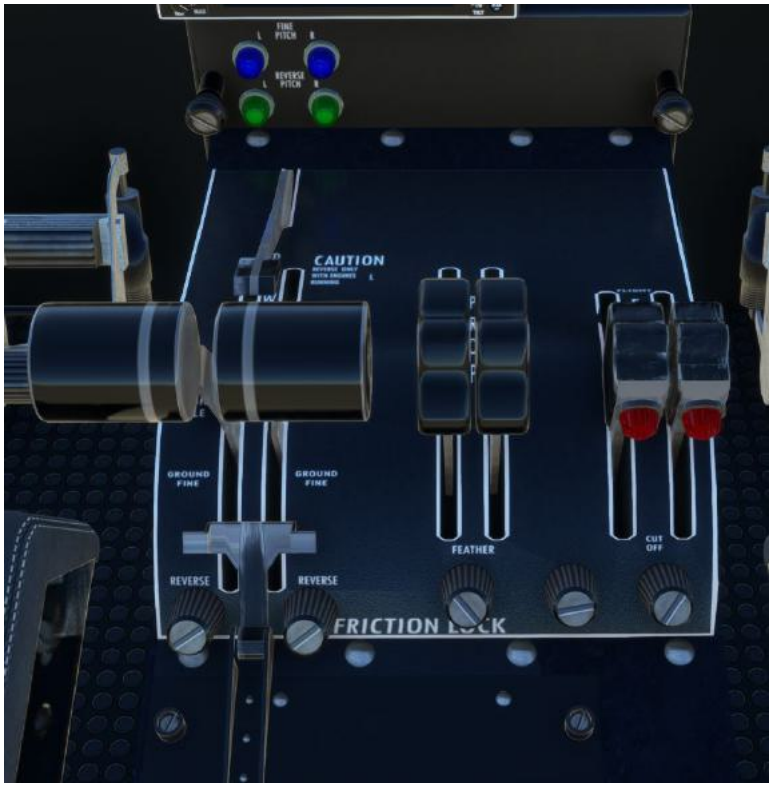
The three-position fuel lever on the centre console sets the minimum engine speed and provide a means of shutting the fuel off and stopping the engine.

The three positions are OFF, GROUND, and FLIGHT.
OFF stops the fuel flow to the engine.
GROUND and FLIGHT establishes a mini-mum 71% and 79% Ng (all bleeds off) respectively.
The maximum Ng for both GROUND and FLIGHT is 104%.
The minimum Ng for ground operation is 56%.

To select OFF, the fuel levers must be moved fully aft.



330 Throttle Quadrant (3P)



360 Throttle Quadrant (3P)

RESERVE POWER

GENERAL

The automatic reserve take-off power control system (RTOP) increases the maximum take-off power of an operating engine when an engine failure has occurred. Increased power of approximately 3% Ng is expected.

OPERATION AND INDICATION

The system is armed before take-off by selecting ARM on the RESERVE POWER switches on panel 4P. The system is ARMED at approximately 90% Ng.

With the system armed, loss of torque on one engine will cause the fuel flow to in-crease on the good engine and raise the Ng approximately 3%. This reserve power continues until either the system is selected OFF (RESERVE POWER switches) or the POWER lever is retarded below 90% Ng on the good engine. The good engine's air conditioning bleed is automatically closed when reserve power is activated.

Two RESERVE POWER test switches are located on panel 11P. The system is tested after the engines are started by selecting and holding the test switch.
Ng should increase approximately 1-4% and the two-windowed indicators on panel 1P change from illuminating RTOP ARM to RTOP ON.

Maximum time for operating in reserve power is 5 minutes.

TORQUE SENSING

Measurement of engine power is provided by a torquemeter installed on the reduction gearbox. Torque indications are provided to the pilots by a gage on the main instrument panel. The gage is powered by 26 VAC. The torquemeter is a hydro mechanical device that measures the axial movement of the first stage ring gear against oil pressure and converts that information into usable performance (foot-pound) criteria for the pilots.

The gauges read from 0 to 5,500 lb-ft of torque for each engine.

INSTRUMENTATION

The powerplant instruments are mounted in three horizontal rows on the main instrument panel 1P. Easily Accessible by pressing LEFT Ctrl + 2 on the keyboard

ENGINE INSTRUMENT GUAGES (1P)

ENGINE STARTING

GENERAL

The engine starting system enables each engine to be cranked automatically to self-sustaining speeds by means of starter-generators.

Whenever possible, an external 28-VDC power supply should be used for cranking, however, the internal batteries may be used subject to certain limitation and conditions.

GROUND STARTING

The engines are started individually whether from an external electrical source or from the batteries connected in parallel.

The appropriate booster pump selected ON.

The START MASTER switch is placed to ARMED followed by selecting START on the appropriate engine.

NOTE

The main bus bars must be coupled by selecting the START MASTER switch to ARMED.

The start sequence will not occur unless:

a) Both batteries are connected to their respective bus bars and the bus bars are coupled (internal start) or
b) Both batteries are off-line (external start).

Momentarily holding the START switch to START closes the appropriate relays and begins the sequence. The START switch is magnetically held in this position until 50% Ng and then automatically released.

At 10% Ng, the IGNITION switch is set to NORM (normal).

NOTE

The IGNITION switch EMERG (emergency) setting allows the ignition unit to be directly connected to the start control feeder for an in-flight windmill start or to provide continuous ignition during heavy icing conditions.

When Ng stabilizes above 20%, the FUEL lever is selected to GROUND. Light off should occur within 10 seconds of moving the FUEL lever to GROUND and be within 25 seconds from placing the START switch to START.

The following items are checked:

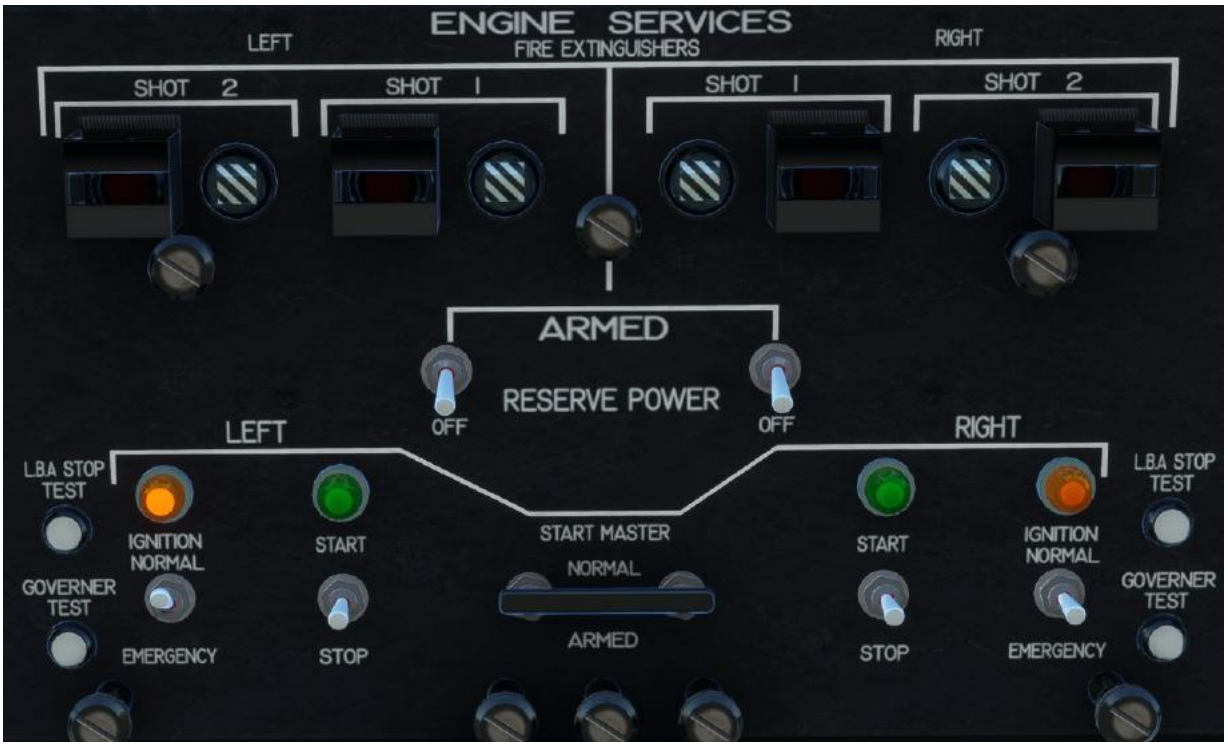
- ITT Maximum 1,000° C for 5 seconds
- Start and ignition light out above 50% Ng.
- Oil pressure 90 psi minimum (oil warning light out)

The starting cycle is terminated when:
50% Ng is reached or
Or the start switch is set to STO.

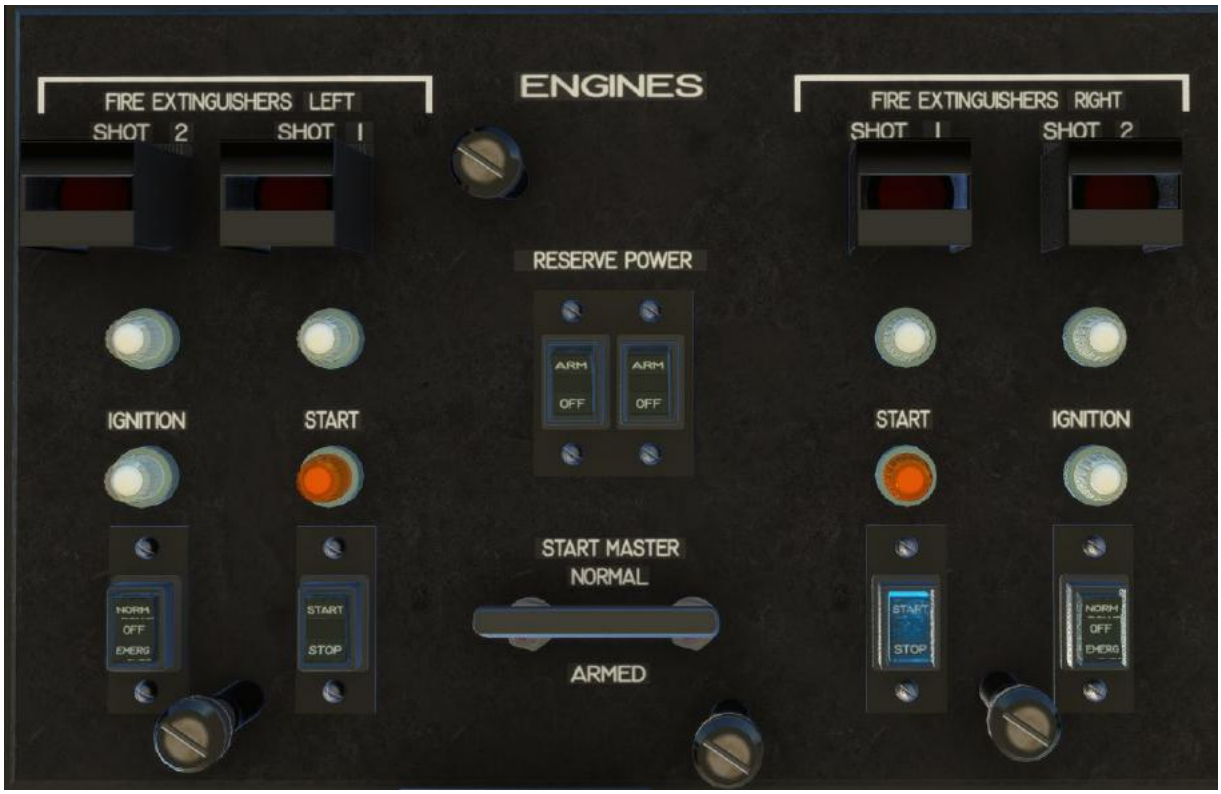
Caution
If the engine fails to "light off" after moving the FUEL lever to GROUND, shut off the fuel, starter, and ignition.

Allow a period of 30 seconds for fuel draining, followed by a 15 second ventilation cycle (dry motoring run) before attempting another start. It is not necessary to allow a rundown after dry motoring before resuming a start sequence.

If for any reason, a start attempt is discontinued, allow the engine to come to a complete stop and then accomplish a dry motoring run. Repeat complete starting sequence (observing starting limitations).



330 Engine Control Panel (4P)



360 Engine Control Panel (4P)

CONTROLS AND INDICATIONS

The systems manually operated controls are located on the ENGINES sections of panel 4P and consist of a ganged start master switch for each engine, a start switch, and an ignition switch. These are operated in conjunction with the appropriate setting of the ELECTRICAL MASTER switch on the adjacent electrical SECTION of the panel.

The starting circuitry includes two warning annunciators, one white and one amber, for each engine. An illuminated white annunciator means that ignition is selected and operating. The illuminated amber annunciator indicates the starter is running.

START ABORT

In the event of a hung or hot start, the fuel lever is selected OFF, the start switch to STOP, and the ignition switch to OFF. Perform the ventilation cycle during the next start attempt.

CAUTION

If there is a hot start, do not set the start switch to stop until ITT de-creases. If high ITT continues, move the LP FUEL valve to SHUT.

AIR STARTING (STARTER MOTOR)

Normal starting procedures are used with the one exception, the PROP lever is positioned to taxi (verses feather) prior to initiating the start sequence.

AIR STARTING (WINDMILL)

This method is used only if the starter fails to work. The PROP lever is positioned to taxi however the propeller may remain in the feathered position.

NOTE

Yawing the aircraft from side to side may be necessary to unfeather the propeller. When Ng reaches 9%, select the ignition to EMERG and the FUEL lever to GROUND.

FIRE PROTECTION

INTRODUCTION

Fire detection and protection is provided for the engines, flight/passenger compartments, lavatory, and baggage compartments. The systems consist of fire loops, smoke detectors, automatic and manual controls, aural and visual warnings, airframe mounted and portable bottles.

GENERAL

Fire protection is provided for the safety of all personnel and the integrity of the aircraft. Various systems are used for detection, warnings and for fire suppressants. Some systems are passive, and others are active involving the aircrew and/or flight attendant.

ENGINE FIRE PROTECTION AND DETECTION

The powerplants use structural design as a form of passive fire protection. A fireproof bulkhead provides protection by separating the power-plants from the wing structure and the three engine zones (exhaust, intake and accessory) are also separated by a fireproof bulkhead. Active protection consists of two fire bottles for each engine that disperse chemical fire retardants at the pilot's command.

ENGINE FIRE DETECTION

Each engine has a continuous fire sensing loop which provides aural and visual warnings in the flight compartment. The loop monitors the temperatures around the engine and provides a warning if the "safe" temperatures are exceeded. The warnings are cancelled automatically, and the system returns to standby if the temperatures return to normal ranges.

The Shorts aircraft can be equipped with several different types of loops with different operating principles. The warning and procedures are the same and applicable to all type of loops.
Each engine loop contains a fault indication circuit which continually monitors the loop and the control unit. If a malfunction develops, indications of a fault are displayed to the pilots by the respective amber FAULT annunciator on the CWP. The fire warning annunciators may not illuminate in this case.

The right and left 28-VDC essential services bus bars provides the electrical power to operate the fire warning system.

ENGINE FIRE WARNING

When temperatures exceed the safe limits, the loop signals the control unit which activates the alarm switch.

The warnings include:

1. An aural warning bell Illumination of:
2. The red FIRE (push to cancel) light on the CWP.
3. The respective Shot 1 and Shot 2 red Engine Fire Extinguisher, switch lights on the 4P engine panel.
4. The red FUEL LEVER warning light on the engine control quadrant panel 3P where fitted.
5. The ENGINE LP FUEL VALVE lever on the overhead console

NOTE

On post-modification 7114 aircraft (construction numbers SH3617 and subsequent) and on prior construction numbers when service bulletin SD360-28-11 is incorporated, the ENGINE LP FUEL VALVE lever lights only illuminate when the related FUEL lever (centre console) is set to OFF during engine shutdown.

ENGINE FIRE TEST

Test switches on panel 11P allow the fire warning system to be tested for system integrity. It specifically checks for the resistance and continuity of each loop and the serviceability of the control unit.

The ENGINE FIRE WARNING test switch allows the system to be checked for the ap-propriate fire indications (bell and warning lights) and fault indications.

The switch is spring loaded to the centre position. Pressing “FIRE” tests fire indications and pressing “FAULT” test’s fault indications.

During the fire test (selecting the FIRE position), pressing the FIRE P to C indicator on the CWP confirms that the bell can be silenced and that all other warning lights re-main illuminated. Selecting the FAULT position tests the integrity of the fire loop and illuminates the appropriate Fire Fault L or Fire Fault R on the CWP.

ENGINE FIRE BOTTLES

The two fire bottles provide two separate ap-plications of fire retardant to each engine. The bottles contain BFC gas and are located in the nacelle aft of the rear engine firewall.

The pilot selects and activates the appropriate ENGINE FIRE EXTINGUISHERS switch in the flight compartment. Each bottle is subsequently discharged by electrically firing the squib (cartridge). Once a bottle has been dis-charged, a white light is illuminated on the engine section of panel 4P.

The right and left 24-VDC battery bus bars pro-vide electrical power to fire the squibs on the fire bottles. The two bottles for each engine use a different battery for its power source, i.e., Shot 1 from its respective battery and Shot 2 from the opposite battery.

SMOKE DETECTORS

Smoke detectors are used in the cabin (300 series), baggage areas, and toilet for fire warnings. Depending on the modifications to the aircraft or the date of manufacture, some of the detectors will not be installed.

DESCRIPTION

The smoke detector works on an optical principle and consists of a photocell and lamp in a lightproof chamber. Either or both detectors can trigger the warning annunciators in the flight compartment. The amber SMOKE FWD or SMOKE AFT annunciator on the CWP identifies which baggage compartment has triggered the alarm. The detectors will reset when the smoke density decreases below the trigger threshold.

NOTE

The fire bell does not sound with the smoke detectors.

Electrical power comes from the right 28-VDC essential services bus bar.

TESTING AND INDICATION

Testing is accomplished by selecting the SMOKE DETECTOR FWD/AFT switches on panel 11P. Each of the test positions checks the sensors and its appropriate circuitry. Confirmation that the system is functional is indicated by illumination of the appropriate warning annunciator.

BAGGAGE COMPARTMENT

Each baggage compartment, forward and aft, has two smoke detectors and an amplifier. Warning indicators are located in the flight compartment on the CWP.

BAGGAGE FIRE EXTINGUISHER

The aft baggage area on aircraft after modification A8515 or Service Bulletin SD360-53-37 is provided a fire extinguishing system. A single fire bottle filled with Halon can be released in the aft baggage area through a switch in the flight compartment. The pilots are alerted to the smoke by the illumination of the amber SMOKE AFT annunciator on the CWP and the red control switch/ indicator on panel 1P.

PORTABLE FIRE EXTINGUISHER

Fire protection for the flight compartment, passenger compartment, and baggage areas are provided by three hand-held fire extinguishers. One is located in the flight compartment and the other two at the aft end of the passenger compartment below the flight attendant's control panel.

The fire extinguishers contain HALON gas and are discharged by depressing the trig-ger. This action breaks a seal and provides indication that the extinguisher has been used. When the trigger is released, the extinguishment is stopped until the trigger is depressed again.

ICE AND RAIN PROTECTION

INTRODUCTION

The aircrafts ice and rain protection systems are designed to anti-ice or de-ice critical surface areas of the airplane. The systems are designed for in-flight operations, although some systems may be used during ground operations.
The airplane is certified for flight into known icing conditions with the installed standard anti-icing equipment.

GENERAL

Anti-icing, de-icing, and rain protection are accomplished by engine bleed air, electrical heating, rain repellent solution, and mechanical removal.

The leading edges of the wings and stabilizers are de-iced by using engine bleed air to pneumatically inflate rubber boots.

The engine inlets, pitot-static, stall warning systems, propellers, and windshield are all electrically heated.

The engine intake inertial anti-icing system and windshield wipers are mechanical methods used for ice and rain protection.

An ice detection system and inspection lights help provide a means to detect ice build-up.

ROTARY ICE DETECTOR

Description

A rotary ice detector unit is installed on the bot-tom fuselage, forward of the nose gear. The motor torque required to drive the rotary unit increases as ice accumulates. The increased motor torque due to ice accumulation causes the motor unit to rotate slightly which illuminates the amber ICE annunciator on the central warning panel (CWP).

OPERATION

The rotary ice detector is activated by selecting the ICE DETECTOR switch to ON. The switch is located in the anti-icing section of panel 4P. The system should be activated when operating in known icing conditions or with visible moisture and the OAT below +4° C.

Electrical power for ice detector operation comes from the right 115-VAC bus bar. The right 28VDC essential service bus bar provides power for the warning indicator.

WING ICE SPOTLIGHT

An ice spotlight illuminates the leading edge of the left wing, allowing visual inspection of the leading-edge during icing conditions. The ICE SPOTLIGHT ON/OFF switch is located on the anti-icing section of panel 4P.

ICE PROTECTION PNEUMATIC SOURCE

WING AND EMPENNAGE DE-ICE SYSTEM

De-icing boots, inflated by engine bleed air, are installed on the leading edge of the wing's horizontal stabilizers, and vertical stabilizer.

COMPONENT DESCRIPTION

The leading edges of the wings outboard of the engines and the horizontal and vertical stabilizers have inflatable rubber boots in-stalled to shed ice accumulation. The wings have an inner and outer boot and each stabilizer, one boot.

The boots consist of a smooth rubber fabric blanket containing small expandable pneumatic tubes and are cemented to the leading edge of the aerofoils. With proper care, life expectancy can be up to five years.

Bleed air is initially directed through a two-position shut-off valve, NORMAL (open) and SHUT (closed). SHUT is used when an abnormal situation exists, making it necessary to stop all engine bleed air from entering the wing and empennage de-ice system manifold.

Bleed air is passed from the engine to a pressure regulator, a common manifold, and to the ejector flow control valves that direct air into the boots. These valves serve two purposes, inflation of the boots according to the selected timer schedule and deflation of the boots when the system is not being used. When the system is not being used, the ejector flow control valves create a partial vacuum. The vacuum draws the boots flat to the leading-edge wing surface, thus retaining the wing`s aerodynamic shape.

OPERATION

The TIMER control is a three-position switch, OFF, 1 MIN, and 3 MIN. When either 1 or 3 MIN is selected, bleed air first enters the inner wing boots for 5 seconds, then the outer wing boots for 5 seconds, and last to the empennage for 5 seconds. A period of rest for 45 or 165 seconds (1- or 3-MIN selection) completes the cycle.

The cycle continues as long as the TIMER is on (1- or 3-MIN selection). If the TIMER is selected OFF, the cycle continues until reaching the starting point. Momentary operation of the control switch from OFF to 1 or 3 MIN se-lection, then back to OFF provides for one complete cycle.

The ejector flow control valves are heated when the PITOT/STATIC/STALL switches, panel 4P, are selected ON.

INDICATIONS AND WARNINGS

All indicators and warning lights are located on the pneumatic section of panel 4P and the Central Warning Panel (CWP).

The positions of the shutoff valves, open or closed, are indicated by the illuminated green NORMAL or the amber SHUT lights. These lights are located above their respective control switches.

Five green indicator lights on panel 4P show when the ejector flow control valves are open, allowing bleed air to enter their respective boots.

A high pressure or low pressure situation il-luminates the amber DUCT PRESS light on panel 4P and the amber BLEED light on the CWP. The high pressure switch is activated when the duct pressure exceeds 24 PSI, and the low pressure switch is activated when pressure is 5 psi or less. These warning systems are wired in with the engine oil pressure system and are only functional when the engines are running.

NOTE

These indications are advisory only and appropriate action must be manually initiated.

Electrical power for the wing and empennage de-ice system comes from the left and right shedding bus bars.

ICE PROTECTION ELECTRICAL SOURCE

DESCRIPTION

Each propeller blade has an electrically heated mat bonded to it that provides anti-icing protection. Each propeller's heating system is separately controlled by its own timer control located on the anti-icing section of panel 4P.

TIMER CONTROL SWITCH

The timer control switch has three positions, ON–OFF–TFR. ON and OFF activates and de-activates the system. TFR transfers the timer functions from the failed timer to the oppo-site timer.

INDICATOR

The heating cycle indication is provided by il-luminating the green ON EI above each control switch on panel 4P.

Electrical power for heating comes from the left and right 28-VDC main bus bars and power for system control comes from the left and right 28-VDC shedding bus bars.

OPERATIONS

Once the system is activated, each blade begins a heating cycle for 90 seconds then powers off for 90 seconds. If TFR is in use, the heating cycle is continuous, and the light re-mains illuminated ON (on the system with the good timer).

The timer switches are wired in series with the engine oil system and must have sufficient oil pressure (engine running) to close the necessary relays (model 300 only).

NOTE

The TFR switch is functional when it becomes necessary to use that timer from an engine that has been shut down.

When the timers are initially switched on, the timing sequence starts at the timing position when the system was turned off.

ENGINE AIR INLET

DESCRIPTION

The lip of the engine intake is electrically heated to provide intake anti-icing protection. A copper alloy heating mat is incorporated into the lip of the engine intake structure. It is imbedded into the fiberglass fabric and coated with Erocoat Black for protection from the environment.

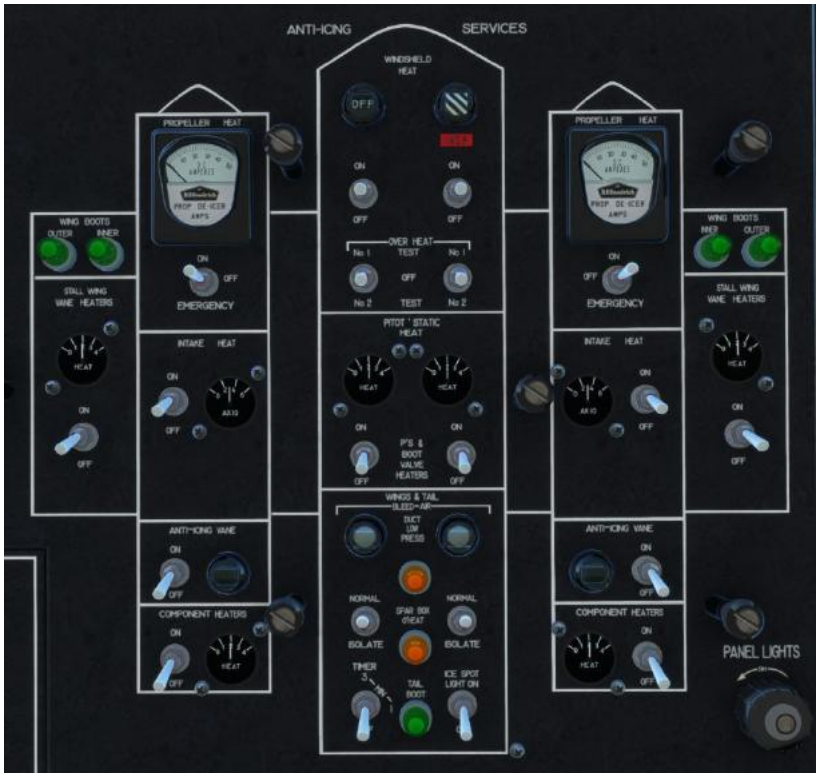
The heating elements automatically shut off when the temperature reaches 80°C and restarts once the temperature falls to 70°C.

OPERATIONS

The two-position (ON–OFF) INTAKES switch provides power to the system.
Indication that the system is heating is provided by an illuminated green ON annunciator light above the control switch. System controls are located on the overhead panel, 4P.

The system should be activated when operating in known icing conditions or with visible moisture and the OAT below +4°C.

Electrical power for systems operation comes from the left and right 28-VDC main bus bars. Power for the controls and indicators comes from the left and right 28-VDC shedding bus bars.



330 Anti-Icing Services Panel (4P)

360 Anti-Icing Services Panel (4P)

WINDSHIELD

DESCRIPTION

The two forward facing windshields are protected from icing by electrical heating elements. The windshields, three acrylic plies laminated to an outer glass panel, have a heating element embedded within the lamination.

The heating elements have two sources of control, the normal controls that maintain a windshield temperature range of 31°C to 39°C and overheat controls that maintain temperatures between 39° C and 60°C.

The normal control cycles the heat on and off to keep the temperatures within the specified range. When the heat is on, a green NORM annunciator is illuminated.

The overheat control provides a backup by cycling the heating element off if temperatures reach 60°C. Heating is restored when the temperature decreases to 39°C.

An amber O/HEAT annunciator and the green NORM annunciator illuminate when within the overheat range (39°-60°C). The O'HEAT annunciator is extinguished when the temperature reaches 60°C (power is removed).

Electrical power comes from the left and right main bus bars.

The system should be activated when operating temperatures are below +4°C, in visible moisture.

OPERATION

Control for the windshield heating is provided by two switches, ON–OFF, in the anti-icing section of panel 4P. The indicators are located above the switches.

Windshield heating should be on if the OAT is below +4°C in visible moisture. If the windshield heat fails and OAT is –15°C or below, keep IAS below 190 knots.

PITOT-STATIC AND STALL WARNING VANE

DESCRIPTION

Anti-icing protection for the pitot heads, static vents, and stall warning vanes is made available by heating elements within each unit. Separate controls, power supplies, and indicators are furnished to each left and right component group.

Two ON–OFF switches, PITOT/STATIC/STALL, on PANEL 4P provides system control. The switches also control operation of the heating elements for the pneumatic system ejector flow control valves.

Electric power for heating comes from the left and right 28-VDC main bus bars. Power for the warning and indicator lights come from the left and right essential service bus bars.

The system should be activated when operating in known icing conditions or with visible moisture and the OAT below +4°C.

INDICATION

A two-window annunciator is located above each switch and illuminates a green STATIC and STALL light when the system is functional. The illuminated STATIC and STALL annunciators provide confirmation that the respective static vents and stall warning indicators are being heated. Below the STATIC/STALL annunciators are annunciators that will illuminate amber LOW if the aircraft is on the ground and the respective weight switch is functional. This indicates the respective stall vane is being heated by a low power setting. When the aircraft is airborne, and during the stall warning test, the indicator switches from amber LOW to a green HIGH, indicating the stall vanes are being powered by a high power setting.

An amber PITOT L and PITOT R annunciator light on the CWP illuminates when power is not supplied to the respective pitot heating elements (Figure 10-11). The annunciators illuminate when either the PITOT “STATIC“ STALL switches are off or when they are on and there is a failure in the pitot heating elements.

ICE PROTECTION— MISCELLANEOUS

ENGINE INTAKE INERTIAL DESCRIPTION

Two mechanical linked vanes in each engine intake cowl deflect air flow, preventing ice and snow particles from entering and/or clog-ging the compressor inlet screen. The first vane causes the air flow to speed up through the venturi effect, and the second vane deflects the ice and snow overboard through the bottom of the engine cowling. The position change of the second vane exposes a passage for the ice and snow to vent overboard (Figure 10-12).
This procedure reduces drag by allowing air to pass from the engine inlet immediately overboard rather than through the engine. If an engine fails during take-off power (88%NG or greater), propeller auto feathering is initiated which also activates the circuitry for the electrically controlled anti-ice vane. The vane auto-deploys, regardless of switch position, to the anti-ice position effectively reducing the drag on the failed engine.

NOTE

Retarding either power lever below approximately 88% NG (power levers activate a microswitch) over-rides the auto-deploy feature allowing the vanes to move to their normal position. Selection of the appropriate INTAKE ANTI-ICING switch to ON should be accomplished prior to retarding the power lever.

OPERATION AND INDICATION

The system is controlled by two ANTI-ICING INTAKE switches located on panel 4P. A green NORMAL annunciator above the switch is illuminated when OFF is selected. A white ANTI-ICE annunciator illuminates after transit of the vanes when ON is selected.

Electrical power for the vane movement comes from the left and right 28-VDC main bus bars.

The system should be activated when operating in known icing conditions or with visible moisture and the OAT below +4°C.

WINDSHIELD WIPERS

Each front windshield has an independent wiper and controls for each pilot. Controls include an ON–OFF–PARK switch and a FAST–SLOW switch, both located on panel 1P.

Selecting the switch to PARK positions the wiper blade on the outside edge of the windshield and when released, the switch is spring-loaded and automatically returns to the OFF position.

Electrical power is supplied by the left and right 28-VDC essential services bus bars.

CAUTION

Do not operate wipers on a dry windshield or at airspeeds in excess of 150 knots.

WIPER CONTROL PANEL (1P)

AIR CONDITIONING

INTRODUCTION

The aircrafts air-conditioning system provides warm or cool conditioned air to the crew and passengers. Compressor bleed air is mixed with refrigerated air to provide the desired temperature and fresh air supply. The system provides separate temperature zones for the crew and the passengers and works either automatically or manually.

OPERATION

A single air-conditioning system provides conditioned air to the flight and passenger compartments with separate controls for each. Bleed air from the engines provides the hot air for the system to work. Bleed air is ducted through pressure and temperature sensors to a heat exchanger, an air cycle machine, a water separator, mixing box, and then to ducting which provides conditioned air to the flight and passenger compartments.

Note

The Air Conditioning system is for visual indication only and will not affect the actual temperatures.

SYSTEM DESCRIPTION

GENERAL

The refrigeration unit is located on the fuselage roof just slightly aft of the flight deck. Engine bleed air is supplied from two bleed connections on each engine, P2.5 and P3. The air from both engines enters a common line to a dual heat exchanger and a three-wheel air cycle machine. It is compressed, cooled, and delivered to a water separator. From there, air enters the mixing box, where hot bleed air is added. Conditioned air is then directed to distribution ducts within their respective compartments.

OPERATION

Engine bleed air is supplied from two bleed connections on each engine, P2.5 and P3. P3 supplies bleed air during operation at low power settings. At higher power settings, P3 is inhibited, which allows only the P2.5 to sup-ply bleed air.

During P2.5 operation, if the temperature in the common bleed lines falls below 300° F, temperature sensors modulate the temperature control valve (TCV), allowing P3 bleed air to mix with P2.5 thus maintaining a temperature above 250° F.

Green P2.5 and amber P3 annunciators on air-conditioning panel 9P provide indication of the pneumatic source from each engine.

Bleed air passes through a hot-air shutoff valve (HA/SOV), a venturi, and a one-way check valve prior to entering the common pneumatic line. The one-way check valve al-lows single pneumatic source operation. Expect reduced performance when operating with one pneumatic source.

The HA/SOVs are controlled by ON/OFF indictor/switches on panel 9P. The vertical green electric indicator (EI) shows the valve is commanded open whereas the horizontal amber EI shows it is commanded closed.

The valve(s) will close automatically when the following occur:

- The reserve power system is activated (the respective valve will close).
- The temperature in the common line exceeds 525°F. (Both valves close and are locked out.)
- The pressure in the common line exceeds 35 psi. (Both valves close and are locked out.)

When either the temperature or pressure limits are exceeded, the BLEED light on the control warning panel (CWP) and the OVERHEAT or OVER PRESS light on panel 9P illuminate.

NOTE

The system can be reset when all the warning lights have extinguished. Reset is accomplished by selecting the HA/SOV off and tripping and resetting circuit breakers No. 90 and No. 211 on panels 1D and 2D, respectively.

Low pressure warning is provided by illumination of the DUCT LOW PRESSURE annunciator on panel 9P. Three sensors, one located in the common line and one after each HA/SOV, can activate the warning if the duct pressure falls to 5 psi or below. The HA/SOV must be fully opened for its respective sensor to function.

Warning annunciators are provided if the temperature exceeds 110° C in the spar box. The BLEED annunciator on the CWP, the SPAR BOX O'HEAT annunciator on anti-icing panel 4P and the SPAR BOX OVERHEAT annunciator on air-conditioning panel 9P will illuminate.

SYSTEM OPERATIONS

GENERAL

Air conditioning with the engine's bleed air is initiated by selecting the bleed-air switches to ON. Prior to selecting the switches ON, both engines should be running with the power lever set at flight idle. The bleeds should be selected ON in turn, with a minimum interval of three seconds between selecting each bleed.

Normally, P2.5 provides bleed air for about ten seconds until P3 achieves operating temperature, then P3 supply will be chosen automatically at low power settings. This can be identified by a rapid rise in ITT (40 to 60° C), a fall in Ng (about 1.5%), and an increase in noise from the air ducts. Also, under certain conditions (usually associated with low ambient temperatures and/or pressures), P3 will not be achieved automatically. This can be rectified by momentarily selecting ground fine. Thereafter, P3 supply should be monitored, observing the limitations of 765° C above 62% Ng, and 715° C below 62% Ng.

NOTE

Use bleed air from both engines for maximum cooling and heating.

NOTE

For maximum heating on the ground, the MAIN FAN switch should be ON provided the OAT is above –10° C.

NOTE

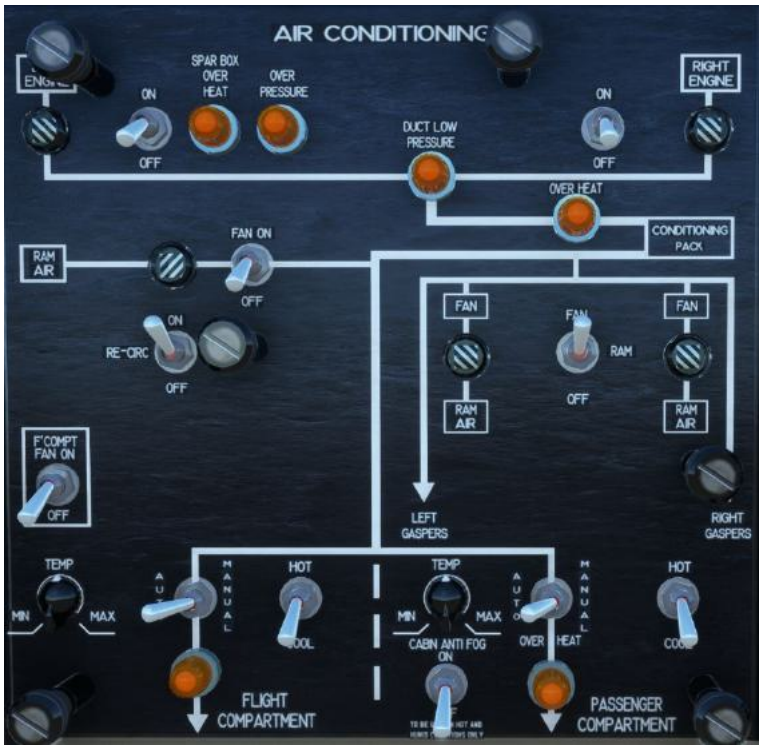
For maximum cooling, select the SUMMEINTER switch to SUMMER. The MAIN FAN switch should be OFF.

NOTE

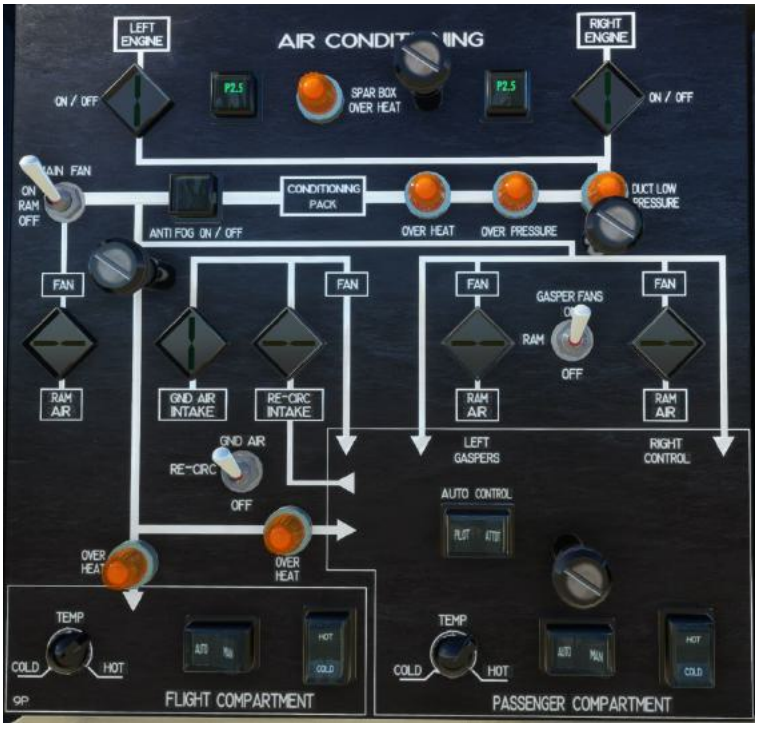
In hot humid conditions, if fogging occurs, select the ANTI FOG switch to ON and the MAIN FAN switch to OFF.

NOTE

The engine bleed switches are turned OFF for take-off.



330 Air Conditioning Panel (9P)



360 Air Conditioning Panel (9P)

HYDRAULIC POWER SYSTEMS

INTRODUCTION

Hydraulic power in the aircraft is provided by two engine-driven pumps and backed up by a series of accumulators. Hydraulic power is used by the landing gear, brakes, flaps, and nosewheel steering.

GENERAL

The aircraft uses a single hydraulic system, powered by two engine-driven variable displacement pumps. Fluid is stored in one reservoir that is common to the four using systems. One accumulator provides for fluctuations in demand and pressure, and accumulators also provide backup to the landing gear, wheel brakes, and flaps.

The engine-driven pumps maintain a pressure of 3,000 +200/-100 psi under a no load condition. The system is designed for one pump to handle all the hydraulic load if necessary. The reservoir has a capacity of 1.32 gallons.

HYDRAULIC SYSTEM COMPONENTS

GENERAL

This section covers the functions and locations of the various hydraulic components. Refer to the hydraulic system schematic.

RESERVOIR

One common reservoir is used for all the hydraulic systems. It is basically a cylinder housing a floating piston. The piston divides the chamber into two compartments, one for hydraulic fluid and the other for nitrogen. The reservoir has a capacity of 1.32 gallons (5 litres) and is precharged with 25 psi of nitro-gen.

Quantity indication is measured by the physical position of the piston within the cylinder. The quantity indicator on the reservoir is a direct readout mechanical gage. The pilot's indication is provided by an electrical transmitter that is operated by the reservoirs gage drive mechanism.

Pre-engine start quantity readings should be in the yellow or black sector of the hydraulic CONTENTS gage. Reading may be higher if the emergency brake accumulator had been used and is now empty. Upon engine start, the reading moves to the green sector.

The reservoir is located in the upper area of the fuselage just aft of the main spar.

SHUTOFF VALVES

An electrically operated shutoff valve is introduced in the inlet line to each engine-driven hydraulic pump. The valves are designed to stop the flow of hydraulic fluid from the reservoir to the engine driven hydraulic pumps in the event of an engine fire. The valves are controlled by the PUMP INLET VALVE L and R switches on panel 7P. The valves also are closed when the L.P. fuel valves are positioned to SHUT (panel 4P).

NOTE

The microswitch at the L.P. fuel valve control levers ensures closure of the appropriate shutoff valve during engine fire emergencies or anytime the LP valve is closed.

Electrical Indicators (EIs) on panel 7P provide confirmation of the PUMP INLET VALVEs position, OPEN or SHUT.

PRIMARY PUMPS

System hydraulic pressure is developed through two engine-driven pumps. The pumps are mounted on the engine's accessory gearbox and have no controls available to the pi-lots. The pilots are able to monitor the temperatures of both the fluid and pumps and can control the flow of fluid to the pumps by the shutoff valves on panel 7P.

HIGH PRESSURE RELIEF VALVES

Two high-pressure relief valves, one for each pump, are designed to protect the system from high pump pressures. If the pump pressure in-creases, the valve opens. When system pressure reaches 3,500 +50/–00 psi the valve opens and reduces pump pressure to approximately 450 psi. The valve remains in the open position while there is flow through the valve (engine-driven pump still functioning). The valves are located between the pump main pressure line and the reservoir.

ACCUMULATORS

The hydraulic system incorporates four nitrogen-filled accumulators to maintain system pressure and to provide backup for emergency operations. The accumulator's de-sign is similar to the reservoir, a cylinder with a floating piston that separates the gas and fluid. Three of the accumulators (emergency brake, gear and flap) incorporate one-way check valves. This allows the accumulator to trap and store hydraulic pressure for use in an emergency.

The accumulators precharge pressures are monitored by gages on hydraulic panels 7P and the hydraulics servicing panel. The emergency accumulators for the landing gear and wheel brakes can be monitored from panel 7P, while all the system accumulator pressures can be monitored on the hydraulic servicing panel.

Checking the precharged pressures requires that the hydraulic pressures be reduced in the main system as well as the emergency systems. Once the systems are bled down, the pressure indications should reflect accumulators precharges, approximately 1350 psi (at 70°F OAT).

MAIN SYSTEM ACCUMULATOR

The main system accumulator provides a smoothing effect on the engine-driven pumps during fluid demands and sudden changes in system requirements.

LANDING GEAR EMERGENCY ACCUMULATOR

This accumulator allows the landing gear to be extended and locked down when the normal hydraulic system has failed. This does not provide for gear retraction.

BRAKE EMERGENCY ACCUMULATOR

This accumulator allows the brakes system to be functional for a limited number of applications when the normal hydraulic system has failed. The antiskid system is inoperative under these conditions, plus there is no wheel brake pressure indications. Also brake inhibiting is inoperative.

FLAP ACCUMULATOR

The flap accumulator is designed to hold the flaps in position should the hydraulic system fail. The flaps will hold the selected position for approximately seven minutes. The UP flap position has an internal mechanical lock, which is internal to the actuator, and is not dependent upon hydraulic system pressure to remain up. This accumulator is electrically activated.

HYDRAULIC SYSTEM OPERATION

During normal operations, hydraulic fluid, pressurized by the engine-driven pumps, is drawn from the reservoir, through filters, and made available to the using systems. The PUMP INLET VALVEs are normally in the OPEN position except to check for abnormalities on panel 7P.

Gages are available to monitor the system quantity and pressure, and to monitor the emergency accumulator pressures for the landing gear and wheel brakes. High temperature warning are provided by a FLUID O'HEAT annunciator light and two pump temperature gages. These warning indica-tors are on panel 7P.

Failure of one engine-driven pump cannot be detected while both engines are running and both PUMP INLET VALVE switches are in the OPEN position. Checking the pumps requires each PUMP INLET VALVE switch to be al-ternately selected SHUT and monitoring the system pressure. Hydraulic pressure from one pump, even though reduced, is still sufficient for normal system operations.

PUMP LOW PRESSURE WARNING

A pressure switch in the supply line from each pump triggers a warning if the pressure falls below 1,500 +100/-00 psi. The associated warning lights, HYD L, HYD R, are located on the CWP. During engines start, the low pressure warning lights are illuminated until reaching ap-proximately 2000 psi, then they extinguish until system pressure drops below 1500+100/-00 psi.

HYDRAULIC OVERHEAT WARNING

Temperature of the returned hydraulic fluid is measured at the common return line prior to the reservoir. If the temperature exceeds 107°C, the HYD L, HYD R, (CWP) and FLUID HEAT (panel 7P) annunciator lights are il-luminated advising of a possible problem. Nothing is automatically shut down.

PUMP TEMPERATURE

Pump temperatures are monitored on panel 7P. A red line is provided at the excessive temperature of 115° C. Additional warnings or indications are not provided should pump temperatures exceed normal operating limits.

330 Hydraulic Services Panel (7P)

360 Hydraulic Services Panel (7P)

GEAR CONTROL

An electric selector lever is located on panel 1P for normal operations. The lever moves in a slot between two gated positions, UP and DOWN.

Each position activates a solenoid on the landing gear selector valve that directs main system hydraulic fluid into the gear actuators for either retraction or extension.

Electrical power for gear control is taken from the 28-VDC right essential services bus bar. Without electrical power, the gear cannot be lowered normally.

The selector lever is prohibited from being moved to the UP position when the aircraft is on the ground (weight switches). The re-striction can be mechanically overridden to permit on-the-ground retraction. This is accomplished by twisting the selector lever knob clockwise approximately 60° and then selecting the UP position.

Emergency lowering of the gear can be accomplished by pulling the LANDING GEAR DOWN EMERGENCY control lever on the flight compartment roof console. The lever is cable connected to the emergency gear accumulator and a manual hydraulic fluid three-way selector valve. This valve directs hydraulic fluid to the extension lines and allows fluid from the retraction lines to return to the reservoir.

INDICATION

Gear position is provided by three annunciator lights that are illuminated green when the gear is down and locked. Each light also illuminates red when the gear is in transit or if the respective lock has not engaged.

The warning horn will sound if all three gear are not locked down (three green down lights) when:

- Either or both power levers are retarded to approximately FLIGHT IDLE, and/or
- The flap selector lever is selected beyond 15° down.

The horn can be silenced if it is activated be-cause of power lever position but not for flap selection. Selecting the L/GEAR HORN switch to CANCEL silences the horn for power lever position only.

NORMAL OPERATION

Movement of the gear selector lever energizes electrical solenoids that control flow of hydraulic fluid to the gear actuators. The gear se-lector lever requires 28 VDC from the right essential services bus bar. The gear uplocks and down locks require hydraulic pressure to release but lock mechanically once the gear is in the selected position.

EMERGENCY EXTENSION

Emergency lowering of the gear can be accomplished by pulling the LANDING GEAR DOWN EMERGENCY control lever on the flight compartment roof console.

NOSEWHEEL STEERING

GENERAL

The aircrafts hydraulic system provides power to operate the hydraulic steering rack on the nose gear. Control is by the tiller (steering handle) on the pilots left side, below panel 7P.
Steering is available up to 55°either side of centreline.
Nosewheel steering is available only while the airplane is on the ground (weight switch).

OPERATION

Nosewheel steering requires:

- System hydraulic pressure
- 28 VDC from the left essential services bus bar
- Nosewheel steering switch ON (panel 7P)
- Weight switch operation (on ground)

With these requirements met, the pilot can use the tiller (steering handle) to effectively taxi the airplane 55° either side of centre line. If turns become greater than 55°, steering control through the tiller is lost and free-castering is automatically initiated. Steering control becomes effective once the turn has decreased to 55° or less.
Turns made by differential thrust or brakes will automatically move the tiller (steering handle) due to feedback from the steering control unit.

Note

Due to limitations within MSFS The rudder controls will be linked with Nosewheel Steering unless control lock is applied.

Full castering of the nosewheel (180°) is available due to the automatic disengage design feature of the system at 55° either side of centreline.

Once the airplane is airborne, centering cams automatically centre the nosewheel. The centering cam is effective within 30°of centreline.

CAUTION

The steering tiller must not be moved in flight due to the stretching of the nosewheel input circuit cables.

BRAKES GENERAL

Each main wheel is equipped with a brake system that incorporates a Maxaret antiskid unit. Main system hydraulic pressure that is reduced to 1,500 +150/-50 psi is used for nor-mal braking. A brake accumulator is used for emergency braking.

Brakes can be applied from either the pilots or copilot's position.
Normal brakes use main system pressure through the Maxaret antiskid units.

The emergency brake system from the brake accumulator bypasses the antiskid unit and goes directly to the brakes. Consequently, the antiskid brake system will be inoperative.

OPERATION

Normal antiskid brakes are available to both pilots anytime normal system hydraulic pressure is available. Normal system hydraulic pressure is reduced to 1,500 +150/-50 psi as indicated by the two gages, WHEEL BRAKES LEFT and RIGHT, mounted on panel 7P.

The wheel brake indicators are not functional when the emergency brake accumulator has been activated. Reference must be made to the EMERGENCY ACCUMULATORS WHEEL BRAKES gage for remaining system pressure. When the emergency accumulator reaches approximately 1,500 psi (close to precharge pressure), braking capability is nearly exhausted.

NOTE

The brake system is inhibited when the gear is being retracted. The brake inhibitor pressure reducing valve cuts out main system pressure to the brake control unit when the gear is selected up by sensing hydraulic pressure in the gear uplines.

Left and right toe pedals for both pilots allow for selective wheel braking to aid in directional control, as well as stopping.

The Maxaret antiskid system operates full-time and allows for skid protection through all ranges of speed.

NOTE

The antiskid system is inoperative when the emergency brake system is activated.

NOTE

The wheels must be allowed to spin up (approximately 12 kts) before the Maxaret antiskid system will function. Therefore, there is no lock wheel protection below 12 knots.

PARKING BRAKE

The parking brake normally uses hydraulic system pressure through the Maxaret anti-skid units; however, it can use the emergency system pressure. The emergency system uses the brake accumulator and bypasses the anti-skid unit, going directly to the brakes. The parking brake can be set with the emergency brake handle pulled, effectively allowing all available pressure to the brakes.

The parking brake handle is located below panel 7P, on the pilot's left side.

FLIGHT CONTROLS

INTRODUCTION

The aircraft uses conventional control columns, control wheel, and rudder pedals to actuate the primary flight control surfaces, all of which incorporate trim tabs. Trimming of the aircraft is by cable-operated controls which adjust the ailerons, rudder, and elevator tabs. The dual flight controls all operate manually, without hydraulic power assistance. A control lock restricts engine power and locks each primary control in a neutral position. The flaps are operated hydraulically by servo-valve actuators.

GENERAL

The flight control surfaces consist of metal ailerons, rudder, elevators, and wing flaps.

Operation is performed manually by push/pull rod and lever systems from conventional control columns, handwheels, and rudder pedals. The rudder pedals are pilot adjustable for in-dividual leg length. Routing of the push/pull rods and cables are segregated in the fuselage areas which are most susceptible to damage due to catastrophic powerplant failure or propeller intrusion. This segregation insures that should the primary or trim controls become damaged, backup controls are available.

AILERONS CONTROL

The ailerons are located on each wingtip, out-board of the flaps. Movement is differentially controlled by a system of push/pull rods and levers which directly connect the control handwheels on the flight deck with the inner hinge arm on each aileron.

Each of the control column mounted hand-wheels is connected by a series of cables, pulleys, sprockets, bell-cranks, and chains to the ailerons for roll control.

TRIM

Each aileron is equipped with a trim tab which is operated by a handwheel on the centre console. A trim indicator is located forward of the trim control handwheel.

ELEVATORS CONTROL

Elevator movement is controlled by a series of push/pull rods and levers from the control columns to the elevator torque tubes.

TRIM

Two trim tabs, one for each elevator, provide for neutralizing flight controls. The trim hand-wheel is mounted on the centre console with the indicator located to its right side.

RUDDER CONTROL

Rudder movement is controlled by a system of push/pull rods and levers which directly connect the rudder pedals on the pilot's floor with an operating torque tube on the bottom of the rudder.

TRIM

The rudder can be trimmed by a tab located on the rudder which aerodynamically assist movement beyond the neutral position. Trim position is indicated just forward of the rudder trim handwheel.

CONTROL COLUMNS

The flight control columns are a basic design with a horn-type handwheel coupled to a dual chain drive system for control inputs. They are symmetrically rigged and connected to the aileron and elevator control system to pro-vide dual capability. The hand-wheel is limited to 90° each side of neutral.

A three position microphone control switch, RT-OFF-INT, is mounted on the handwheel above either the left or right handgrip (pilot or copilot).

Each control column has an electrically activated stick shaker to warn the pilot of an approaching stall.

FLAPS

DESCRIPTION

The six flap sections, three on each side (inner, mid, and outer), are operated hydraulically by six actuators. Hydraulic system pressure maintains the selected down position and is backed up for a limited time by a flap accumulator should the hydraulic pressure fail. Flap selection is by a lever on the pilot's centre console.

The flaps can be placed into gated positions -:
0°, 4°, 8°, 15 and 35° on SD3-30.
0°, 5°, 15°, and 30° on SD3-60.

The flap indicator is on panel 1P at the copilot's position. Each of the six actuators have internal restrictors, which control the rate of movement, and an internal lock which engages when the flaps are fully up. The lock is hydraulically released when a down se-lection is made.

OPERATIONS

A springpot is incorporated to allow flap se-lection to be made in one quick movement. When a selection is made, the total input motion is absorbed by the springpot and released as all six actuators respond at their limited rate of travel. When the springpot resumes its settled or normal length, the actuators marginally run on until their operating levers reach the null position. This simultaneously creates a hydraulic lock at the actuators and stops the flaps in alignment at their selected position.

The adjacent ends of the mid and outer flaps are connected by a link which allows sufficient movement to accommodate normal variations of relative positions without loading the links. The links provide a safety feature to be dis-cussed later.

FLAP INDICATION

The Shorts SD3-60 uses one dual flap indicator that provides separate indications for the right inner flap and indications for the left mid and outer flap sections.
The indicator is located on the right side of panel 1P on SD3-30
The indicator is located above the 1st Officers Air Speed Indicator on SD3-60

28-VDC from the Right Essential Service bus bar provides required power.

FAILURES AND MALFUNCTIONS

CONTROLS JAMMING FAILURE

A signalling system is incorporated into the flap system to detect jamming of the flap controls between the actuators and the flap surfaces. The affected actuator stops (stopping its signal) which also stops the signalling of the remaining actuators. The remaining actuators continue operating until reaching a null position thus arresting all six surfaces in approximate alignment.

MECHANICAL FAILURE

If a mechanical failure occurs between an actuator and the inner flaps, the system remains functional because full asymmetry can be adequately corrected by aileron actions.

NOTE

A damper on each inner flap acts as a snubber and retards flap retraction in the event of a disconnect. The rate of retraction can be effectively countered by aircraft trim changes.

If the failure occurs between the actuator and either mid or outer flaps, the link which connects the adjacent ends of these flaps takes effect to allow full functioning of both flaps from one actuator.

SIGNALLING FAILURE

If a loss of signal occurs to a mid or outer flap actuator, the affected actuator becomes hydraulically locked. This affects the linked flap and it's signalling system simultaneously stop-ping all signalling systems and stopping the flaps in approximate alignment.

MAIN SYSTEM PRESSURE FAILURE

Backup for loss of main system pressure is provided by the flap accumulator pressure via a solenoid valve when the FLAPS selector lever is at any position other than fully up (0°). The backup pressure is introduced downstream of a check valve in the main system pressure line, thus ensuring the selected flap position for a limited time (approximately seven minutes).

CONTROL (GUST) LOCKS

The primary flight controls are capable of being locked in a neutral position for taxiing or parking. The locked position restricts the power lever movement (approximately 85%Ng, midway between flight idle and take-off power) during ground operations. The locking is accomplished by a lever on the pilots' aft centre console when the aircraft is on the ground (the weight switch prohibits activation inflight).

The CONTROL LOCKS warning light (panel 1P) illuminates when the control locking lever is not in the unlock position or if the controls are not fully unlocked when the control locking lever is in the unlocked position.

Power to lock the controls comes from the 28-VDC Right Essential Service bus bar.

STALL WARNING

Warning of an approaching stall condition is provided by two electrically anti-iced vane type detector units, one on each of the leading edges of the outer wings. The units electrically activate stick shakers on each pilot's column, then simultaneously sounds an audible (horn) warning and illuminates a red warning light. The warning system is operationally inactive on the ground except for the test function.

Each detector vane has three heating elements for icing protection. Selection of the appropriate PITOT/STATIC/STALL switch on panel 4P to ON initiates heat to the unit case, mounting plate, and detector vane. Heat is reduced on the ground by the addition of two resistors to the electrical circuit. Once in-flight, the resistors are removed (landing gear weight switch) and heating is increased. The stall EI illuminates when the ANTI-ICE PITOT/STATIC/STALL switch is ON.
The LOW indicator illuminates for ground operations and the HIGH indicator illuminates inflight (65AR and 67R only).

28-VDC left and right Main DC and left and right Essential Services bus bars respectively supply power for the stall warning system.

AVIONICS

INTRODUCTION

The aircraft has a full accompaniment of navigation and communication equipment necessary for commercial operations. This manual covers the equipment standard in the 200 series aircraft. It will be necessary to consult the Crew Manual and Airplane Flight Manual for those models having the electronic horizontal situation displays.

GENERAL

Two electrically heated pitot-static system are installed on the airplane. The systems are independent and supply the pilot and copilot's instruments from different sources of information.

AVIONICS MASTER SWITCH

The Avionics Master Switch controls electrical power to the flight and navigational instruments. It also functions as the single ON-OFF switch for those instruments.

The switch is located on panel 1P.

PITOT-STATIC SYSTEM

The aircraft incorporates two independent pitot-static systems that are electrically heated. Heating is provided through the anti-icing system (PITOT/STATIC/STALL switch) and heats the elements of the pitot tubes and the static ports.
The left and right pitot systems (P1 and P2) provide independent sources of information to the pilot and the copilots instruments.

VERTICAL SPEED

Vertical speed information is provided to the pilots by two conventional pressure-volume relational instruments. The pilot and copilot's indicators are separately connected to the S1 and S2 static system, respectively.

AIRSPEED

Two airspeed indicators, one for each pilot, are mounted on panel 1P. Each indicator receives pitot and static inputs from its respective source, S1 or S2 and Pitot 1 or Pitot 2. The indicators provide airspeed range from 0 to 260 knots and a selectable reference bug on the scale.

HIGH SPEED WARNING

An aural warning for high airspeeds is provided by activating a flasher unit that cycles the landing gear warning horn on and off. The unit is activated when airspeeds exceed 202 ±3 knots. The high airspeed switch is incorporated in the P1 and S1 pitot-static system.

OUTSIDE AIR TEMPERATURE

Outside air temperature is measured from the underside of the left wing and displayed in ^{o}C for the pilot on panel 1P. With the left engine in feather, the temperature may read high.

COMPASS SYSTEMS

GYRO COMPASS SYSTEM

Two gyro magnetic compass systems are in-stalled in the aircraft, one for each pilot. Each system provides information to the respective pilot's flight director system horizontal situation indicator (HSI) and the radio magnetic indicator (RMI).

The system uses flux detectors in each wing tip and two directional gyros to generate heading information that is used by the HSI and RMI.

Initial warm-up period of five minutes is re-quired before a heading can be generated. Both AC and DC electrical power is required.

STANDBY COMPASS

The standby compass is a self-contained magnetic wet compass that provides constant indication of aircraft heading.

The compass is mounted on the windshield centre pillar, visible by both pilots.

FLIGHT DIRECTOR SYSTEM

The flight director systems assist the pilot in manually flying the airplane or to monitor the autopilot (if equipped). The system uses two-axis flight director commands to drive two pointers.

The pointers, steering command bars (V-bars), flank the aircraft symbol on the attitude direction indicator (ADI). They always move in unison and give the pilot a “fly to” indication.

Each pilot has an identical but separate flight director system that consists of an ADI, a horizontal situation indicator (HSI), a flight control panel (FCP), a vertical gyro, a flight guidance computer (FGC), and an air data sensor.

The ADIs provide pitch and roll information and the HSIs provide magnetic heading and navigation information to the pilots. Warning flags indicate the status of various inputs to the system.

The flight control panel allows for mode se-lection, annunciation, and self-test.

The VOR/ILS/Marker Beacon system supplies information to the flight guidance computer. More information is covered in another section of this chapter.

Electrical requirements consist of 28 VDC, 26 VAC, and 115 VAC.

Flight Director Control Panel (1P)

FLIGHT DIRECTOR CONTROL PANEL

OPERATIONAL MODES

The FCP provides for selection of various modes of operations that control the V-bars on the ADI. The modes are:

HDG—Heading
APPR—LOC Approach
ALT—Altitude Hold
VS—Vertical Speed Hold
NAV—VOR Navigation
REV—Reverse (Back Course)
ALT SEL—Preselected Altitude
IAS—Indicated Airspeed Hold operational when the altitude preselect option is used)

MODE INDICATORS

The statuses of the various modes are indicated above the mode select buttons.
These annunciators illuminate when the mode is armed, activated, or failed (the annunciator will flash for a mode failure). The annunciators and colours are:

HDG (green)—Heading mode.
NAV (green)—VOR Navigation mode
ARM (amber)—VOR Navigation mode armed.
DR (green)—Dead Reckoning mode
VS (green)—Vertical Speed Hold mode
GS (green)—Glideslope mode.
GA (green)—Go Around mode.
APPR (green)—LOC Navigation mode
ARM (amber)—LOC Navigation mode armed.
REV (green)—Reverse mode
ALT (green)—Altitude Hold mode.
ARM (amber)—Glideslope armed mode.
IAS (green)—Indicated Airspeed mode.

MODE TEST

The self-test button causes the system to check the status of the unit's supplying data to it. If a failure is detected, the appropriate annunciator will light.

VERTICAL GYRO

Two vertical gyros, located in the fuselage roof, supply pitch and roll information to the flight directors. Each unit automatically fast erects during starting. Each pilot has a fast erect switch located on panel 1P. The switch is labelled ADI REMOTE GYRO.

The left gyro provides stabilization to the weather radar and the right gyro provides inputs to the flight data recorder.

FLIGHT GUIDANCE COMPUTER

Two FGCs process all the information from various sources to drive the respective V-bars and the warning flags.

AIR DATA SENSOR

The two air data sensors collect indicated airspeed, barometric altitude, and vertical speed information for the FGC.

ATTITUDE DIRECTION INDICATOR

The ADI provides a three dimensional for-ward view display to each of the pilots. A stationary delta-shaped aircraft shows the relationship between the aircraft's attitude and the horizon.

Steering guidance can be provided by the FGC through the V-bars.

Additional displays include glideslope and localizer deviation, radar altitude deviation, and an annunciator for decision height. An inclinometer at the bottom of the ADI shows the quality of flight.

Warning flags on the ADI cover the computer, gyro, radar altitude, and glideslope deviation pointer. A runway symbol provides deviation indications when an ILS frequency is tuned. When a frequency is invalid, a shutter closes removing it from view.

HORIZONTAL SITUATION INDICATOR

The HSI is an electro-mechanical instrument that provides the pilot information about aircraft heading, localizer and glideslope alignment, to and from indications, compass slaving information, and warning flags for system failures.

Heading and course selection knobs allow the pilot to mark specific headings and to select VOR courses to aid in navigation and course alignment.

STANDBY GYRO

Each pilot has a standby gyro on panel 1P. The gyro works on 115 VAC.

VOR/ILS/MARKER BEACON SYSTEM

VOR and glideslope information is supplied to the pilots by the VOR/ILS/Marker Beacon system. This is a dual installation with each pilot receiving information from his respective system. The system consists of navigation receivers, NAV controllers, radio magnetic indicators, repeater indicators, and antennas.

NAVIGATION RECEIVERS

The navigation receivers are each located on panel 2P and supply information to the respective pilots ADI, HSI, RMI, and the other pilot's backup ILS indicator.

NAV CONTROLLER

The pilots set the frequencies through the controllers that are located on panel 2P. The control head contains displays, function and frequency switches, and test and tune buttons.

The active frequency is displayed in the top window and the pre-selected frequency is dis-played in the bottom window. Transfer of the frequencies Occurs when the TUNE button is selected, i.e., the active becomes the pre-selected and vice versa.

The preselect (ACT PRE) switch allows the selected frequency to be changed by the frequency select knobs. It is not necessary to transfer the frequencies to pre-selected position for changes.

The frequency select knob consists of two concentric knobs, the larger controls the left three digits and the smaller controls the right two digits.

The function switch has four positions. They are: The test button activates the systems self-test.
OFF—Power is removed.
ON—Power is on.

The test button activates the system's self-test.

NAV RECEIVER

Two navigation receivers are installed, each capable of receiving 200 VOR/LOC channels from 108 MHz to 117.95 MHz and 40 glides-lope channels that are paired with the LOC channels. The units are identical but function independently of each other.

VOR/LOC SELF TEST

Select the controller function selector to NAV and select a VOR frequency. Set the course pointer at approximately 5° on the relevant HSI and hold the controller TEST button. The following should occur:

1. With a VOR signal present, the VOR/LOC flag will stay out of view, or if no signal is present, it will go out of view after approximately three seconds.
2. The course deviation bar will approximately centre and the HSI will indicate TO.
3. The corresponding RMI needles will indicate approximately 5° magnetic bearing.
4. All the marker lights flicker, and a buzz can be heard in the marker beacon audio.

When the button is released and a VOR signal is present, the VOR/LOC flag will show in one second and clear in five seconds. If no signal is present, the VOR/LOC flag will show in one second

LOC SELF-TEST

Select a localizer frequency and press and hold the controller TEST button. The following should occur:

1. With a LOC signal present, the VOR/LOC flag will stay out of view or if no signal is present, it will go out of view after approximately three seconds.
2. The course deviation needle and the runway symbol deflect right approximately one dot.
3. With a glideslope signal present, the GS flags will go out of view. In both cases, the GS needles will deflect down approximately one dot.
4. All three marker lights flicker, and a buzz can be heard in the marker beacon audio. When the button is released and a LOC signal is present, the VOR/LOC flag will show in one second and clear in five seconds, and likewise if a glideslope signal is present, the GS flags will show in 0.5 seconds and clear in 2.5 seconds. If no signals are present, the VOR/LOC flag will show in one seconds and the GS flag will show in 0.5 Seconds.

DISTANCE MEASURING EQUIPMENT

The DME readouts are built into the Pilot and 1st Officers HSI.

DME is automatically selected when appropriate LOC/ILS frequencies are selected. The capability exists for using separate frequencies for both the LOC and DME from the same controller.

OPERATIONS

The indicator has a three selectable readouts. It can display distance (KMS) to the selected station, ground speed (KTS) and time-to-station (MIN) to the selected station.

NOTE

KTS and MIN are only accurate when flying toward the station and slant range and ground distance are almost equal.

RADIO MAGNETIC INDICATORS

Two RMIs are installed at each pilot's station on panel 1P. Heading information is presented on a servo-driven compass card and read under a fixed lubber line. A heading warning flag appears to indicate any fault in the heading data.

Bearing information from the VORs and/or ADF is supplied by two needles, one a single shaft and the other a double shaft. The single shaft needle displays NAV 1 or ADF 1 and the double shaft needle displays NAV 2 (or ADF 2 if the aircraft is equipped).

The needles will park at the three o'clock position if the VOR signal is not valid or if a localizer is selected.

A repeater indicator for the localizer and glides-lope information is provided at each pilot's position. The information presented is repeated from the other pilot's data inputs. Warning flags appear if the data is invalid or failed.

AUTOMATIC DIRECTION FINDING

The aircraft is normally equipped with one automatic direction finding (ADF) system; however, it does have the capability for the second system. It works with the gyro compass system to provide headings to the ADF station. It operates in the frequency range from 190 kHz to 1749.5 kHz. The receiver and controller are Collins ADF-60A and CTL-62 respectively. The antenna is a Collins ANT-60A, an integrated loop and sense antenna mounted on the underside of the aircraft.

OPERATIONS

The control of the ADF is similar to both the COMM and NAV controllers. The pilots set the frequencies through the controller that is located on panel 2P. The control head contains two displays, function and frequency switches, and test and tune buttons.

The frequency in the top display is the active frequency or the one currently being used. The bottom frequency is the preselected frequency and is ready to be used upon selection, i.e., pressing the TUNE button.

The active frequency can be changed by placing the active/preselect switch to ACT and rotating the frequency select knob. The preselected frequency is changed in a similar manner except the active/preselect switch is placed to PRE. The frequency select knob consists of two con-centric knobs, the larger knob selects the two left digits and the smaller selects the three right digits. The smaller knob has a variable roll rate, i.e., the faster the knob is turned, the more digits per click are changed as compared to one digits per click with the larger knob.

The function switch has four positions:

- OFF—Power is removed
- ANT—Station identification is possible, but the RMI needles remain parked.
- ADF—Both audio and directional in-formation is available.
- TONE—Both audio and directional in-formation is available, and a one kHz tone identifies keyed continuous wave (CW) stations.

The TUNE button switches the active and pre-selected frequencies.

The TEST button initiates a self-test of the system. When pushed, the RMI needles will point to the 090° position and a one kHz tone is heard.

ANTENNAS

Three antennas are shared by the system. A two-bladed split antenna on the fuselage provides VOR/LOC information. The marker beacon antenna is mounted on the underside of the fuselage. The glideslope antenna is mounted directly behind the radome and below the weather radar antenna.

MARKER BEACON

The Marker beacon has separate controls and indications for each pilot. The controls located on panel 1P, provide each pilot the capability of controlling his volume and sensitivity.

TRANSPONDER

The aircraft is equipped with two cockpit selectable transponders controlled by one head on panel 2P. In addition to the selected ATC codes, encoded height information from the altimeters is also transmitted when interrogated by a ground station.
The transponders have a transmit frequency of 1090 MHz and a receive frequency of 1030 MHz Modes A and B are identification pulses and Mode C is the carrier for altitude information.

OPERATION

The transponder is controlled by the CTL-90 control unit. The selected code is displayed.
The operating controls are:

- Code selector knobs Two concentric knobs, the larger controls the left two digits and the smaller controls the right two digits. A two to five second delay (after a code change) occurs before the new code is transmitted. This gives the pilot time to check the code and prevent inadvertent transmission of a partially changed or emergency code.
- 1-2 switch Select NO.1 or NO.2 transponder.
- IDENT button/light Causes an extra pulse to transmit with the selected code. The pulse is transmitted for approximately 20 seconds after the button is depressed. The button illuminates when the system is responding to an interrogation and during a system self-test (illumination indicates that the self-test is normal).
- TEST button Activates the system self-test.
- Function switch the function switch has four detented positions:
- OFF The system is not powered.
- STBY The system is powered but not transmitting.
- ON The system is powered and the selected transponder is transmitting.
- ALT REP—The system is powered, and the selected transponder is transmitting code and altitude.
- TEST Button — Initiates the self-test of the selected transponder.
    - System Normal — The current code will modulate from min to max brightness and an “AL” will be displayed. The display will be in either the upper or lower window depending on which transponder is selected.
    - Failure — The upper window displays “DIAG,” and the lower window dis-plays a two-digit diagnostic code.

VHF COMM CONTROLLER, CTL20

The control units have the following displays and controls:

- Two windowed display.
- Upper for the active frequency.
- Lower for the preset frequency.
- Two concentric frequency select knobs.
- An active/preselect switch with two positions:
- ACT—The frequency select knobs controls the upper display and tunes the transceiver directly.
- PRE—Frequency select knobs control the lower display but do not tune the transceiver.
- Transfer/memory switches the preselected frequency to the (upper window) active display and tunes the transceiver. The active frequency is switched to the preselected display (lower window) for changing or reactivation. The TUNE button lights up (green) when the transceiver is transmitting.
- The function switch is a rotary switch that controls on/off, volume, and test. The squelch circuit is disabled causing a large increase in background noise which confirms the system is active.

ANTENNAS

The COM 1 antenna is mounted on the fuselage roof and COM 2 is underneath the fuselage. COM 1 is more suitable for ground operations.

OPERATIONS

Prior to start (AVIONICS MASTER switch OFF), select the audio panel rotary switch to NORMAL. The amber BATTERY DIS-CHARGE annunciator is illuminated and the indicated COMM system is operable from the respective battery using a headset and yoke transmit switch. If both pilots' rotary switches are at NORMAL, COMM operation is also available via speakers and hand microphones.

Prior to start, return the rotary switch to the appropriate COMM position and ensure the BATTERY DISCHARGE light is out.

Note

Currently Unavailable in MSFS Please activate batteries and Avionics switch to use NAV/COMMS

COMMUNICATIONS SYSTEM

GENERAL

The aircraft is equipped with VHF transceivers, interphones, and on some models, HF radios. The aircraft is also equipped with a voice recorder, passenger address system, and a tape player.
The passenger address system and chime call is installed for use by the pilots and the flight attendant. The main system has an emergency system that only the pilots can use.
The interphone system is designed for communication between the pilots, ground personnel, and the flight attendant.

VHF RADIOS

The aircraft is equipped with two Collins VHF-20A very high frequency (VHF) transceivers. The two control units are Collins CTL20, designated COM 1 and COM 2. The radios operate in a frequency band from 118.0 to 135.975 MHz on 720 channels spaced at 25 kHz. Controls for the radios are on panel 1P.

The radios are capable of operating directly from the battery when the rotary switch on the audio panel is positioned to the battery. This allows radio usage prior to the bus bars being energized and provides an alternate source of power for the radios.

Normal electrical power for each radio comes from the respective AVIONICS bus bar and the alternate source is the respective battery.

WEATHER RADAR SYSTEM

GENERAL

A Collins weather radar system, WXR-270, is installed on SD3-60 aircraft to provide continuous enroute weather information. A Bendix BXRDR1200 is fitted SD3-30 Aircraft.

TRANSMITTER/RECEIVER

The transmitter/receiver is mounted in the nose of the aircraft. It is capable of long and short range operations (250 to 10 nautical miles), fault monitoring, and automatic range adjustment thresholds.

ANTENNA

The nose mounted antenna provides a scan pattern 60° either side of the nose and 30° up or down. The flat-plate phased-array antenna produces a pencil beam that reduces loss due to side lobe radiation.
Antenna stabilization is provided by the left flight director system.

ELECTRICAL POWER

Electrical power for the antenna comes from the left 115-VAC busbar. 28 VDC from the left avionics busbar supplies the rest of the system.

GROUND MAPPING

The system is capable of limited ground mapping that can assist as a navigation aid. Prominent terrain features such as lakes, rivers, large industrial buildups can be displayed. Tilting the antenna down helps define the ground echoes.

COLLINS WXR-270 OPERATIONS

OPERATING MODES

The radar operates in two modes, map and weather. A test and standby mode is there for a self-test and for safety.

The modes are selected by the push buttons on the left side of the display unit.

- OFF—System. Off.
- SBY—Standby. System is powered but no transmitter output. Range marks, azimuth lines, and STBY are displayed in blue.
- TST—Self-test.
- WX—Weather depiction mode. Contour areas alternate between red and black. WX, azimuth lines, range marks, and all annunciators are in blue.
- MAP—Ground mapping mode. Range marks, azimuth lines, and range and mode annunciators are in green.

RADAR CONTROLS

GAIN SWITCH

The GAIN switch allows adjustment from 0 (MAX) to –24 dB (MIN) reduction. If a gain position less than MAX is selected, GAIN will alternately be displayed with the selected mode on the mode annunciator.

If the GAIN switch is rotated to TGT, target alert enabled, radar echoes of a specified strength will automatically be displayed regardless of the range selected. The echo must be within 15° of the centreline and between 60 and 160 NM. If no echoes are present, a T is displayed on the mode annunciator.

TILT SWITCH

Tilt is controlled (–10°/+10°) by rotating the TILT knob.
Pulling out the TILT knob switches the flight director gyro inputs to antenna stabilization circuitry.

Note

The TILT Feature has no effect in MSFS At this time

HOLD BUTTON

The HOLD button freezes the display in both weather and map. The mode annunciator alternates between HOLD and the mode.

INT KNOB

The intensity (brightness) of the display is adjusted by rotating the INT knob.

RANGES

Range selection is made by the push buttons on the right side of the display unit. Ranges are available from 250 down to 10 nautical miles (NM). Five range marks are displayed on all range selections. The distance between each range mark is 1/5 of the range selected, i.e., 50 range button is selected making each range mark equal to 10 NM.

INDICATION

The indicator consists of the display and controls in one unit mounted on panel 2P. Colour is used to differentiate the levels of target intensity for Collins WXR-270 (Green Monochrome for Bendix). Four colours are used in the weather mode:

- Black—No echoes
- Green—Lowest level of intensity
- Yellow—Medium level of intensity
- Green—Lowest level of intensity
- Red—Greatest level of intensity (alternates with black)

Collins WXR-270 (Showing Test Sweep)

BENDIX RDR-1200 OPERATIONS

OPERATING MODES

All operational controls are located on the front panel of the indicator. These controls and their function are described in the following paragraphs.

FUNCTION ROTARY SWITCH

- **OFF** Power removed from system.
- **STBY** Power applied to system but transmitter, antenna scan and indicator display are inhibited. (warm-up time is approximately 120 seconds.)
- **TEST** Applies drive to antenna and activates test circuit and indicator display.
- Ranges **5, 10, 25, 50, 100, 200**

WX-MAP/WXA ROTARY SWITCH

- **Wx** - Places indicator in automatic contour mode. Contoured storm cells will be outlined by lighter shades automatically.
- **MAP** - Places indicator in MAP mode (disables contour feature) and activates manual gain con-trol. All targets will be presented on the indicator in up to 3 different shades, dependent on the radar echo strength and the particular click gain setting used.
- **WxA** - When the Mode Selector is in the WxA position the display on the indicator will cycle to verify if a dark hole is a contour or storm cell. If the dark hole is a contour or storm cell, its presentation will alternate from darkest shade to brightest shade approximately 1 time per second. If a dark hole remains the same intensity while in the WxA mode, then this area of the display does not represent a contour or storm cell.

BRT

Controls the brightness of the indicator display.

HOLD

HOLD Freezes the display on the indicator until the function switch is changed or until power is removed from the system.

TILT

Adjust the tilt of the antenna to allow the best indicator presentation.

Note

The TILT Feature has no effect in MSFS At this time

STABILISATION ON/OFF

By pulling the tilt control knob out, the stabilisation circuitry is inhibited. Use in the event of a gyro or stabilisation malfunction .

Bendix RDR-1200 (Showing Test Sweep)

INDICATION

Monochrome shades are used to differentiate the levels of target intensity.

- Black/Dark—No echoes or/highest level intensity(if withing storm cell)
- Mid tones—Medium level of intensity
- Light tones—lowest level of intensity

WARNING

- ***Do not operate radar inside a hanger or other enclosure. Carry out function checks on an apron pointing away from nearby buildings.***
- ***Do not permit personnel at the open end of a waveguide unless the radar is off and will remain off.***
- ***Do not permit personnel within 50 feet of an area being scanned by the antenna with the system transmitting.***
- ***Flash bulbs may be exploded by radar energy.***
- ***Take note of any local restriction governing the use of a radar system.***

AUDIO CONTROL PANEL

Each pilot has an audio control panel mounted outboard of the dash. The panel controls all volume (except ADF) inputs, allows selective monitoring of COMM and NAV frequencies, controls choice of transmitters, and provides for emergency operations.

The following controls and functions are provided through the audio panel:

- SPEAKER VOL—Controls associated speaker output. Full counterclockwise rotation selects speaker OFF.
- ATTENDANT
- Switch—ON selection enables ground crew and attendant's microphone to be connected to the interphone when associated yoke switch is at INT. Communication with an individual pilot is possible if the other pilot's yoke switch is not selected to INT.
- CALL—A pushbutton that initiates a Hi/Lo chime in the cabin to call the attendant.
- Receiver Selector Switches—ON selection connects receivers to both telephones and speakers. Switches captioned V or I enable filtered audio to be received thus facilitating reception of identification tones (I) or weather broadcasts (V). If the ATTND'T H'MIC position is selected (rotary selector switch), the speakers receive the attendant and ground crew. When PA NORM is selected, attendant's PA announcements may be monitored.

- Rotary select switch—This switch selects transmitters, flight attendant and ground personnel communication, and emergency backup capability. With the ATTND'T H'MIC position selected, communication is established with flight attendant and ground crew via the hand microphone.
- INTERPHONE VOL Controls inter-phone volume level in headsets for as-sociated pilot and observer.
- AVIONICS VOL—Controls level of incoming avionics audio signals except for the ADF that has its own volume control.
- STANDBY AUDIO—This switch is provided to cover radio and/or inter-phone failure. Selection of FAIL switches that individual to the oppo-site audio centre. Instructions for its use are marked beneath it. An amber annunciator reminds crews when FAIL is selected.

STATIC DISCHARGE SYSTEM

Static electricity accumulated in flight is dissipated by ten flexible dischargers located at the trailing edges of the ailerons, elevators, and rudder, i.e., four on the tail and three on each wing.

RADAR ALTIMETER

The aircraft has a single radar altimeter that sup-plies information to the radar altimeter indicator, both ADIs, and the GPWS.

The altimeter automatically provides altitude information from 0 to 2500 feet on the pilot's indicator and 0 to 200 feet on the ADIs.

Decision height can be set from all altitudes up to 2500 feet. Descending below the decision height causes the DH warning annunciator on the ADI to illuminate and the GPWS (When fitted) to trigger the aural warning one time, "MINIMUMS—MINIMUMS."

A red flag appears in the indicator for power or system failure. Failure flags also occur in both the ADIs.

VOR/ILS/MARKER BEACON SYSTEM

Aircraft after modification A8062 use a Collins VIR-32 navigation receiver and a Collins CTL-32 controller. All other equipment is the same for this system.

RADIO MEMORY STORAGE

All radios have memory channels, these can be pre-programmed by the user in the PANEL.XML located in the ***/SimObjects/Airplanes/*Aircraft Type*/panel*** folder.

<!-- Stored Frequencies [COM1] -->
<COM1_1>***121.50***</COM1_1>
<COM1_2>***121.70***</COM1_2>
<COM1_3>***121.80***</COM1_3>
<COM1_4>***122.95***</COM1_4>
<COM1_5>***121.50***</COM1_5>
<COM1_6>***123.30***</COM1_6>

<!-- Stored Frequencies [COM2] -->
<COM2_1>***121.50***</COM2_1>
<COM2_2>***121.70***</COM2_2>
<COM2_3>***121.80***</COM2_3>
<COM2_4>***122.95***</COM2_4>
<COM2_5>***121.50***</COM2_5>
<COM2_6>***123.30***</COM2_6>

<!-- Stored Frequencies [NAV1] -->
<NAV1_1>***110.50***</NAV1_1>
<NAV1_2>***113.90***</NAV1_2>
<NAV1_3>***115.70***</NAV1_3>
<NAV1_4>***112.20***</NAV1_4>
<NAV1_5>***114.10***</NAV1_5>
<NAV1_6>***115.50***</NAV1_6>

<!-- Stored Frequencies [NAV2] -->
<NAV2_1>***110.50***</NAV2_1>
<NAV2_2>***113.90***</NAV2_2>
<NAV2_3>***115.70***</NAV2_3>
<NAV2_4>***112.20***</NAV2_4>
<NAV2_5>***114.10***</NAV2_5>
<NAV2_6>115.50</NAV2_6>

<!-- Preset XPNDR Codes -->
<XPNDR1_1>***7700***</XPNDR1_1>
<XPNDR2_1>***7777***</XPNDR2_1>