Falcon 900B Notes

Class notes taken by the Flightstar crews trained at FlightSafety

For Training Purposes Only. Accuracy is limited to the listening and typing skills of pilots so beware of possible errors.

GENERAL LIMITATIONS

Weights and Altitudes	
Weight Max Ramp	46,700 lbs
Max T/O Weight	46,500 lbs
Max Landing Weight	42,000 lbs
Max Zero Fuel Weight	30,870 lbs
Average 900 BOW	26,500 lbs
Minimum Operating Weight	20,700 lbs
Baggage Compartment Limit	2866 lbs
CG Limits	14% MAC forward, 31% MAC aft
Datum	25% MAC
Max Approved Operating Altitude	51,000 ft
Min/Max Altitude For T/O & Landing	-1,000 ft to 14,000 ft
Min / Max Temp For T/O & Landing	-54ºC to +50º C
Max Altitude For Operating Flaps or Slats	20,000 ft
V Speeds	
V_{mo}	350 KIAS increasing w/altitude
V_{mo}	370 KIAS at 10,000 ft
M_{mo} Above 35,000 lbs	
25,000 to 33,000ft	.87 Mach
33,000 to 37,000ft	.87 to .84 Mach
Above 37,000ft	.84 Mach
M_{mo} Below 35,000 lbs	
25,000 to 37,000ft	.87 Mach
37,000 to 42,000	.87 to .84 Mach
Above 42,000ft	.84 Mach
V_a	228 KIAS
Turbulent Air Penetration Speed	280 KIAS / .76 Mach
V_{lo}	190 KIAS
M_{lo}	.70 Mach
V_{le}	245 KIAS
M_{le}	.75 Mach
V_{wwo}	215 KIAS
D.V. Window	215 KIAS
Cracked or Bubbled Windshield	7.5 psi diff and 230 KIAS
V_{abo}	No Limitation
V_{abe}	No Limitation
V_{fe} Slats+Flaps 7º	200 KIAS
V_{fe} Slats+Flaps 20º	190 KIAS
V_{fe} Slats+Flaps 40º	180 KIAS
V_{mcg}	Falcon 900 has no Vmcg
V_{mca}	85.5 KIAS
Demonstrated Crosswind	30 Knots
Max Tailwind –1,000 to 10,000ft	10 Knots
Max Tailwind Above 10,000ft	10 Knots w/ 6-225mph tires
Max Runway Slope	+/- 2.5%
Max Tire Rotation Speed	195 KIAS (225 mph tires)
V_h Hydroplanning Speed	89 KIAS
Max Speed For Total Hydraulic Loss	260 KIAS / .76 Mach
Wing Root Lights On Ground	15 min followed by 45 min cool down
Load Factors	Clean +2.53G to –1G
	Flaps Extended +2.0G to 0G

TFE-731-5BR-1C Engines (Engine Computers must be operative for takeoff)

Takeoff Thrust	4750 LBS
Max Cont Thrust	4634 LBS
N_1/N_2:	
Takeoff	100%/100.8%
Transient (5 Sec Max)	103%/103%
ITT:	
Start	978º C
Takeoff	978º C (5 Minutes Max)
Max Continuous	968º C
Max Cruise (recommendation only)	927º C
RPR Operating (Five Minutes Total)	996º C
RPR Transient (5 Sec Max)	1006º C
Starting Limitations:	
N2 10% to Lightoff Ground or Starter Assisted	10 Seconds
Lightoff to Idle	60 Seconds
Windmilling Air Start	45 Seconds Maximum
Starter Limitations:	
40 seconds ON (if req, after1 min motor 15 sec-2 minutes off)	3 minutes OFF
30 seconds ON (if req, after1 min motor 15 sec-2 minutes off)	3 minutes OFF
30 seconds ON	30 minutes OFF
Oil Pressure Limitations:	
Idle	25-46 PSI
T/O	38-46 PSI
Transient (less than 3 minutes)	55 PSI

Oil Light will illuminate at less than 25 PSI or when chip is detected.

Oil Temp Limitations:	
Sea Level to 30,000 Feet	127º C
Above 30,000 Feet	140º C
Transient (less than 2 minutes)	149º C
Minimum for exceeding idle	30º C
Generator Limitations:	
FL430 and below	300 amps (up to 350 amps for 1 min)
Above FL 430	260 amps (cooling limitation)
Max System Voltage	32 volts DC

GTCP 36-150 APU

N1	110%
Start (less than 10 seconds)	870º C-985º C
Stabilized	679º C
Generator Limitations:	300 amps (up to 350 amps for 1 min)

Pressurization

Max Presssure Differential (pressure relief valve setting)	9.6 psi
Normal Pressure Differential	9.3 psi

Fuel	Total Useable Capacity	2,845 gallons	19,065 lbs
	Left Wing & Center Wing G1	904 gallons	6,058 lbs
	Right Wing & Center Wing G3	904 gallons	6,058 lbs
	Front and Rear Fuselage Tanks G2	1,037 gallons	6,949 lbs
	Min / Max Refueling Pressure	30 psi min	50 psi max

Autopilot Limitations:

Minimum height during FMS approach	300 ft
Minimum height Radio Altimeter Operative	50 ft
Minimum height Radio Altimeter Inoperative	150 ft
Minimum decision height	200 ft
Minimum height except during approach	1,000 ft

Fuel Burn Rule of Thumb *(for constant .78 Mach cruise)*

	BURN / HR
First Hour	3200 LBS
Second Hour	2200 LBS
Third Hour and Beyond	2000 LBS

Converting Pounds to Gallons-- drop the zero and add half of what you get back. I.E. 1800 pounds equals 180 gallons plus 90 gallons or 270 gallons.

V_{ref} Rule of Thumb

Gross Weight times 2 plus 50 = $\mathbf{V_{ref}}$

i.e. 36,000 lbs…….36 x 2 = 72 + 50 = ***122 KIAS***

Climb Schedule For Long Range

Below 10,000’	250 KIAS
10,000’ and above	260 KIAS to .72M

High Speed Climb Schedule

Below 10,000’	250 KIAS
10,000’ and above	300 KIAS to .80M

Walk Around Notes

Electrical and hydraulic systems wise, the Falcon 900 can be thought of as a two engine aircraft. The #1 Engine and its accessories power the left main bus and the #1 hydraulic system and the #2 Engine and its accessories power the right main bus and the #2 hydraulic system. The #3 Engine is just a back up to the #1 Engine for these two systems. Pneumatics is also divided up like this.

Recommend start sequence is 2,3,1 regardless of APU operation (new Falcon recommendation).

All fault panel lights are powered by Primary Bus A1 automatically backed up by Primary Bus B1.

The lower red strobe is powered by Primary Bus B2. The upper red strobe is powered by Primary Bus A1.

Wiper must be stowed prior to T/O, will extend and possibly separate and be ingested by engines. OFF position is automatic park. 215 knot limitation.

Tires and Shock Struts:	Nose	148 psi	3-5’’ extension
	Mains	197 psi	=>3” extension

Emergency exit on right side of cabin. It is important to check plastic bubbles for condition. It could separate and be ingested in the engines if they are torn. Also serves as water seal.

Landing lights are limited to 15 minutes use on the ground followed by 45 minute cool off period. No limits for use in flight.

Taxi light on nose automatically turns off with gear retraction, regardless of switch position.

Dimensions: 63'5" wide, 66'4" long, 24'9" or 25'2" high (sat com antenna)

TFE-731-5BR-1C TFE = turbo fan engine, 7= 2 spool engine (N1, N2), 3= 3 stage LP turbine, 1= 1 stage HP turbine.

No access allowed in baggage compartment during TO/LDG or above FL410. **BAG ACCESS** illuminates if door is opened.

NOSE CONE OVHT (70ºC): Check maint panel to help determine what is causing the overheat. Called minelco indicators (red or white-same as on oil panel filter bypass)

700 PSI minimum O2 dispatch level.

Main Entry Door can't open with any cabin pressure. The 2 prox switches on top right and left activate **CABIN** light. Activation of this light without audio indicates a door problem. With audio indicates a cabin altitude problem. 10 latches on main door.
Rear Compartment Door. Do not operate APU or engine supplying bleed to the ECU because exhaust from ECU will damage paint on door.

Baggage Door. Motor is located in the door assembly. It is possible to close door without power. This has caused numerous injuries upon opening. Closing Requirements:

1. Battery bus power
2. Overcome crash logic (any gen or bat switch ON)
3. Bag door handle unlatched
4. Lower step stowed
5. Push UP button. When motor clutch slips, latch door. (15 second timer for door motor) Down button interrupts up power to stop door. Door opens without electrical power.

NEVER ATTEMPT TO OPEN DOOR WITHOUT HOLDING YOUR HAND ON THE DOOR in case it was improperly closed without power. SB142 provides a safety latch for the baggage door.

Door Open Annunciators:

Cabin Door	**CABIN**
Forward Lav Service Door	**CABIN**
Interior Baggage Access Door	**BAG ACCESS**
Exterior Baggage Access Door	**REAR DOORS**
Rear Compartment Door (hell hole)	**REAR DOORS**
Fueling Panel Door (either one)	**FUELING**
GPU Plug Door	***NO WARNING***
Aft Lav Service Door	***NO WARNING***

Outboard slats: they always extend first, retract last.

MLG doors may be opened on the ground by releasing the door uplock.

HELL HOLE: All accumulators in the hell hole should be at 1500 psi minimum, all pressure holding valves should be at 1700 psi minimum. External parking brake accumulator should be at 1000 psi minimum (right wing root). There are 5 hydraulic filter pop up valves for #1 hydraulic system and 4 hydraulic filter pop up valves for the #2 hydraulic system that should not be up. Each fire bottle should have 600 psi. It is normal for the #2 hydraulic system to appear a little in the red during preflight, with the #1 hydraulic system 1/3 to 1/2 way in the green. The air trap should have mostly hydraulic fluid. Air only in the trap requires maintenance servicing.

There are 9 fuel sumps.

APU generator air inlet and exhaust are on left side of aircraft. APU compartment cooling screens are on the left side. When the APU is running, a venturi effect is created that sucks in the cooling air and exhausts the internal heated compartment air. This is why we wait 10 seconds after shutdown before discharging the APU fire bottle (we want the retardant to fight the fire, not leave the compartment). APU engine intake and exhaust are on right side.

Before leaving the aircraft with batteries connected (ie lunch) make sure 1) both fueling doors are closed, 2) slat flap handle is clean, 3) the “Battery In Use” light by the main door is extinguished, and 4) crash logic is satisfied or the main batteries will drain. MAKE SURE THE IRS UNITS ARE TURNED OFF OR THEIR BATTERIES WILL DRAIN.

For towing, disconnect scissor link. Do not disconnect cannon plugs. Do not allow towing by LEKTRO equipment.

Do not allow washing of aircraft without covering wheels and brakes.

Fuel tank vent valves can be closed manually fairly easily but it still requires a mechanic.

When Dassault designs one switch to control two items, the left item always has priority.

With fuel panel selected to partial fuel, all fuel gauges in the cockpit power up. For a partial fuel load, go past where you want and then bring it back to the desired quantity. The quantity of fuel selected is divided by three and the fuel is then delivered to each tank system based upon the derived target value per tank system.

Closing the fuel panel door will kill power to the coupling area. If a lineman closes the panel door, and then closes the vent valves and closes the coupling door, you will see the **FUELING** light illuminate and then go out when you first power up the aircraft.

If you accidentally leave the APU bleed switch in AUTO or the valve fails to close, 8 seconds after you begin the takeoff roll (exceed PLA > 54°) the **APU BLEED** light illuminates.

Do not forget to drain the forward galley water lines located behind the coffee maker. These lines run overhead behind the headliner to the aft portion of the aircraft and if frozen will ruin the headliner.

The aircraft can be dispatched with one boost pump inoperative provided that the wing tanks are pressurized. Only gauge is in rear compartment.

If you have inadvertently left something on (namely there is no battery problem except you) and the batteries are drained to no lower than 18 volts, you can use a GPU to start the APU and then use the APU to recharge the batteries. Less than 18 volts, and the M&B switches don’t work and the batteries need to be removed.

In the right main wheel well is a pressure holding valve for the airbrakes. 1700 psi minimum. Used to help hold air brakes in the retracted position.

The standby hydraulic pump is wired directly wired to the left main bus but controlled by A1 bus.

Batteries are primary in providing engine start power. Generators only assist when available. Battery charge rate should be below 50 amps before any engine start is initiated. The initial starter motor load is 800 amps.

330-360 amps is the average total electrical load in cruise flight.

Generator #1 (Left main bus)	95-105 amps
Generator #2 (Right main bus)	140-150 amps
Generator #3 (Left main bus)	95-105 amps
Total	330-360 amps
Total Left Main Bus	190-210 amps
Total Right Main Bus	140-150 amps

Lose two engines and load shedding is imperative to get below 300 amps.

150 amp load on batteries alone (total electrical failure) gives 15-20 minutes power

IRS battery voltage need to be checked while busses are unpowered. HRZN and EBAT2 test need left main bus power to test.

FALCON 900B PHASE ONE MEMORY ITEMS

ENGINE FIRE IN FLIGHT

1) **Power Lever CUT-OFF**
2) **Fuel Shut Off ACTUATED (trans light ON then OFF)**
3) **Airspeed < 250 KIAS**
3) **Fire Extinguisher DISCH Switch POSITION 1**
If fire warning persists
4) **Fire Extinguisher DISCH Switch POSITION 2**
5) **Call For Checklist**

APU FIRE

1) **APU Master Pushbutton Light SHUTDOWN**
2) **APU Generator Pushbutton Light OUT**
3) **APU Bleed Air Switch OFF**
Wait 10 seconds, then
4) **APU Fire Extinguisher DISCH Switch POSITION 1**
5) **Call For Checklist**

FIRE IN BAGGAGE COMPARTMENT

1) **Bag Switch ~~HEAT~~**
In flight below 410 with the bag comp pressurized,
2) **Copilot dons smoke hood and fights fire with Hand Fire Exting**
During Takeoff, Landing, or >410, or with bag comp unpressurized,
1) **Bag Switch ISOL, BAG ISOL light ON**
2) **BAG COMP extinguisher POSITION 1**
3) **Do not open the baggage comp door until after landing**
4) **Call For Checklist**

SMOKE AT AIR CONDITIONING OUTLETS

1) **Crew O2 masks and goggles 100%/DONNED**
2) **Microphone Selector MASK AND TEST**
3) **NO SMOKING sign ON**
4) **Passenger Oxygen Controller OVERRIDE**
5) **Passenger masks DONNED**
6) **Call For Checklist**

ELECTRICAL SMOKE OR FIRE

1) **Crew O2 masks and goggles 100%/DONNED**
2) **Microphone Selector MASK AND TEST**
3) **NO SMOKING sign ON**

If there are no flames in the cabin

4) **Passenger Oxygen Controller OVERRIDE**
5) **Passenger masks DONNED**
6) **Call For Checklist**

SMOKE REMOVAL

1) **Crew O2 masks and goggles 100%/DONNED**
2) **Microphone Selector MASK AND TEST**
3) **NO SMOKING sign ON**

If there are no flames in the cabin

4) **Passenger Oxygen Controller OVERRIDE**
5) **Passenger Masks DONNED**
6) **Call For Checklist**

INADVERTENT THRUST REVERSER DEPLOYMENT IN FLIGHT

1) **#2 Engine IDLE**
2) **TR NORM/STOW switch STOW**
3) **Airspeed =< 230 KIAS**
4) **Call For Checklist**

ALL ENGINES INOPERATIVE

1) **Communications VHF 1 / ATC 1**
2) **Establish aircraft within relight envelope**
3) **Reduce electrical load to lowest possible**
4) **Relight engine using airstart procedure**
5) **Call For Checklist**

LOSS OF BOTH HYDRAULIC SYSTEMS

1) **Autopilot and Yaw Damper DISENGAGE**
2) **Airspeed 260 KIAS / .76 Mach Maximum**
3) **Call For Checklist**

WARNING PANEL

"A1" bus powered backed up by "B1"

CMPTR 1 CMPTR 2 CMPTR 3	The control switch is off or manual or computer has failed
L. AOA	The heating system is not on or AOA heating has failed
R. AOA	The heating system is not on or AOA heating has failed
OIL 1 OIL 2 OIL 3	Oil pressure is < 25 psi or chip has been detected
L. PITOT	The heating system is not on or has failed
R. PITOT	The heating system is not on or has failed
ST BY PITOT	The heating system is not on or has failed
GEN 1 GEN 2 GEN 3	The generator is not tied to the power system or start relay is closed
L. WHL OVHT	An overheat condition is detected in the L gear well
R. WHL OVHT	An overheat condition is detected in the R gear well
BAT 1	The indicated battery is not connected via make-and-break switch
BAT 2	The indicated battery is not connected via make-and-break switch
BUS TIED	L & R buses are tied or Bat 2 contactor closed
HOT BAT	Temp of one of the batteries has exceeded 150° F
AUTO SLATS	*Discrepancy exists*: between two slat control flt/grd contacts, or between these two contacts and nose and left main squat switches, or between angle of attack sensors of +5°, or one of the ADC contacts controlling slats detects <265 kts while ADC monitor=280 kts
FLAP ASYM	Asymmetry exits between L and R flaps
FUEL 1	Fuel pressure equal to or less than 4.6 psi
FUEL 2	Fuel pressure equal to or less than 4.6 psi
FUEL 3	Fuel pressure equal to or less than 4.6 psi
XTK 2 OPEN	Front to rear transfer valve is open when it should be closed
XTK 2 CLOSED	Front to rear transfer valve is closed when it should be open
BAG ACCESS	Cabin baggage compartment door is not closed
LO FUEL 1	Fuel level < 200# in group G1
LO FUEL 3	Fuel level < 200# in group G3
LO FUEL 2	Fuel level < 200# in group G2
AIL ZERO	The emergency aileron actuator is not in the neutral position
AIL FEEL	Discrepancy exists between ADC IAS and aileron Arthur actuator
PITCH FEEL	Discrepancy exists between Arthur actuator and stab position or Arthur box malfunction
REV UNLOCK	TR doors not locked in the stowed position
FUELING	A fuel vent is not closed, or the refuel valve is not closed, or an access door is open, or the gravity fuel switch is on, or bus B2 has failed, or the defuel switch is on, or the vent valve control lever is in raised position
AP	The autopilot has failed or automatically disengaged
MISTRIM	AP trim coupler has failed
MACH TRIM	Mach trim system is disengaged or has failed

BLEED OVHT	Overheat of HP/LP => 335º C
ECU OVHT	Overheat => 230ºC at ECU outlet or turbofan bypass valve is not closed (gear down)
COND'G OVHT	Overheating in supply ducts => 95ºC
NOSE CONE OVHT	Overheat in nose cone => 70ºC
BLEED APU	APU bleed is not completely closed (switch off) or PLA >54
BAG ISOL	Bag isolation valve not open (bag comp not pressurized)
#2 P BK	***Steady***: pressure to #2 brakes > 260 psi ***Flashing***: the p brake accumulator is <1200 psi
CABIN	With audio: cabin alt is => 10,000 With out audio: main door unlocked or front lav panel door open
REAR DOORS	The exterior baggage door is unlocked or rear comp door is unlocked
T/O CONFIG	The light illuminates and audio warning sounds if on ground & PLA >82 if: slat/flap control is clean, or flap deflection is => than 22, or airbrakes are not retracted, or stab trim of out of TO range, or slats are not extended

Fire Panel Warning Lights

FIRE 1	Fire detected in indicated compartment
FIRE 2	Fire detected in indicated compartment
FIRE 3	Fire detected in indicated compartment
FIRE BAG COMP	Smoke detected in baggage compartment (Optical Sensor Only)
FIRE APU	Fire is detected in APU compartment
TRANS	Discrepancy between switch and valve position

Hydraulic Panel Warning Lights

PUMP 1	Pressure of the indicated pump is less than 1500 psi
PUMP 2	Pressure of the indicated pump is less than 1500 psi
PUMP 3	Pressure of the indicated pump is less than 1500 psi
ST BY PUMP	Standby pump cycle is > 60 seconds, or Standby pump selector in rear comp is not in flight position (*FORWARD*)
L R	On when brake pressure in #1 => 225 psi Off when brakes are released and pressure in #1 =< 136 psi

Other Warning Lights

ENG 2 FAIL	**In Flight:** S-duct is not closed, or **On Ground** with PLA=> 84, N1 < 85%
PWR INC	Indicates correct operation of RPR for hot and high T/O (~5000' & >18.5º C)

APU Panel

APU *(master)*	Steady: Master ON; Flashing: Fault resulting in shutdown
OIL	Low APU oil pressure or high APU oil temperature
GEN	APU generator is off line

DC System Panel

APU	The APU generator has excitation voltage. The APU generator switch is on.

Engines Panel

IGN 1 IGN 2 IGN 3	The ignitor unit of the applicable engine is energized;

Fuel System Panel

XTK	The side tank group interconnection valve is not closed
X.BP *(center)*	One of the 1-3 or 3-1 crossfeed valves is not closed
LEVEL *(3)*	Fuel level in tank is less than 1000#
X.BP *(2RH & 2LH)*	One of the associated crossfeed valves 1-2 or 3-2 is not closed

Bleed-Air Panel

ISOL	The bleed air isolation valve is closed

Anti-Icing Panel

Engine 1, 2, or 3	***Green Light***: 4 psi>pressure<90 psi ***Amber Flashing Light***: pressure >90 psi also over temp in S Duct ***Amber Steady Light***: pressure < 4psi
Wing	***Green Light***: proper temperature and pressure ***Amber Flashing Light***:over temperature ***Amber Steady Light***: pressure drop < 4 psi
XFR	Either pilot or copilot windshield is defective and detection and regulation is transferred

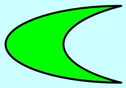
Configuration Panel

Flashing

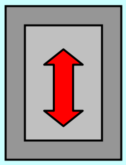
1. The handle is UP and gear is not yet UPLOCKED
2. The handle is DOWN and gear is not yet DOWNLOCKED
3. The handle is UP and at least 1 gear is not DOWNLOCKED, or airspeed < 160 KIAS and one power lever is at reduced power

AIRBRAKE

STEADY: at least one of the six panels is not stowed
FLASHING: after automatic retraction of airbrakes and handle is extended

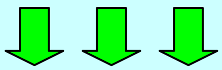


STEADY: all slats extended
FLASHING: only outboard slats are extended



During movement of slats,or
If any one of the slats has failed to retract or extend, or
When slat position disagrees with handle position

Mains (left and right red lights): gear door is not closed
Nose (center light): nose gear not locked or either of the doors not fully open



Corresponding gear is locked down

AUDIBLE WARNINGS

Powered by A1 backed up by B1

V_{mo}/M_{mo}	**Tone**	***NON* Silenceable**
Cabin Pressure	**Voice CABIN**	**Silenceable**
Fire	**Two Pitch Tone**	**Silenceable**
Stall	**Beep-Beep**	***NON* Silenceable**
Altitude Deviation	**Voice ALTITUDE**	***NON* Silenceable**
Stab Movement	**Clacker**	***NON* Silenceable**
Ldg Gear (normal)	**Voice GEAR**	**Silenceable**
Ldg Gear (abnormal)	**Voice GEAR**	***NON* Silenceable**
DH	**Voice MINIMUM**	**Silenceable**
AP Failure	**Voice AUTOPILOT**	***NON* Silenceable**
T/O Config	**Voice NO TAKEOFF**	**Silenceable**

More than one voice warning can be silenced one at a time.

AUDIBLE WARNING TESTING

V_{mo}/M_{mo}	**ADC1 or ADC 2 buttons**
Cabin Pressure	**Cabin Press Test Button**
Fire	**Lights-Test-Fire switch to FIRE**
Stall	**Stall 1or Stall 2 button**
Ldg Gear	**LG Test Button**
T/O Config	**Reproduce conditions**

ELECTRICAL SYSTEM

This aircraft is *totally powered by DC* with those instruments needing AC having their own internal inverters of which you have no control over.

Power is or can be supplied by:

Batteries: (2) 26 volt, 23 ampere (some 36) hour nicads
Engine Driven Generators: (3) 30 volt 300 amp Auxilec generators regulated to 28.5 volts (rated at 9kw—watts=volts X amps)
Generators limited to 260 amps >FL430
APU Driven Generator: (1) 30 volt 300 amp Auxilec generator regulated to 28.5 v
(APU NOT CERTIFIED FOR FLIGHT)
GPU: 28 volt 1200 amp max

Hot Wired To Battery Bus:
1. Fuel Panel and SP Refueling *(hot-no switches required)*
2. Outboard Slat Control *(hot-no switches required)*
3. #2 Position Fire Exting Systems *(hot-no switches required)*
4. Generator Field Excitation
5. **Baggage Door Motor** ***(through Gen or Bat Switches)***
6. **Service Lights** ***(through Gen or Bat Switches)***
7. **Oil Panel** ***(through Gen or Bat Switches)***

BOLD ITEMS CONTROLLED BY *CRASH LOGIC* *(at least one bat or gen switch on)*

DC Buses (8):

The Crash Logic term is derived from off field landing procedures.

Battery Bus *(located in 6PA)*

(becomes a hot bus by hooking up either battery)
Both batteries supply power directly to the battery bus and then to the main electrical box (called **6PA**) only if at least one bat or gen switch is on (5,6,&7 above). Because of this, disconnect the batteries after each flight or do the following:

1. Complete crash logic (all gen and bat switches off)
2. Slat handle clean
3. Fuel panel door closed

Start Bus *(located in 6PA)*

Power is supplied to the start bus from #1 battery and then the #2 battery and/or one of the generators for starting assist depending upon start logic circuits.

Left Main Bus *(located in 6PA)*

(normally powered by #1 battery, #1 generator, or/and #3 generator)

Primary Bus A1 *(located behind CB panel in cockpit)*
(left and upper center CB panel—WHITE CB's)

Warning Light Panel (backed up by B1)
#1 Comm, Nav, DME, ***Pilot EFIS***
Landing Gear Control
Airbrake Control, ***Cabin Altitude Warning Light and Horn***
Emergency Stab Trim
Trim Indicator
Slat Indicator and Normal Control
#2 Brakes
Elevator Arthur
Standby Hydraulic Pump Control
Hydraulic #1 Indicator
LH Fuel Gauges
Fire Detect Engine #1, ***Engine #1 Fire Fault Light Illuminates***
Fire Panel

A1 Major Items

Red items are clue to which bus failed.

Primary Bus A2 *(located behind CB panel in cockpit)*
(left and upper center CB panel—WHITE CB's)

- Antiskid
- Flap / Air BK Indicator
- ***Pilot FMS, Pilot ID802***
- Fire Detect Engine #3, ***Engine #3 Fire Fault Light Illuminates***

A2 Major Items

Right Main Bus *(located in 6PA)*

(normally powered by #2 battery, #2 generator, or/and APU generator)

Primary Bus B1 *(located behind CB panel in cockpit)*
(right and lower center CB panel—GREEN CB's)

- Warning Light Panel (backed up by A1)
- Stab Trim
- Emergency Slat Control
- Landing Gear Indicator
- #2 Comm, Nav, DME, ***Copilot EFIS***
- Hydraulic #2 Indicator
- RH Fuel Gauges
- Fire Detect Engine #2, ***Engine #2 and APU Fire Fault Lights Illuminate***
- Fire Panel

B1 Major Items

Primary Bus B2 *(located behind CB panel in cockpit)*
(right and lower center CB panel-- GREEN CB's)

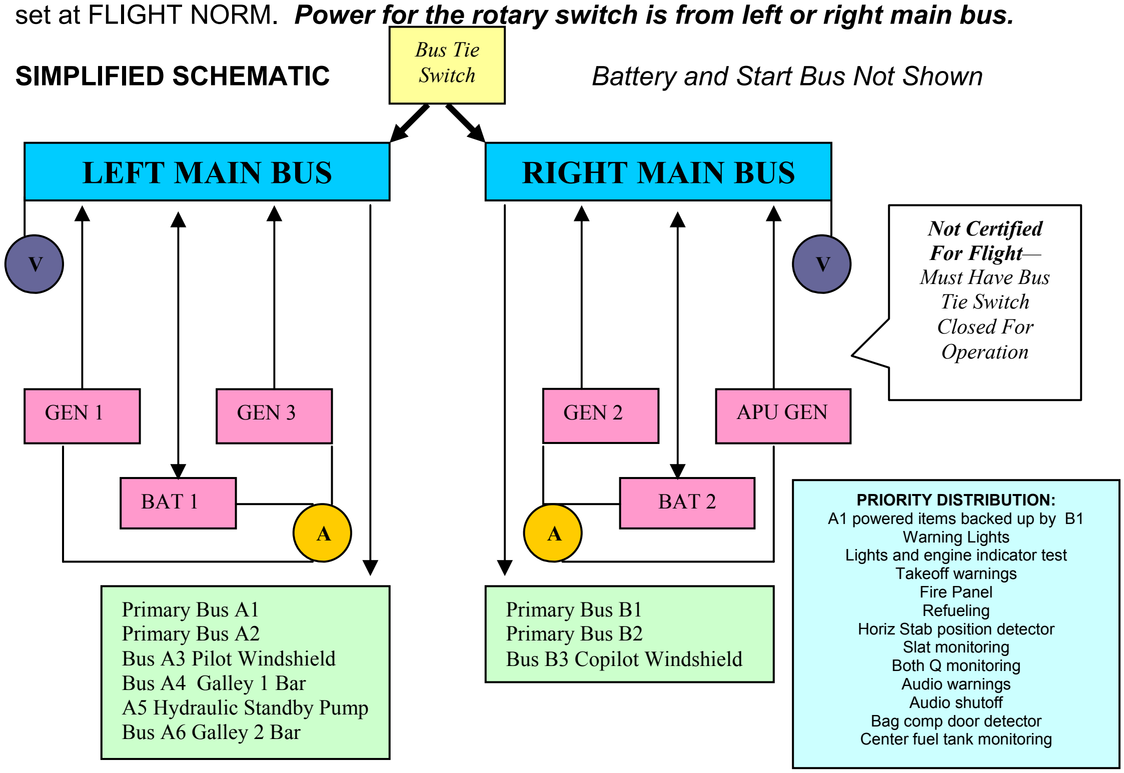
- Thrust Reverser Control
- Flap Control
- Center Fuel Gauges
- Nose Wheel Steering, **FUELING** ***Light Illuminates***
- ***Copilot FMS, Copilot ID802***

B2 Major Items

Left and Right Main Buses can be tied together to allow operation of the total system with one generator. **BUS TIED** Light looks at relay position. This bus tie switch must be closed for APU and engine starting and automatically closes when the external power switch is on. For flight, it is set at FLIGHT NORM. ***Power for the rotary switch is from left or right main bus.***

SIMPLIFIED SCHEMATIC

Battery and Start Bus Not Shown



Fault panel is "A1" bus powered backed up by B1. **Gear down indicators are "B1" bus** powered backed up by "A1".

Battery bus gets power by hooking up batteries. The majority of the electrical components are located in the rear compartment. Either left or right main buses get power by turning on the associated battery switch or generator switch with the engine running, or by running the APU for the right main bus. Because the buses must be tied for APU start, the APU will normally automatically power both main buses.

GPU gives power directly to the start bus, automatically closes the bus tie, and thus powers both main buses. Anytime the power cart powers the main buses, neither the batteries or the generators can power them.

Switches

#1 Battery Switch: (19P1 CB)
Tripable switch that connects the #1 battery to the left main bus via the #1 bat contactor to the ***start bus*** and then the make-and-break switch (RCR) to the ***left main bus***. Also satisfies crash logic for the baggage door motor, service lights, and the oil panel. The make-and-break switch (RCR) allows the battery to be charged. ***NORMAL battery only draw on the left main bus is 30-35 amps.***

#2 Battery Switch: (19P2 CB)
Tripable switch that connects the #2 battery to the ***right main bus*** via the make-and-break switch (RCR). Also satisfies crash logic for the baggage door motor, service lights, and the oil panel. The make-and-break switch (RCR) allows the battery to be charged. #2 battery switch also causes battery ventilation blower to run on the ground. Inflight ventilation is from low pressure ram air at the vent duct. Does not power start bus through the #2 bat contactor except through start logic circuitry. ***NORMAL battery only draw on the right main bus is 20-25 amps.***

Both battery switches act as reset switches for the associated make-and-break switches. A ***reverse current of 250 amps*** trips them open (bat switches trip too) and disconnects the battery from its associated main bus. M&B switches require 18 volts to close and 7-9 volts to remain open.

Generator Switches:
3 tripable switches in the cockpit that connect the engine generators to the main buses. There are also 3 engine generator line disconnect switches located in 6PA. The APU has an ON/OFF generator button.

Generators #1 and #3—LEFT MAIN BUS
Generator #2—RIGHT MAIN BUS
APU Generator—RIGHT MAIN BUS (ground ops only)

Serves four purposes:
1) Circuit protection
2) Provides field current and ON / OFF
3) Starter interlocks
4) Satisfies crash logic—allows baggage door motor, service lights, and oil panel to operate from the battery bus.

NEVER RESET A TRIPPED GEN SWITCH UNLESS SPECIFIED IN A PROCEDURE!

Bus Tie Switch: (is protected by current limiters)
Ties the main buses. Is a start interlock. Auto bus tie with GPU. Pwr from either bus.

Volts = potential. Amps = flow.

Voltmeters (nonselective-shows highest voltage on bus—no way to see individual voltage of generators):
Has battery and generator green arcs.
Each voltmeter is directly connected to its associated main bus.
IRS1, IRS2, IRS3, HRZN checks individual battery voltages (24v min prior to battery power for IRS checks, battery power on for HRZN check)

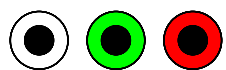
Min voltage for main engine start: 22 volts. Below 22, battery is less than 20% charged.
Min voltage for APU engine start: 23 volts.

Ammeter/Loadmeters (selective-can select amperage of individual items):
Indicates load in amps. GEN 1, BAT 1, GEN 3 switch or GEN 2, BAT 2, APU switches.
These two switches control what you are looking at on the ammeters for each main bus.

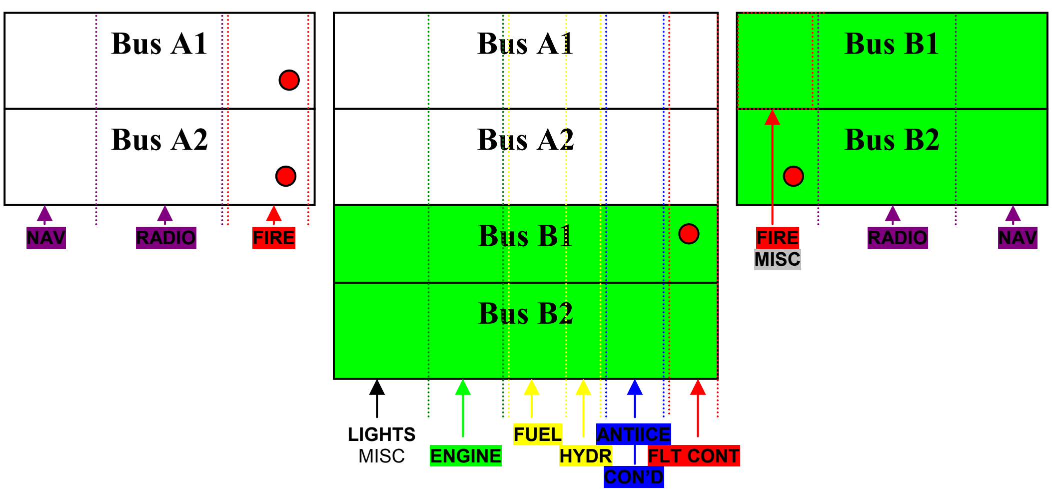
Circuit Breakers

Circuit breakers are collar color coded: A B Both

WHITE bus A1 or A2
GREEN bus B1 or B2
RED bus A1 backed up by B1



Circuit breaker overhead layout:



BUS TIE CB not only provides power to the bus tie relay but provides power to the associated voltmeter.

Fault Lights

TEST feature illuminates all fault lights, however **BLEED OVHT** flashes.

Either **GEN 1**, **GEN 2** or **GEN 3** annunciator lights indicate the respective generator is no longer connected to the power system (respective main bus). The associated reverse current relay is open or the start relay remained open.

BAT 1 or BAT 2 light indicates that the respective battery is not connected to airplane power system (respective main bus) through its make-and-break switch. The **BAT 1** light actually looks at both the make and break ground and the contactor position. The **BAT 2** light looks at make and break only.

HOT BAT light indicates that the temperature of one of the batteries has exceeded 150 degrees F. Also lights > 150º F Illuminates when temp exceeds 120º F. If the Hot Bat illuminates, turn the associated battery switch off.

BUS TIED light indicates that the left and right main buses are tied together. It looks at the relay position. It also looks at the battery 2 contactor position and the current limiter. If the bus tie light stays on after closing the selector, turn off battery #2. If you still have current on ammeter #2, you have a stuck bat 2 contactor. If you don't you have a stuck bus tie relay.

Power Selector Switch

Normal detent:
Both main buses are powered by the associated batteries or generators.

External Power detent:
Isolates batteries when selected. Isolates the generators (including the APU generator) when there is power to the small pin on the GPU plug. The switch also automatically closes the BUS TIE. Thus with external power selected and on, we will see 2 Bat lights, 3 Gen lights, and a Bus Tie light. If we select External Power during flight nothing will happen with the generators because there is no power to the pin but *both batteries will isolate and the bus tie will close.*

Batteries

23 amp hour batteries on most aircraft. Some aircraft have lead acids.
20 cell nicads
Normal operational voltage is 24-26 volts
22 volts minimum for main engine start
23 volts minimum for APU start

APU Generator

30 volt, 300 amp, regulated to 28.5 volts.
After start, RCR closes and connects APU generator directly to the right main bus which also supplies B1 and B2. Since the bus tie is already closed, the left main bus and A1 and A2 are also supplied.

Battery 1 is charged and the battery bus is powered through Bat 1 make-and-break switch. The start bus is powered from the left main bus through the Bat 1 make-and-break switch. Battery 2 is charged through the Bat 2 make-and-break switch. In this config, Bat 2 does not power the start bus.

Auto Load-Shed (INFLIGHT SYSTEM ONLY)

In the event of the loss of one generator's output, certain A6 items such as galley, lav, and cabin entertainment systems will automatically load shed. After proper load reduction by the crew, the Auto Load Shed switch can be placed in the override position to reapply power to those systems. If a second generator is lost, auto load shed will happen a second time with no option for the crew to override it. Auto shed works only in flight. Upon touchdown, everything comes back on.

Positions Of Start Selector Switch

Air Start (should be labeled Ignitors):
Turns igniters on. *Also allows you to bypass "on ground logic" to start engines*. Is also a ***start interlock when airborne*** (one of the start interlocks is to be on the ground!). If you have a flame out, the airstart switch must be on to get starter rotation when you press the button.

Ground Start:
Use for starter assist starts ***on the ground*** (battery, GPU, APU assist, Generator assist)

Motor Start/Stop:
Used to terminate the engine start for: 1) if you abort the start prior to idle after the engine has motored; 2) if the computer does not automatically terminate the start at idle. Also used to motor engine with start button.

GCU (Generator Control Unit)

1. Terminates start at 50% $\mathbf{N_2}$.
2. Parallels load.
3. Limits output to less than 300 amps via controlling generator field.
4. Provides progressive field weakening during engine start.
5. Trips Gen at 32 volts.
6. Not capable of controlling above 350-400 amps.
7. It may be possible to control voltage with engine RPM if GCU fails

APU

Start

10%	Fuel and ignition
50%	Starter drop off
60%	Oil light out
97%	Gen light out (4 sec delay) APU hobbs now runs

Steady Green **APU** master indicates that the ground prox switches think that the aircraft is on the ground and interlocks are satisfied. Works on #1 prox detectors (outboards) of each main gear.

Flashing Green **APU** master indicates that the prox switches think you are airborne or you have had an external failure. APU will not start in this condition.

Honeywell suggests 1 minute delay after APU start before turning on APU bleed.

Shutdown

APU STOP button pushed
Always shutdown from loaded condition
<10%, APU Master OFF
After shutdown, turn off bleed switch
APU maintenance panel can be checked for APU faults. Minelco indicators.

Auto APU Shutdown

APU Master ***flashes*** due to external causes:

Generator overvoltage
Generator overamperage (short or differential)

ECU overheat 230º C

APU Master ***does not flash*** for internal causes:

Low oil pressure <35psi
High oil temp >147º C
Overtemp 732º C
Internal short
Overspeed (108.1% backed up by 109.0% sensors)

Recommended Start Sequence (APU,2,3,1) and Indications with APU assist

1) Bat & Gen switches ON
2) Bus Tie Closed
3) Standby #2 boost pump ON
4) Fire Warning Tested
5) APU master ON
6) APU start
7) #2 engine start
8) #3 boost pump ON
9) #3 engine start
10) #1 boost pump ON
11) #1 engine start
12) Start sequence complete

During Start			*Start Completed*		
GEN1	GEN2	GEN3	GEN1	GEN2	GEN3
BAT1	BUS TIED	BAT2	BAT1	BUS TIED	BAT2
GEN1	GEN2	GEN3	GEN1	GEN2	GEN3
BAT1	BUS TIED	BAT2	BAT1	BUS TIED	BAT2
GEN1	GEN2	GEN3	GEN1	GEN2	GEN3
BAT1	BUS TIED	BAT2	BAT1	BUS TIED	BAT2
GEN1	GEN2	GEN3	GEN1	GEN2	GEN3
BAT1	BUS TIED	BAT2	BAT1	BUS TIED	BAT2

Engine Start Procedures

1) Push the start button until $\mathbf{N_2}$ (turbine RPM) starts to move.
2) At 12-15% $\mathbf{N_2}$ minimum and <u>$\mathbf{N_1}$ rotation</u>, move throttle to idle.
3) Check igniter lights.
4) Check fuel flow.
5) Check ITT.
6) Check $\mathbf{N_1}$, $\mathbf{N_2}$.
7) Check oil pressure, minimum 25 PSI at idle.
8) When igniter lights extinguish, start sequence has terminated.
9) Check associated hydraulic pressure.

Some cases of fan rotation stopped by ground ice accumulation

Do not start the next engine until the generator output is less than 300 amps.

If GEN light is still on after start, and generator is producing amps, the start relay has not opened. If this scenario happens you have a stuck start relay.

.

Engine Starting Interlocks

Battery or APU

1. Aircraft on Ground, proximity detectors #1 on LMLG and RMLG in ground mode
2. Circuit Breakers In (APU CB B2 bus, Engines CB IGNTR 1,3,2)
3. Power Levers Cutoff
4. Generator Switches (engine specific) ON
5. Both Battery Switches ON
6. Bus Tied
7. If airborne, start selector switch to Airstart Position to bypass #1 above

GPU
Same as above except battery switches don't need to be on. Start Selectors should be in Ground Start (airstart position will by pass a faulty on ground prox switch) but is not a true interlock.

GPU
Two large power pins and one small control pin. Voltage on control pin isolates generators and allows selection of DC power selector. Selecting EXT power isolates batteries and allows GPU to power all buses. GPU needs to be 28.5 volts and 1000 amps.

GPU Start Sequence
Plug In GPU
Select External Power. This closes the GPU contactor, closes the Bus Tie, and disconnects both batteries from the main buses and inhibits all generators.
Battery and Gen Switches Same As Normal Start
Start Engines
All generator, battery and bus tied lights will remain on as long as the GPU is connected and operating.
Select Normal
Disconnect GPU

GPU powers all buses but does not charge the batteries because of diodes (one way electrical check valves)

Generator Malfunctions

D Differential (dead short --not resetable. Caused by *OVERAMPERAGE*) TRIPS GEN SWITCH ("rubber switch" will not reset).
O Over voltage TRIPS GEN SWITCH at 32 volts
R Reverse current (.5 volts diff or 10-30 amps diff)
M Mechanical (broken wire, sheared shaft)

D & O are most severe malfunctions. Only D & O will trip the Gen switch. R & M will take the gen off the line. **All will light the GEN light.**

DORM Gouge:
D & O **DO** trip the switch
R & M Switch **R**e**M**ains on

Check Position of Associated Generator Switch:

GEN 1, 2, or 3 LIGHT

GEN Switch Still On (R & M)		**GEN Switch Tripped (D & O)**	
Reverse Current	Mechanical Fail	Short-Overamp(Diff)	Overvoltage
Check Gen Voltages	No Volts	One Reset	One Reset
To Determine Bad Gen	No Amps	These resets are allowed only under dual generator failure conditions!	
Bad Gen Switch Off	Gen Switch Off		
Two Resets Max			

One GENERATOR inoperative:

GEN1 GEN2 GEN3 or GEN1 GEN2 GEN3

GEN Switch Still On (R&M): Check amps & bus voltages. If above 28.5V, turn off on line generator. If at 28.5, leave faulty generator off. Limit load on operating generator.

GEN Switch *Tripped* (D&O): Check amps & bus voltages. Watch for battery amps pegged. Be prepared to turn off battery if meter pegs. Limit load on operating generator. ***DO NOT ATTEMPT RESET.***

GEN1 GEN2 GEN3

GEN Switch Still On (R&M): Check amps & bus voltages. Two resets MAX. If right bus battery load is normal after reset attempts ***(140-150 amps for right main bus***), close Bus Tie Switch.

GEN Switch *Tripped* (D&O): If right bus battery load is normal (***140-150 amps for right main bus***), close Bus Tie Switch. ***DO NOT ATTEMPT RESET.***

Two GENERATORS inoperative:

GEN1 GEN2 GEN3 or GEN1 GEN2 GEN3 or GEN1 GEN2 GEN3

Check voltages on buses. Limit load on operating generators. ***NEVER TIE THE BUSES TOGETHER WITHOUT PREVIOUSLY CHECKING THE VOLTAGES AND LOADS ON THE BUSES.***

NORMAL RIGHT MAIN BUS LOAD IS 140-150 AMPS *(one generator)*
NORMAL LEFT MAIN BUS LOAD IS 190-210 AMPS *(95-105 each generator)*

ONE or NO GEN Switches has tripped: ***(do not attempt reset of the tripped switch)***

GEN 1

If Left Main Bus voltage is normal, NON-TRIPPED switch only, two resets max. If bus voltage is above the green, turn off Gen 3 switch and Gen 1 should come on line. If it doesn't, two resets max. Consider bus tie.

GEN 3

If Left Main Bus voltage is normal, NON-TRIPPED switch only, two resets max. If bus voltage is above the green, turn off Gen 1 switch and Gen 3 should come on line. If it doesn't, two resets max. Consider bus tie.

GEN 2

If Right Main Bus voltage is normal, NON-TRIPPED switch only, two resets max. Consider bus tie.

TWO GEN Switches *Tripped*: ***(exercise extreme caution resetting tripped switches)***

NORMAL RIGHT MAIN BUS LOAD IS 140-150 AMPS *(one generator)*
NORMAL LEFT MAIN BUS LOAD IS 190-210 AMPS *(95-105 each generator)*

GEN1 GEN2 GEN3 or GEN1 GEN2 GEN3

Bus tie switch FLIGHT NORMAL. Bat switch associated side ON. #2 Engine throttle idle. Attempt ***one*** reset of tripped #2 Gen switch. If it cannot be reset, check voltages and loads on both left main bus and right main bus for normal indications. If they are normal, TIE the BUSES.

GEN1 GEN2 GEN3

Bus tie switch FLIGHT NORMAL. Bat switch associated side ON. Engine #1 throttle idle. Attempt ***one*** reset of tripped #1 Gen switch. If it cannot be reset *(after you have added power back for #1*), engine #3 throttle idle. Attempt ***one*** reset of tripped #3 Gen switch. Check voltages and loads on both left main bus and right main bus for normal indications. If they are normal, TIE the BUSES.

E BAT Switches:

E BAT 1 Switch
Emergency Gyro (usually turned on shortly after start)
E BAT 2 Switch
Xpdr, Comm2, Copilot Baker Box (turned on only when needed)

TOTAL ELECTRICAL FAILURE *(you're having a bad day)*

- **Clean Wing Landing**
  Vref + 30 kts, double runway length required
- **NO airbrakes**
- **NO antiskid--#1 brakes**
- **NO thrust reverser**
- **NO stab trim**
- **NO gear down indications—gear extension via emergency (handle)**
- **Pressurization is manual control**

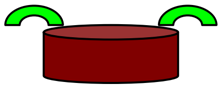
Lighting

Taxi Light
Automatically turns off with gear retraction

Landing Lights
Landing lights are your recog lights. Ground ops of landing lights limited to 15 minutes then 45 minutes off, no inflight limitations.

Exterior Lighting
Top anticollision light is A1. Lower is B2. Strobes operated by anticollision light switch.

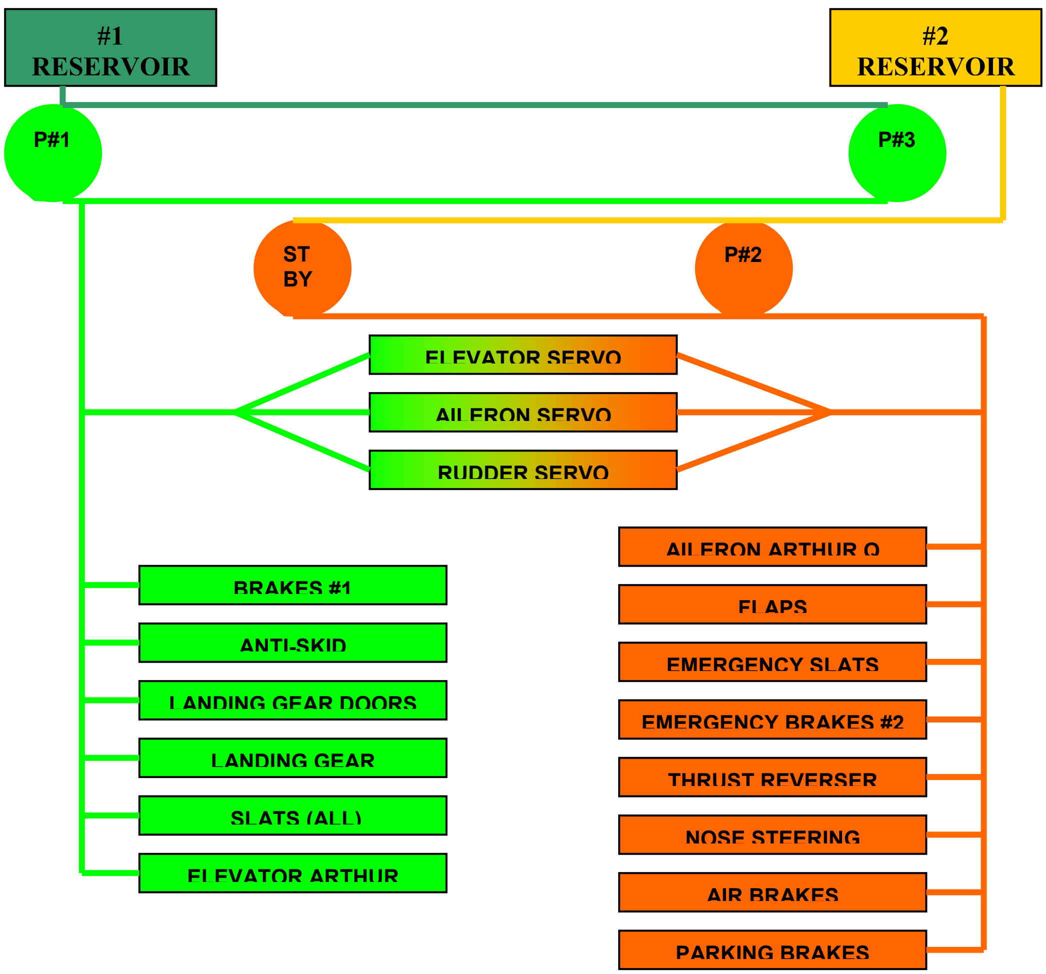
Emergency Exit Lights
Off, On, Armed. ON simulates a A1/B1 bus failure. EMERG LIGHTS illuminate when ON or ARMED with main bus power loss. Also stays on if a jet pack has failed. Supplies power for 10-20 minutes.



HYDRAULICS

Two independent systems, three Abex 3000 psi engine pumps, pumps #1 and #3 driving the #1 system and pump #2 driving the #2 system, and a standby pump for #2 system backup. Each engine driven pump (constant pressure, variable volume) delivers 7.6 gpm at max flow. The standby pump delivers 1.2 gpm (constant volume, variable pressure). The standby pump can be used for testing #1 system components ONLY on the ground. Its primary purpose is backing up pump #2. Uses hydraulic fluid MIL-H-5606 only (Red). No Chlorine based cleaners allowed near any hydraulic component.

Reservoirs are in the tail. 2.38 gallons for the #1 reservoir and 1.58 gallons for the #2 reservoir. Each reservoir is pressurized by its corresponding hydraulic system. System pressure acting on a small piston mechanically attached to a larger piston results in approximately 40 psi of pressure imposed on the fluid. This is in lieu of a bleed air head pressure system. Thus there is not supposed to be air in the reservoir tanks. Reservoir pressure for each hydraulic system is maintained after shut down via a pressure holding valve located in each system (1700 psi).



Each reservoir in the rear compartment "hell hole" has direct reading fluid level indicators, one scale for pressurized and one scale for unpressurized. Pressurized means "engines running". It is normal for the #2 system to appear a little in the red during preflight, with the #1 system 1/3 to 1/2 way in the green. The air trap should have mostly hydraulic fluid. Air only in the trap requires maintenance servicing. #1 indicator is powered by bus A1. #2 indicator is powered by bus B1.

Each ***engine driven*** pump supplies a constant 3000 psi, variable volume (4 gpm at idle and 7.6 gpm at 100%) hydraulic fluid supply to each associated system. The pump shafts are designed to shear in the event of pump seizure.
The ***standby pump*** supplies a constant volume (1.2 gpm) and a variable pressure (1500 – 2150 psi) and can be routed to either system #1 or #2 on the ground (via pump selector valve in "hell hole") and ***#2 system ONLY inflight***.

Fault Lights

PUMP 1, **PUMP 2**, or **PUMP 3** illuminate when pressure downstream of the respective engine driven pump is less than 1500 psi. Signifies pump failure or loss of fluid.
PUMP 2 light will stay on when the standby hydraulic pump is operating the #2 hydraulic system. **ST BY PUMP** will illuminate when the standby pump runs longer than 60 seconds or the "hell hole" pump selector valve is in the ground position (aft).

Hydraulic System Gauge Panel
"**A1** powers #1 gauges, **B1** powers #2 gauges"
The cockpit hydraulic quantity indicators show pressure and quantity.

Hydraulic Pressure Ranges:

1200 psi	**#2 P BK** light flashes
1500 psi	**PUMP 1**, **PUMP 2** **or** **PUMP 3** lights illuminate
1500 psi	Standby pump begins operation if required
2150 psi	Standby pumps cycles off if required
2150 psi	**PUMP 1**, **PUMP 2** **or** **PUMP 3** lights go out
3000 psi	Normal system pressure
3780 psi	Overpressure relief valve

#1 Hydraulic System

Pumps #1 and #3

Control Pwr From:

Elevator/Ailerons/Rudder Servoactuators

Brakes, Normal #1	**N/A**
Antiskid	A2
Landing Gear	A1
Landing Gear Doors	A1
Slats, Normal *(inboard and outboard)*	A1
Elevator Arthur	A1

The #1 system is **B A L L S E**

#2 Hydraulic System

Pump #2 backed up by Standby Pump

Elevator/Ailerons/Rudder Servoactuators

	Control Pwr From:
Aileron Arthur	B1
Flaps	B2
Emergency Slats *(outboard)*	B1
Emergency Brakes #2	*Requires* A1 *pwr for selection*
Thrust Reverser	B2
Nosewheel Steering	B2
Airbrakes	A1
Parking Brake	**N/A**

The #2 system is **A FEET NAP**

Standby Pump

Bus A1 controlled. Bus A5 supply powered. Supplies emergency hydraulic for #2 hydraulic system. 1.2 gpm constant volume, variable pressure 1500-2150 psi pump. Draws 65-80 amps.
Standby pump CB also powers #2 brake selection

Standby Pump Switch (A1 controll power)
Three position switch, OFF ON and AUTO

OFF is OFF
ON pump activates when #2 system pressure drops below 1500 psi
AUTO pump:
IN FLIGHT: activates as above AND airbrake lever is out of position 0
ON GROUND: activates when #2 system pressure drops below 1500 psi

Thus, while in flight with the standby pump switch in the AUTO position, should we experience a #2 hydraulic pump failure, the standby pump will not run until we deploy airbrakes or touch down. So if you need it, turn it on. Otherwise, it is ready for an emergency decent that requires airbrake extension.

Standby Pump Selector
Located in "hell hole". Has two positions, Ground Test and In Flight. In Flight position is FORWARD. Allows testing of #1 hydraulics via the standby pump while on the ground.

Reservoir Servicing (requires *special tool* in fly away kit)
#1 System requires:

1. Gear down and locked
2. Slats retracted
3. Reservoir depressurized (depress red button on pressure holding valve)
4. Check nitrogen charges:
   a. System accumulators 1500 psi
   b. Pressure holding valves 1700 psi

#2 System requires:

1. Slats and airbrakes retracted
2. Reservoir depressurized (depress red button on pressure holding valve)
3. Check nitrogen charges (same as #4 for system #1)
4. Check nitrogen charges of other accumulators and holding valves:
   a. TR accumulator 1500 psi
   b. Parking brake accumulator 1000 psi (right wing root)
   c. Airbrake pressure holding valve 1700 psi (right wheel well)

LANDING GEAR AND BRAKES

Tricycle type, electrically controlled (Bus A1), #1 hydraulically actuated, mechanically and hydraulically locked down. The main gear utilize locking mechanisms integral with the main gear bracing cylinders as well as hydraulic pressure to hold them down. The nose gear has a telescopic locking tube that mechanically locks the gear down as well as using hydraulic pressure. The nose gear telescopic locking tube also functions as a drag brace. Vle: 245, Vlo: 190

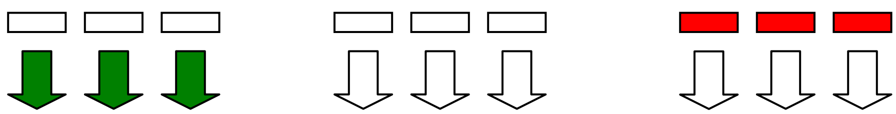
NORMAL Operation
(extend and retract)

Uses #1 Hydraulic Pressure
Held ***up*** by mechanical uplock boxes only
Held ***down*** by **BOTH** hydraulic pressure and mechanical locks
Requires electric control power "A1 bus"

Normal gear operation is controlled by sequencing the gear and doors through prox switches. The gear will not extend or retract unless the door actuators are fully open.

NORMAL GEAR INDICATIONS
all "B1" bus with "A1" bus backup

3 DOWN & LOCKED | **GEAR UP** | **MOVING**



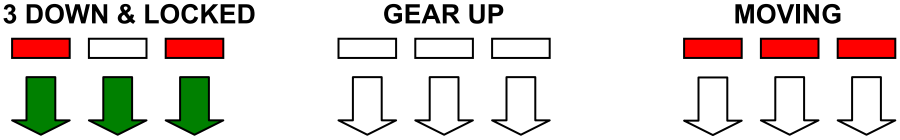
EMERGENCY Operation
(extend only)

Uses #1 Hydraulic Pressure for unlocking and extension
Held ***down*** by **BOTH** hydraulic pressure and mechanical locks
NO ELECTRIC REQUIRED

Pulling the red GEAR PULL handle mechanically actuates a hydraulic selector valve in the hydraulic emergency extension system to direct #1 hydraulic pressure for unlocking the doors & gear and for gear extension. A micro switch on the selector valve interrupts electrical power to the gear sequencing system if power exists. The #1 hydraulics effectively bypass both the electric door selector valve and the electric gear selector valve. Since the main gear doors remain open, both red lights will remain illuminated. Pushing the handle back in restores sequencing.

EMERGENCY GEAR EXTENSION INDICATIONS
all "B1" bus with "A1" bus backup

3 DOWN & LOCKED | **GEAR UP** | **MOVING**



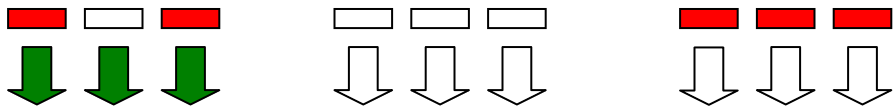
MANUAL EXTENSION Operation
(free fall extend only)

The gear can be released for free fall
Held ***down*** by **mechanical locks only**
NO ELECTRIC REQUIRED

Three independent manual control handles for manually releasing the gear doors and uplocks. In order to use this system, ***you still pull the red GEAR PULL handle*** before unlocking the gear. Even without hydraulics, this releases any trapped fluid that may impede the free fall of the gear.

MANUAL GEAR EXTENSION INDICATIONS
all "B1" bus with "A1" bus backup

3 DOWN & LOCKED **GEAR UP** **MOVING**



Panel Indicators
Flap / Slat indicator powered by "A2"
Gear position indicators powered by "B1" bus backed up by "A1" bus
Handle and handle light powered by "A1" bus

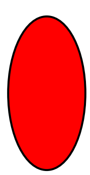
Gear Handle Protection
Copilot flipper bar
Anti handle retraction bar
- Left main #1 proximity switch
- Nose gear #1 proximity switch
- Has override button which moves the bar. NEVER TOUCH.

Gear Doors
Electrically controlled, hydraulically actuated. The sequence for NORMAL operation is controlled by proximity switches on the uplock units. **RED LIGHTS** on main gear panel indicate that gear doors are unlocked. They have nothing to do with gear position itself. **The landing gear will not retract or extend until all three gear doors are fully open. Gear must be fully up or down before gear doors will move.** You can manually release doors and gear from uplocks with "D" rings, one for each gear.

The main gear doors can be opened for inspection manually by releasing the door up lock in the wheel well.

Gear Indicators

Handle

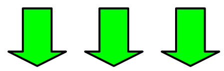


Flashing

1. The handle is UP and gear is not yet UPLOCKED
2. The handle is DOWN and gear is not yet DOWNLOCKED
3. The handle is UP and at least 1 gear is not DOWNLOCKED, or airspeed < 160 KIAS and one power lever is at reduced power

Panel Indications

Mains (left and right red lights): gear door is not closed
Nose (center light): nose gear not locked first and then either of the doors are in transit.



Corresponding gear is locked down

GEAR DOWN INDICATIONS:

1. 3 Green Lights
2. 2 Green Lights and No Red (doors would not have closed if gear was not sensed down)
3. Gear handle light not flashing with handle in down position
4. No audible horn when flaps are selected to 40

Warnings

Lights:

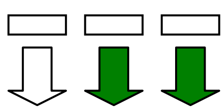
1. Flashing red light in gear handle is a warning that the gear does not match handle position. Also warns of low airspeed coupled with low power if gear is up.
2. Red lights on gear panel only mean gear doors are not closed and locked.

Audible:

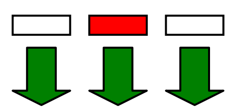
1. Any gear not down and locked and flaps extended to 40 degrees – non-cancelable.
2. Reduced throttle position and gear handle up.

If during a gear retraction you get an **AUTO SLATS** light on, you have had the nose strut compressing during retraction due to low nitrogen charge in the strut. The retract sequence is interrupted at that point. Put the gear handle down and gear extends normally.

Some Abnormal Gear Indications



Some proximity switch has sensed that the gear is down. Emerg gear will make door lights red



Gear is down but do not retract gear on go-around. Gear door may jam nose gear.

NOSE WHEEL STEERING

#2 hydraulic system, "B2" bus
Nosewheel is self centering and a shutoff valve prevents inadvertent nosewheel steering operation in flight. Pressing down on tiller electrically activates the steering selector valve supplying hydraulic pressure to the system. This also provides shimmy damping. CB is bottom center row, center panel.

Tiller movement of 0-60º results in 8º nosewheel displacement
Tiller movement of 60-120º results in 8-60º nosewheel displacement

BRAKES

10 piston carbon rotor brake units, 5 pistons with #1 hyd system, 5 pistons with #2 hyd (emerg) system. Both wear pins on each main should visible. Tool is required for actual measurement. #1 Brakes, #1 hydraulic, anti skid available. #2 Brakes, #2 hydraulic, NO ANTI SKID. Emergency/Parking brakes, #2 hydraulic / accumulator, NO ANTI-SKID.

During gear retraction, 360 psi is applied to main wheels to stop rotation.

In the event of a total electrical failure, #1 brake system is automatically selected and normal braking without antiskid is available from the #1 hydraulic system.

Normal Brakes (#1): differential and progressive with ANTISKID

Switch Position: #1 ON *(#1 OFF same without antiskid)*

Powered by #1 hydraulic system, pilot/copilot pedals. Metered pressure of 1595 psi. Indication of pressure being applied is by illumination of green **L** or **R** lights when pressure exceeds 225 psi. Lose all electrical power and #1 brakes are automatically selected. Touchdown protection is provided with antiskid on.

Emergency Brakes (#2): differential and progressive (A1 power required for selection)

Switch Position: #2 OFF

Powered by #2 hydraulic system, pilot/copilot pedals. Metered pressure is 1080 psi. Indication of pressure being applied is by illumination of **#2 P BK** light when pressure exceeds 230 psi.

Parking Brakes (handle): progressive

Powered by #2 hydraulic or brake accumulator. Pulling the handle progressively applies brake pressure. The first detent provides 800 psi and is used for ***emergency braking.*** The second detent meters 2175 psi. Either position can be used for parking. **#2 P BK** light illuminates when handle pulled to either detent. A *flashing* **#2 P BK** light means that you don't have sufficient pressure to hold the brakes. In this case, the standby pump can be used to build up the pressure before engine start. Parking brake accumulator nitrogen charge is checked at the right wing root aft of landing light—should be 1000 psi.

Brake Light Indications:

Green **L** or **R** lights	The # 1 brake system is being used and >225 psi is applied
#2 P BK ***Steady***	The #2 brake system is being used (pedals or handle)
#2 P BK ***Flashing***	Insufficient pressure remains in the accumulator (<1200psi)

Antiskid

Bus A2 power. Tied to #1 brake system. #1 brake system will provide touch down protection (senses shock strut extension and no wheel rotation). Six tach generators, one each wheel. Nose wheel tach generators provide airplane rolling speed. The use of antiskid allows 0.3G deceleration upon touchdown, 0.6G deceleration when nosewheel touches down and speed is > 50 kts, and 0.3G deceleration < 50 kts. Does not disarm at slow speeds.

Requirements to operate antiskid:

1. Power
   A. Circuit Breaker
   B. Anti Skid switch set to **#1 ON**
   C. Gear Handle down
2. System Armed
   A. Shock absorbers compressed
   B. Main wheel spool up

Anti Skid Testing:

Ground: 1) Set Parking Brakes
2) Depress brake pedals and observe green lights
3) Press test button for 1.5 seconds lights should extinguish
4) Release test button. After 2.5 seconds lights come back on

Flight: 1) Gear handle down
2) Depress brake pedals. NO GREEN LIGHTS
3) Press test button. Should see GREEN lights after .8 seconds, they remain illuminated for 1-2 seconds, and then go out
4) Release the pedal pressure and the lights should stay out

FUEL SYSTEM

19,065# usable fuel in three tank groups: *Left* Wing and *Left* Center G1, *Right* Wing and *Right* Center G3, *Fuselage* G2 (front and rear). Groups 1&3 tanks are considered integral tanks while Group 2 tanks are a structural part of the aircraft. Each engine normally draws its fuel from its respective tank. The APU draws its fuel from the Fuselage G2. All tanks are automatically pressurized by low pressure bleed (~3psi) from either the #1 or #2 engines.

Each wing tank has four jet pumps, three to facilitate fuel transfer from the outboard portions of the wings to the center portion and one to facilitate transfer from the center forward portion to the boost pump compartment.

The front and rear fuselage tanks are connected by two pipes. The right pipe is positioned to facilitate gravity transfer from front to rear should it become necessary. The left pipe is where normal transfer occurs from front to rear fuselage tanks via jet pump action. The rear fuselage tank has three jet pumps, one used for the transfer described above and the other two reposition fuel to the boost pump compartment.

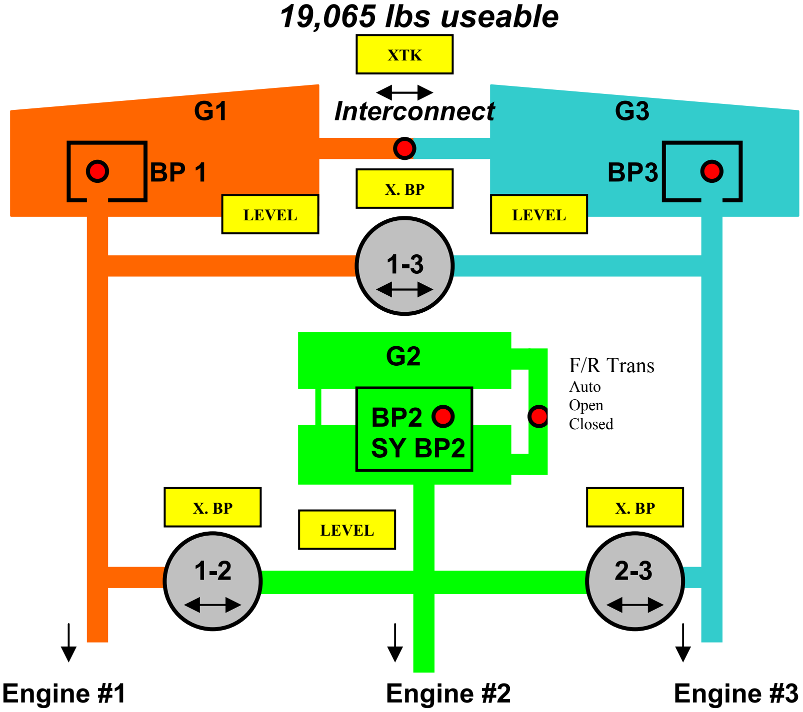
Tank Capacities:

Each wing tank – 6077lbs each	907 gal each
Front center tank – 3649lbs	544.6 gal
Rear center tank – 3362lbs	501.8 gal

Useable Fuel:

Group G1 (left wing)	**904 gallons**	**6058 lbs**
Group G2 (center fuselage)	**1037 gallons**	**6949 lbs**
Group G3 (right wing)	**904 gallons**	**6058 lbs**

19,065 lbs useable



Toggle Switches

Boost Pump #1

Bus "A1" powered. On / Off Switch. Provides fuel pressure at 7.25 psi to the Group 1 interconnect manifold, Group 1 crossfeed manifold, and then to the #1 engine. Also supplies the motive flow for the four jet pumps in Group 1 that siphon fuel from the outboard, inboard, and center wing tanks and deliver it to the boost pump compartment.

Boost Pump #3

Bus "B2" powered. On / Off Switch. Provides fuel pressure at 7.25 psi to the Group 3 interconnect manifold, Group 3 crossfeed manifold, and then to the #3 engine. Also supplies the motive flow for the four jet pumps in Group 3 that siphon fuel from the outboard, inboard, and center wing tanks and deliver it to the boost pump compartment.

Boost Pump #2

Bus "B1" powered. Three position switch described *under Standby By Boost Pump #2*. Provides fuel pressure at 7.25 psi to the Group 2 crossfeed manifold, and then to the #2 engine. Also supplies the motive flow for the three jet pumps in Group 2, one that siphons fuel from the front tank to the rear tanks when the transfer valve is open and the other two to siphon fuel from the aft part of the rear tank and deliver it to the boost pump compartment.

Standby By Boost Pump #2

Bus "A2" powered. Acts as a back up for and does the same as Boost Pump #2. Three position switch which controls both BP#2 and SY BP #2:

OFF	Both pumps are off
ST BY	Only Standby pump is ON
NORM	Only normal pump is on unless X.BP 1-2 or2-3 are open in which case the standby pumps operates also to assist normal boost pump #2

Tank Interconnect Switch XTK

Bus B1 powered. The tank interconnect switch allows fuel leveling between the right and left wing tanks. It is a three position switch with the center position off. Moving the switch to the right will move fuel from left to right. Conversely, moving the switch to the left will move fuel from right to left.

When the switch is moved to the right or left, the XTK valve opens supplying ***motive fuel flow*** to open the ***interconnect valve*** (connects both wing tanks G1 & G3) Also, the crossfeed core valves controlling the motive flow to the jet pumps in the tanks are positioned to facilitate fuel transfer from the high side to the low side(allows motive flow to the jet pumps on the high side and shuts off motive flow to the pumps on the low side).

The Tank Interconnect XTK switch is powered ONLY when the 1-3 X.BP selector is horizontal.

Actual fuel transfer can only be accomplished between the wing tanks (groups G1 and G3). No Fuel transfer is available between fuselage tanks and the wing tanks.

Forward / Rear Fuselage Transfer Switch XTK2 (If Installed)

The forward to rear transfer switch is a three position switch. It controls the transfer of fuel from the front fuselage tank to the rear fuselage tank. The rear tank is where both boost pumps are located and where engine #2 normally gets its fuel supply.

AUTO	XTK2 valve is open when: Front tank >1200# or rear tank < 1100# XTK2 valve is closed when: Front tank <1200# or rear tank > 1400#
OPEN	XTK2 valve is open
CLOSED	XTK2 valve is closed

Manual XTK Valve (If Installed)

A manual transfer shutoff valve is located in the cabin on the left side in line with the #11 and #12 windows. Used only if the valve fails to close using the F/R fuselage transfer switch (**XTK2**).

Fuel Shut Off Valve Switches

Two position switches that shut off fuel only.

Rotary Selector Switches

Crossfeed Selector (1-3) (*top one*) bus B1
Allows BP1 to supply fuel to engines 1&3, or
Allows BP3 to supply fuel to engines 1&3

Crossfeed Selector (1-2) (*bottom left one*) bus B2
Allows BP1 to supply fuel to engines 1&2, or
Allows BP2 or SY BP2 to supply fuel to engines 1&2

Crossfeed Selector (2-3) (*bottom right one*) bus A1
Allows BP2 or SY BP 2 to supply fuel to engines 2&3, or
Allows BP3 to supply fuel to engines 2&3

Maintenance Panel

Located on copilot's right side wall. Has gravity refueling switch.

Normal Operations

Normal fuel operations are automatic with the exception of a takeoff with full fuel described below under fuel management.

Crossfeed

Crossfeed, better called cross boost, allows one boost pump to do the job of two should a boost pump failure occur. Crossfeed is controlled by the XBP switches. The core valves controlled by these switches ensure proper jet pump operation for both normal and boost pump failure conditions, namely the jet pumps in the failed BP compartment are shut off from their motive flow. *(the XTK toggle reestablishes motive flow to those jet pumps to assist in fuel transfer between G1 and G3)*

Jet Pumps

Jet pumps are located in each tank group to facilitate transfer of fuel to the boost pump compartments. Operated by motive flow from the boost pumps. In G2 (fuselage), the there are three jet pumps, one to transfer fuel from the front tank to the rear and two to transfer fuel in the rear tank to the boost pump compartment. In G1 and G3 (wings), there are four jet pumps each, three to transfer fuel from the outboard portions of the wing to the center portions and one to transfer fuel to the boost pump compartment. The primary purpose of the jet pumps is to ensure that the boost pumps stay submerged.

Tank Pressurization

All fuel tanks are pressurized (~3 psi) from bleed air from the #1 and or the #2 engines. This pressure assists the boost pumps in normal operations and gravity feed if needed. *Venting the fuel tanks in the 900 at the end of the day is not required or recommended.*

Gravity Feed

All engines are capable of drawing fuel via gravity (assisted by tank pressurization pressure) from their respective tanks with no assist from the boost pumps should this be necessary. ***Altitude limit for this is 31,000'.***

Cruise Fuel Management

If the takeoff was made with full fuel, the fuselage tank will have approximately 900 lbs more than the right or left wing tanks. Therefore, upon reaching the filed altitude, open boost pump 1-2 and boost pump 2-3 crossfeed valves. #2BP switch needs to be in the normal position for both group 2 pumps to operate (this is where it should be anyway). When the fuselage tank shows a decrease of approx 900 lbs, return the crossfeed valves to normal.

1500' AGL is the minimum altitude approved for fuel management.

Fuel Warnings-Warning Panel

FUEL 1	FUEL 1	FUEL 1
LO FUEL 1	LO FUEL 2	LO FUEL 3
	FUELING	

XTK2 OPEN
XTK2 CLOSED

The FUEL 1 2 3 lights illuminate when a pressure equal to or less than 4.6 psi is detected
The LO FUEL 1 2 3 lights illuminate when fuel level below 200# is detected
The XTK 2 OPEN light illuminates when the front to rear tank transfer valve is open when it should be closed
The XTK 2 CLOSED light illuminates when the front to rear tank transfer valve is closed when it should be open
The FUELING light illuminates when:

One of the two fuel tank vent valves is not closed
The fueling/defueling valve is not closed
The refueling connector door is not closed
The refueling control panel is not closed
The gravity fueling switch is on
The defueling switch is on
The vent valve lever is not stowed
You have a B2 bus failure

Fuel Warnings-Fuel Panel

The XTK light illuminates when the interconnect valve is not closed
The X.BP light illuminates when the associated crossfeed valve is not closed
The LEVEL light illuminates when the fuel level is lower than 1000# for the wings and 1100# for the fuselage tank

Fuel System Electrical Power

Bus A1: BP1, Fuel Flow 1, X.BP 2-3, LH Fuel Quantity, Low Fuel,
Bus A2: SY BP 2, Fuel Flow 3, Low Fuel, Fuel 2 Shutoff
Bus B1: BP 2, Fuel Flow 2, X.BP 1-3, RH Fuel Quantity, XTK
Bus B2: BP 3, CTR Fuel Quantity, X.BP 1-2, Fuel 1&3 Shutoffs, Gravity Refueling

Fuel Quantity Gauges

Three gauges
Fuselage tank gauge has TOTAL / REAR switch and green arcs to indicate proper transfer from front to rear

Fuel Flow Gauges

Typical fuel flow gauge with test *(in maintenance panel)* and reset button

Single Point Refueling Operations (battery bus)

Max truck pressure is 50 psi.
3 On / OFF toggle switches for the 3 tank groups. These switches cause the opening or closing of the refueling solenoid valves.
3 amber FULL lights
A test button for auto shutoff. Fueling stops in 3-5 sec and FULL lights illuminate
A red STOP FUELING light
A full or partial fuel switch along with a partial refueling selector

Pressing the STDY HORZ test button kills power to the fueling panel because it simulates and inflight bus failure.

Overwing (Gravity) Refueling Operations (B2 bus)

Requires electrical power (ie APU or GPU).
Gravity switch ON (cockpit maintenance panel) This opens the refuel/defuel valve in the G2 manifold and opens the tank vents. *(it will open tank vents in flight)*
Special procedure to fill G2 tanks
- X.BP 1-2 and X.BP 3-2 crossfeed switches open
- BP#1 and BP#2 ON
  - (if gravity fueling only from one wing filler port, open the crossfeed and turn on the boost pump for that side only)
- The CENTER refueling switch in the single point panel switched ON

FIRE PROTECTION

Visual and Audible warning for Fire, Overheat, or Smoke for all monitored systems except wheel wells which is visual warning only. Five fire bottles. Engines and APU detectors operate in two modes: general overheat and local overheat conditions. Baggage compartment detects *smoke* and wheel wells are *temperature sensors*. Two hand cabin extinguishers (required) 1 in left cabinet behind pilot's seat, 1 in aft cabin.

Fire Warning Lights (bus A1 backed up by bus B1)

L. WHL OVHT	Overheat in Left Wheel Well
R. WHL OVHT	Overheat in Right Wheel Well
Fire 1	#1 Engine Fire
Fire 2	#2 Engine Fire
Fire 3	#3 Engine Fire
Fire Bag Comp	(Optical Sensor Only) Baggage Compartment Smoke
Fire APU	APU Fire

(firing bag comp fire extinguishing bottle may extinguish the fire but not the smoke so the light probably won't go out)

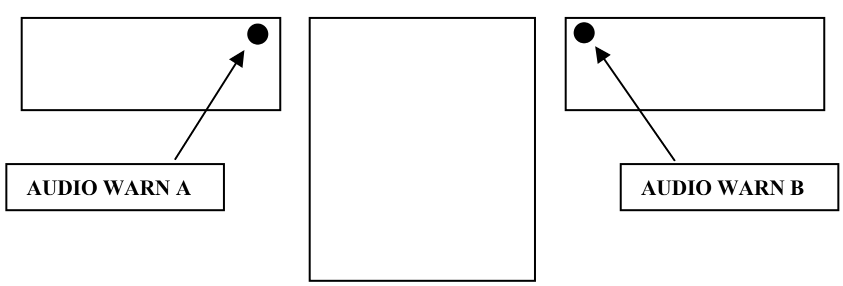
Fire Warning Fault Lights (bus A1 backed up by bus B1 power)

Engine #1 Fault Light	Illuminates with loss of A1 bus power
Engine #2 Fault Light	Illuminates with loss of B1 bus power
APU Fault Light	Illuminates with loss of B1 bus power
Engine #3 Fault Light	Illuminates with loss of A2 bus power

No detect fault lights for Baggage Compartment or Wheel wells.

Should you have a Fire Warning without a corresponding light:

1. Do not silence the warning horn. This is your only way of knowing the fire is extinguished after firing the bottle.
2. Press the Fire Test button. The light that doesn't illuminate is the one with the fire.
3. After power lever cutoff, fuel shutoff, and fire bottle #1 discharge, horn will silence when fire is extinguished.
4. If you inadvertently silenced the horn, you may reset it by resetting the Audio Warning A and Audio Warning B circuit breakers in the 2 Fire Warning CB locations located over each pilot's head.



Fuel Shutoff Switches

Switches that shut off the fuel to the indicated engine. **TRANS** light indicates that the valve is in transit or that the valve is not in the position dictated by the fuel shutoff switch.

Fire Extinguishing Switches

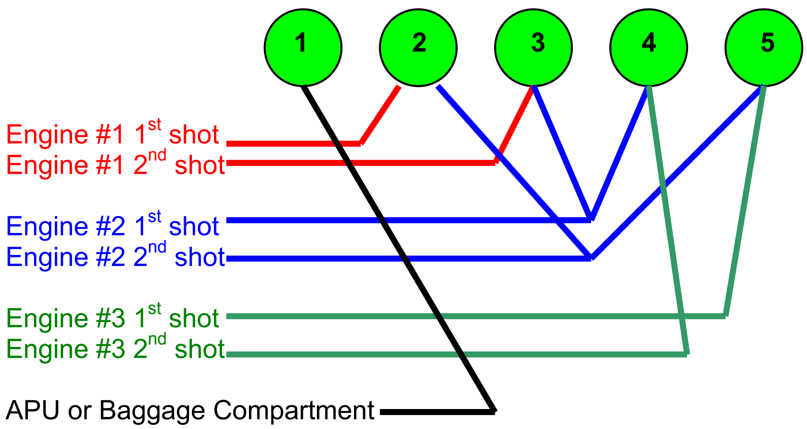
#1 Engine Positions
- 2 - left engine, bottle 3, Battery bus
- 1 - left engine, bottle 2, A1 bus
- 0 - off (and safetied)

#2 Engine Positions
- 2 - center engine, bottles 2&5, Battery bus
- 1 - center engine, bottles 3&4, B1 bus
- 0 - off (and safetied)

#3 Engine Positions
- 2 - right engine, bottle 4, Battery bus
- 1 - right engine, bottle 5, A2 bus
- 0 - off (and safetied)

APU Positions
- 1 – Bottle 1, B1 bus
- 0 – off (and safetied)

Bag Compartment Positions
- 1 – Bottle 1, A2 bus
- 0 – off (and safetied)



Fire Warning Test

Pushing test button checks loops, detectors, horns, and warning lights.
FIRE BAG COMP light is delayed in both illumination and extinguishing during test.

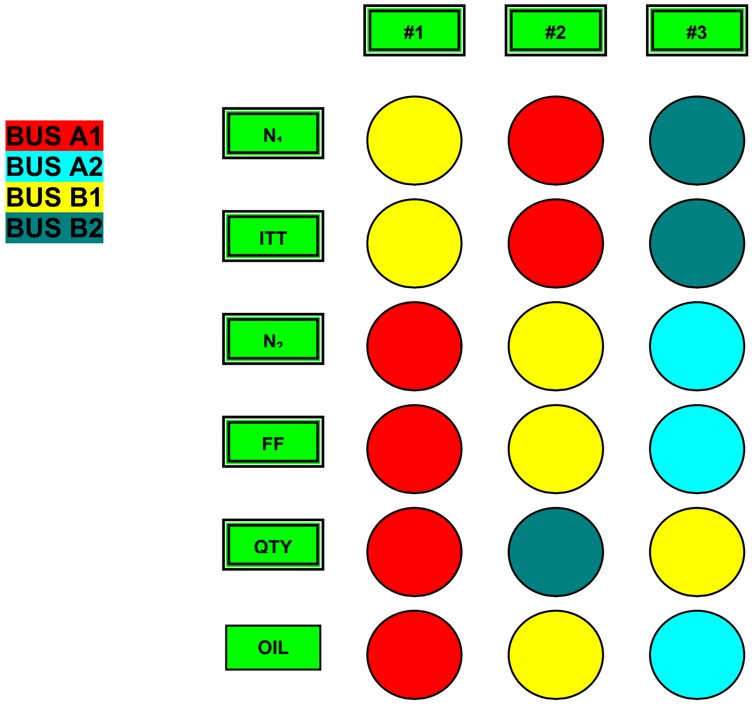
ENGINES

TFE 731-5BR-1C 4750 # thrust rating, high bypass engine. 3.20 to 1 bypass ratio. 60% of thrust is supplied by the fan at sea level reducing to 40% at altitude. Accessories are driven by the **N_2** shaft. 4 stage axial LP compressor and 1 stage HP centrifugal compressor. 1 stage HP turbine and 3 stage LP turbine. Stall and surge conditions controlled by surge bleed valve which has three positions, open, 1/3 open, and closed. This is normally controlled by the computer.

TFE-731-5BR-1C TFE = turbo fan engine, 7= Twin-spool engine (**N_1**, **N_2**), 3= 3 stage LP turbine, 1= 1 stage HP turbine.

N_2: HP turbine connected to HP compressor. Clockwise rotation at 30,300 rpm (100%)
N_1: LP turbine connected to LP compressor and then Fan. Clockwise rotation at 21,000 rpm (100%). Fan rpm is 10,666 rpm. This is the takeoff thrust parameter.

Engine Gauge Electrical Power Sources:



Oil pressure gauge and oil pressure light each have separate sending units.
OIL light detects both low oil pressure and has a separate chip detector.

Oil and filter bypass is checked in rear compartment at service panel. Operates via battery bus power and is activated by On/Off switch. At least one of the generator or battery switches must be on to function (crash logic).

ENG 2 FAIL light during takeoff indicates low engine power ***on the ground*** or the S-duct door is not locked ***in flight***.

Digital Electronic Engine Computers

Three position switch

Auto	Does everything
Man	Only gives $\mathbf{N_1}$ & $\mathbf{N_2}$ overspeed protection
Off	Off

Computer Provides:

1. Optimum engine performance
2. Minimum fuel burn
3. Fastest engine acceleration and deceleration
4. Least pilot attention

Computer Performs These Functions:

1. Automatic start termination
2. Idle to full power as much as 30 seconds faster than manual
3. Permitted to take throttle to firewall for takeoff.
   Computer limits: 4750# thrust, $\mathbf{N_1}$ 100%, ITT 978ºC, whichever it sees first.
4. Ultimate $\mathbf{N_1}$ and $\mathbf{N_2}$ overspeed protection.

Computer opens surge bleed valve for deceleration and closes valve for acceleration. With computer off, surge bleed valve is left in 1/3 open position, slowing acceleration. ***The fuel computers must be operational for takeoff.*** Flight with one inoperative may be permitted if all requirements of the AFM are complied with.

Computer failure or power loss is indicated by **CMPTR** light. The computer will automatically reset if it trips to the manual mode for a momentary input voltage drop.

#1 engine computer is powered by bus A1 backed up by B1
#2 engine computer is powered by bus B1
#3 engine computer is powered by bus A2

Temperature Limitations (ITT)
Takeoff 978º C limited to 5 minutes.
Max Continuous 968º C limited to 30 minutes
Max Cruise Thrust 927º C (not a true limitation, just a recommendation)
RPR 996º C limited to 5 minutes

RPR System
Restricted Performance Reserve, when **PWR INC** is selected, increases the normal engine rating of all the engines to a preset higher rating to improve takeoff and go around performance for hot and high conditions. Available only at altitude range of 3,000 – 7,000 feet and temperatures greater than 18.5º C.

Takes the –5BR engine ITT from 978º to 996º to give rated thrust in warm OAT conditions. The OAT must be warmer than 18.5º C for an increase in performance (the engine cannot exceed rated thrust which it would do if it was colder than 18.5º degrees C). The system is activated when the **PWR INC** button is depressed.

RPR Time Limit
RPR is limited to 5 minutes of use including the duration of normal takeoff power prior to RPR activation. Use of RPR decreases engine life. RPR events are recorded by the engine computers and count as 4 engine cycles.

CMPTR 1 or 2 or 3 light on is caused by:

1). Computer switch OFF or MANUAL
2). Input failure (i.e. cut wire)

START LOGIC

GEN ↓ / START →		FIRST START APU							
APU	OFF								
	ON								
2	OFF	X	X			X	X		
	ON			X	X			X	X
3	OFF	X		X		X		X	
	ON		X		X		X		X
1	OFF	X	X	X	X				
	ON					X	X	X	X
BAT LIGHTS		OFF	ON	ON	ON	ON	ON	ON	ON
START ASSIST									
MAIN BUS POWER		B1 B2	G3	G2	G2 G3	G1	G3 G1	G2 G1	G2 G3 G1

GEN ↓ / START →		SECOND START ENGINE #2							
APU	OFF	X	X			X	X		
	ON			X	X			X	X
2	OFF								
	ON								
3	OFF	X		X		X		X	
	ON		X		X		X		X
1	OFF	X	X	X	X				
	ON					X	X	X	X
BAT LIGHTS		OFF	ON	ON	ON	ON	ON	ON	ON
START ASSIST			G3	APU	APU	G1	G3	APU	APU
MAIN BUS POWER		B1 B2	G3	APU	G3	G1	G1	G1	G3 G1

GEN ↓ / START →		THIRD START ENGINE #3							
APU	OFF	X	X			X	X		
	ON			X	X			X	X
2	OFF	X		X		X		X	
	ON		X		X		X		X
3	OFF								
	ON								
1	OFF	X	X	X	X				
	ON					X	X	X	X
BAT LIGHTS		OFF	ON	ON	ON	ON	ON	ON	ON
START ASSIST			G2	APU	APU	G1	G2	APU	APU
MAIN BUS POWER		B1 B2	G2	APU	G2	G1	G1	G1	G2 G1

GEN ↓ / START →		FORTH START ENGINE #1							
APU	OFF	X	X			X	X		
	ON			X	X			X	X
2	OFF	X		X		X		X	
	ON		X		X		X		X
3	OFF	X	X	X	X				
	ON					X	X	X	X
1	OFF								
	ON								
BAT LIGHTS		OFF	ON	ON	ON	ON	ON	ON	ON
START ASSIST			G2	APU	APU	G3	G2	APU	APU
MAIN BUS POWER		B1 B2	G2	APU	G2	G3	G3	G3	G2 G3

NORMAL APU, #2, #3, #1 start sequence:

1. APU is started via batteries from main bus power.
2. #2 engine is started via APU assist. APU also supplies main bus.
3. #3 engine is started via APU assist. Gen 2 supplies main bus .
4. #1 engine is started via APU assist. Gens 2&3 supply main bus.

APU

Garrett (or Allied Signal, or Honeywell) GTCP36-150. Uses fuel from the center fuel tank (120 lbs per hour) and requires #2 boost pump. Rated for ground use only.

Normal APU Start:

1) Select #2 boost pump to standby position
2) Tie the buses with the BUS TIE switch and check light
3) Push the green APU generator excitation button to the latch-in position
4) Push the green APU master button to the latch-in position
5) Fire Warning Tested
6) Press the APU start button
7) Check oil and gen lights out
8) APU bleed ON after 1 minute

APU Start Interlocks:

1) Bus Tie Switch Closed
2) Both battery switches ON
3) APU GEN latched in
4) APU Master ON
5) Aircraft on the ground

5 ways to shut down APU:

1) STOP button (provides overspeed signal)
2) APU Master
3) #2 Eng Firewall Shutoff (fuel)
4) APU GEN switch (*doesn't work like this in sim*)
5) Complete crash logic

When the APU OIL light illuminates, it is safe to turn off APU master per Falcon AFM.

THRUST REVERSER

General
Clam shell type. Electro-mechanically controlled, hydraulically operated, #2 hydraulic system with emergency accumulator. Bus B2 powered. Operational only with weight on both main gear. There is no minimum groundspeed during thrust reverser operation and thus can be used to a full stop.

Hydraulic Requirements:
Hydraulic system #2 with an emergency accumulator good for one deploy / stow cycle in the event of a #2 system failure.

Components

1. Upper and lower clam-shell doors on center engine nacelle.
2. Safety pins for securing buckets open or closed for maintenance and buckets closed for ferry.
3. Annunciator panel with **REV UNLOCK**, **TRANSIT** and **DEPLOYED** light.
4. Piggyback thrust reverser lever with a hard stop.

Emergency Stow
An emergency stow system is controlled by a guarded two-position switch labeled "STOW" and "NORMAL"

Automatic Stowing
Automatically applies and maintains hydraulic pressure on the stow side of the reverser actuator when any one of the clam shell door latches moves from the locked position.

PNEUMATICS and AIR CONDITIONING

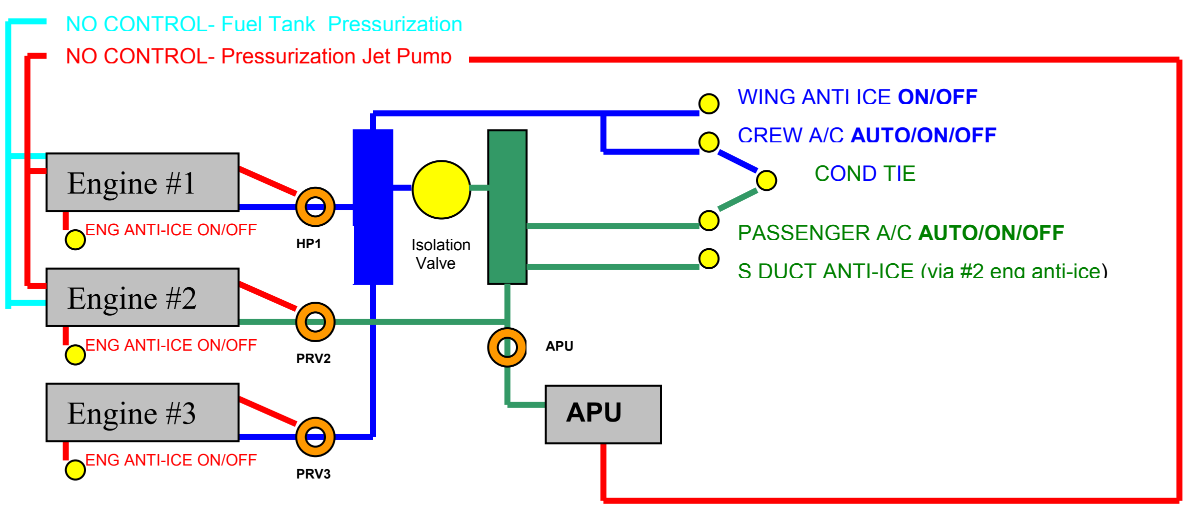
Bleed air to operate aircraft systems and for air conditioning purposes is provided by the engines through bleed ports. LP bleed is mixed with HP bleed. Each engine provides LP bleed from the last stage of the LP compressor and HP bleed from the HP compressor discharge.

LP bleed to the manifolds is non-controllable and happens with engine start. HP bleed is mixed with LP bleed from each engine and all three supply a single air system, which can be divided into two separate subsystems by the isolation valve. The amount of mix is controlled by the HP1, PRV2, and PRV3 valves.

With the isolation valve closed the #1 and #3 engines supply the crew A/C and the wing anti-ice systems. The #2 engine then supplies the passenger cabin A/C and the S-duct anti-ice system.

For air conditioning, hot bleed air is tempered by heat exchangers in conjunction with a turbofan and is then cooled by a turbo cooler (air cycle machine). Electronically controlled valving system mixes the hot, tempered, and cooled air to the proper proportions. Control of this is by the ECU (environmental control unit). Humidity control is by water separators.

PNEUMATICS



Switches

HP1 The HP1 switch controls the HP1 valve and allows HP bleed from engine #1 to mix with the LP bleed in the manifold. With the switch **AUTO**, the valve ***only opens*** when the ***wing*** anti-ice system is in operation and the LP1 bleed air temp is <192º C. OFF commands valve to close. Fails in position.

PRV2 The PRV2 switch controls the PRV2 valve (pressure regulating valve trying to maintain 65 psi) and allows HP bleed from engine #2 to mix with the LP bleed in the manifold. With the switch **AUTO**, it operates as a pressure regulating valve. The PRV2 valve *opens fully* when the #2 engine anti-ice (& S Duct) is on and/or wing anti ice is on (systems not isolated) and the LP2 bleed temp is < 192º C. OFF commands valve to close. All PRV valves are solenoids *(require pressure and electrics)* that fail closed.

PRV3 The PRV3 switch controls the PRV3 valve (pressure regulating valve trying to maintain 65 psi) and allows HP bleed from engine #3 to mix with the LP bleed in the manifold. With the switch **AUTO**, it operates as a pressure regulating valve. The PRV3 valve opens fully when the wing anti-ice is on and/or S duct is on (system not isolated) and the LP3 bleed temp is < 192º C. OFF commands valve to close.

APU The APU switch controls APU bleed air valve allowing bleed to the manifold. Valve is also controlled by PLA >54º switches and the APU electronic unit. APU bleed provides 50 psi pressure.

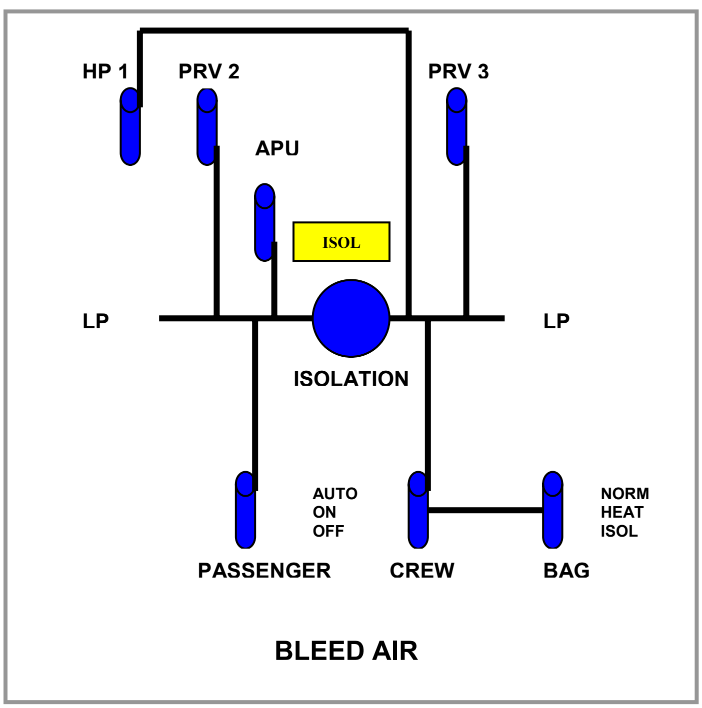
ISOLATION Controls valve that separates bleed system

PASSENGER The switch that directs bleed air supply to the ECU for the cabin
OFF Valve is closed in 2-4 seconds
ON Valve is open in 2-4 seconds
AUTO Valve is open on the ground, closes on takeoff roll (related to PLA 54º), then motors back open. ***Opening takes 2 minutes 15 seconds.***

CREW The switch that directs bleed air supply to the ECU for the cockpit
OFF Valve is closed in 2-4 seconds
ON Valve is open in 2-4 seconds
AUTO Valve is open on the ground, closes on takeoff roll (related to PLA 54º), then motors back open. ***Opening takes 2 minutes 15 seconds.***

BAG The switch that directs bleed air supply to the baggage compartment from the cockpit hot air line
NORM Supply and isolation valves are open
HEAT Closes the supply line but leaves the isolation valve open
ISOL Both valves are closed

COCKPIT BLEED CONTROL PANEL



Bleed Caution Lights

BLEED OVHT	Illuminates when temp exceeds 335ºC ***FLASHES*** when corresponding switch (HP1, PRV2, PRV3) controlling the circuit causing the problem is turned off. Thus, turning off switches one at a time allows you to determine which circuit is overheating.
BLEED APU	Illuminates when APU bleed valve is open and one PLA exceeds 54º or valve is open with switch off.
ISOL	Illuminates when isolation valve is closed. In this position the #2 engine bleed is isolated from the wing anti-icing system. It also isolates APU bleed from the crew ducts.

AIR CONDITIONING

Air conditioning consists of heating and cooling systems. Cooling functions are performed automatically by the ECU. The bleed supply is directed to the ECU by two air conditioning valves controlled by switches labeled **PASSENGER** and **CREW** described above. Cooling is achieved by two dual-pass heat exchangers, a turbofan, and a turbo cooler (ACM). The turbo fan portion sucks air from a duct in the bottom of the fuselage. At 300 kts ***TRUE*** airspeed (with gear up and slats up), the turbofan is braked and the turbocooler uses only ram air from the ram air inlet on the #1 engine pylon.

Distribution

Separate air distribution systems are provided for passenger and crew systems. The systems may be interconnected to allow either system to supply both.The baggage compartment is also supplied via the crew hot air duct (controlled by ***bag*** switch) and the nose cone is ventilated by cabin conditioned air. The cooling air for the EFIS units is supplied from the crew gasper duct.

Controls

Copilot side panel has two levers (*look like foot warmer/defoggers from 10-20. The foot warmer/defog levers are located under the P/CP gaspers in the 900*)

"COND" lever
- NORMAL position—pax and crews ducts are separate
- TIED positioin—pax can crew ducts are tied together

"ISOL" lever
- NORMAL position—nose cone isolation valve is open
- CLOSED position—nose cone isolation valve is closed

Temperature Controls

Two controllers labeled "PASSENGER" and "CREW". Both have AUTO and MANUAL switches and valve position indicators. The temperature gauge receives inputs from the passenger temperature sensor. Passenger also has a remote switch for temp control from the cabin and a cabin temperature gauge.

Caution Lights

ECU OVHT	Illuminates when ACM outlet duct temperature exceeds 230º C, or on ground and bypass valve not closed. Automatically shuts down APU. Most common in summer.
COND'G OVHT	Illuminates when the temperature in either the passenger or crew conditioned air ducts is 95º C or greater. Most common in winter.
NOSE CONE OVHT	Illuminates when the temperature in the nose cone is 70º C or greater.

PRESSURIZATION SYSTEM

Mix of LP/HP bleed air. The pressurized areas are the cockpit, passenger cabin, nose cone, and baggage compartment. Normal pressure differential limit of **9.3 psi** is maintained when in "PROG" mode. Max differential is **9.6 psi**. Cabin altitude at 51,000 ft is 8,000 ft. Components:

Automatic Controller (*bus A1)*

- Active when AUTO-MANUAL switch is AUTO
- Controls the *electro-pneumatic* outflow valve
- Two LCD displays, "LAND ELV" and "QNH"
- Three position switch
  - "PROG" allows automatic operation, set in landing elevation
  - "FL" manual mode when prog test fails, set in flight level
  - "LDG" manual mode when prog test fails, set in landing elevation
- TEST button
- System automatically maintains lowest possible cabin altitude w/"PROG"

Do not select 29.92 when operating at the flight levels. Set departure QNH and then arrival QNH when you get it.

Manual Controller *(no electrics required*)

- Used when AUTO-MANUAL switch is MANUAL
- Allows manual control of pressurization system.
- Controls the *pneumatic* outflow valve
- Knob to allow rate control is located on emergency pressurization control panel.
- A1 bus failure causes the auto controller to fail and the manual takes over. *Outflow valves will spring load closed with either A1 bus failure or selection of manual unless you moved the manual press knob out of the green to the 1 o'clock position.*

Emergency pressurization control

- Two position switch, "NORM" and "EMERG". Selecting EMERG routes LP/HP mixture directly to the crew duct supply system bypassing the ECU and the passenger duct system essentially shutting off the ECU.

Selecting the pax air conditioning valve to CLOSE along with selecting the crew temp controller to MANUAL, FULL HOT does the same thing as selecting emergency pressurization.

Cabin Dump Switch *(A1 bus)*
Opens outflows valves

Outflow Valves
Two outflow valves (one electropneumatic and one pneumatic only) controlled by either the automatic controller or the manual controller. Suction to operate these valves is supplied by a pressurization jet pump which gets its motive airflow from HP from #1 and #2 engines.

Electropneumatic outflow valve is the *master* with the pneumatic outflow valve the slave when AUTO-MANUAL switch is AUTO.

Pneumatic outflow valve is the *master* with the electropneumatic outflow valve the slave when AUTO-MANUAL switch is MANUAL.

CABIN Illuminates when cabin altitude exceeds 10,000ft plus audio"CABIN"

MISCELLANEOUS

Oxygen System

1850 psi cylinder pressure. 700 psi minimum dispatch pressure. Cylinder located under left cabin floor aft of passenger door. Three separate systems, crew, passengers, and first aid.
Copilot panel has PASSENGER OXYGEN controller. Has cylinder pressure gauge, PASS oxygen ON indicator that shows NONE, 19psi, and 70 psi, and a rotary selector switch for first aid, closed, normal,and override.

NORMAL
Ready to operate. Drops masks at ~11,500 ft. +- 500 ft with 70 psi and supplies 19 psi O2 to pax at or above the altitude the masks dropped

FIRST AID
Supplies 19 psi O2 for first aid masks at all altitudes. Does not drop masks unless above 11,500 ft.

OVERRIDE
Emergency position if automatic system fails. Drops masks and supplies 70 psi O2 to pax

CLOSED
Shuts off pax O2 supply. Cylinder provides crew O2 only.

Potable Water

14.5 gallon tank. Bleed air supplies pressure. Water heater powered by bus A6. Direct gravity refilling in lav compartment or through the push-pull handle operated fill valve in the aft left wing root fairing. Water pressure and quantity shown on gauges in galley. In cold weather, make sure to drain the system completely.

Coffee Maker	Forward Sink Water Hot & Cold
Aft Sink Water Hot & Cold	Galley Sink Hot & Cold

Draining the tank: pull heater CB's, close air shutoff valve, open forward and aft vanity valves.

Waste Water

Toilet contains 9.6 gallons of water.

FLIGHT CONTROL SYSTEM

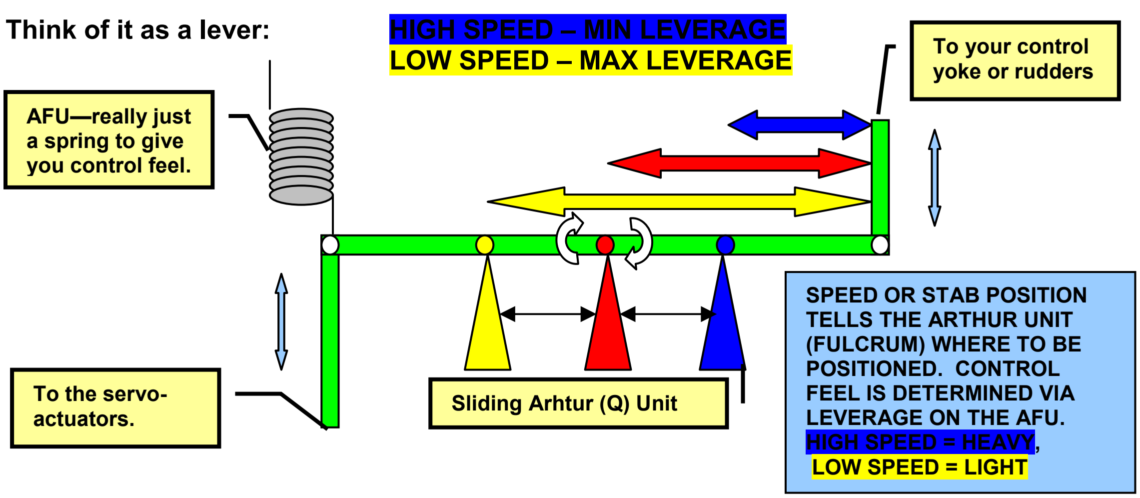
Aileron boosted 3000 psi
Elevator boosted 3000 psi
Rudder boosted 3000 psi

The primary flight controls (elevator, ailerons, rudder) are hydraulically boosted but can be manually actuated in the event all hydraulic systems fail. The secondary flight controls (flaps, slats, air brakes) are electrically controlled and hydraulically actuated.

Control inputs are applied to dual barrel hydraulic servoactuators in the aileron, rudder, and elevator control systems. #1 hydraulic system powers one side (2 pumps), and #2 hydraulic system (1 pump) powers the other side with the standby pump as back up. Manual control linkages allow flight without any hydraulic power at speeds up to 260 KIAS or .76 Mach. Aileron and rudder trim is controlled by electric trim actuators that reposition the applicable servoactuator. Elevator trim is controlled by two electric motors (normal and emergency) that reposition the horizontal stabilizer.

Artificial Feel System
Spring loaded artificial feel units "AFUs" are incorporated into the control linkages to provide aerodynamic feel to the pilot. This is the fixed spring tension. Also provides an auxiliary AFU as a neutral return spring.
Arthur Units
Devices installed in the control linkages to vary the stiffness of the flight controls by changing the leverage on the fixed spring tension (AFU) as airspeed changes. The Aileron and Elevator Arthur units are both hydraulically actuated. The elevator Arthur unit is pressurized by the #1 hydraulic system and the aileron Arthur unit is pressurized by the #2 hydraulic system. The Rudder has no unit. The aileron Arthur is slaved to the standby pitot and static and elevator Arthur is slaved to stabilizer position. Arthur units change control stiffness by increasing or decreasing the leverage applied to the AFU's. Both units are designed to fail in the **low speed position** via an internal spring. The units are also wired to go to slow speed position when the slat/flap handle is taken out of clean.

Think of it as a lever:



Aileron Arthur Q
The aileron arthur Q adjusts the AFU according to airspeed. The aileron arthur Q unit is monitored by comparison of the IAS form ADC1 and the potentiometer on the arthur Q unit. If a difference of 40 knots at slow speed or 60 knots at high speed exists, the **AIL FEEL** light will illuminate. It compares the arthur Q position with IAS inputs from ADC #1 (or #2 for failure of #1). 0-140 KIAS is slow speed mode of arthur Q unit. 140-380 KIAS Q unit position varies.

Elevator Arthur
The elevator arthur adjusts the AFU according to position signals received from the horizontal stabilizer. The arthur unit ratio is 1 with the horizontal stab less than -4º (low speed arthur mode- nose up). The maximum ratio is 3 for stab positions greater than +1º15' (high speed arthur mode-nose down) At any speed, the horizontal stab position has a direct relationship with the center of gravity. The elevator arthur will provide steady feel forces per g, independent of CG. A 0.5º difference in the unit and the stab position results in the **PITCH FEEL** light illuminating. Selecting air brakes causes elevator Arthur to increase pitch feel by 20%. In case of a stuck stabilizer, slat/flap handle out of clean or emerg slat selected places the elevator Arthur in the low speed position.

Trim Gauges (bus A1)
Triple gauge showing aileron trim, rudder trim, and stab trim locations. 6,0,0 is takeoff.

Aileron Emergency (bus B2)
In the event of a linkage seizure, the electric emergency aileron actuator located in the left wing can be utilized to directly drive the aileron servoactuator +- 7º. Left aileron only. There are two buttons for this right below the aileron trim switch. The **AIL ZERO** light illuminates when the actuator leaves the neutral position.

Flutter and Gust Damping
Automatic gust damping of the rudder and elevator with loss of hydraulic pressure *(as in shutdown*).

Air Brake (bus A1)
Electric controlled, hydraulic actuated, 3 panels 2 actuators per side.
One actuator works the Center panels (50º).
One actuator works the Inboard (37º) and Outboard (68º) panels.
Primary bus A1/ #2 hydraulic system.
Handle has three positions, 0, 1, and 2. Position 1 extends the center panels and position 2 extends all 3 panels.
AUTO RETRACTION: If either AOA vane detects AOA increasing above 16.5º, all airbrake panels retract automatically. Also happens during stall test.

Trim Systems:

Aileron Trim (bus A2)
Maximum trim deflection is 12º30'. This equates to 50 on the trim gauge. The 50 represents 50% of total aileron travel. For runaway trim, trim in the opposite direction. Do not attempt aileron trim without hydraulic pressure.

Rudder Trim (bus A2)
Electrically controlled and hydraulically actuated. Maximum trim deflection is 12º30'. This equates to 40 on the trim gauge. The 40 represents 40% of total rudder travel. Do not attempt rudder trim without hydraulic pressure.

Runaway trim procedure same as aileron. Aileron and rudder trims actually move control yoke and flight controls. Do not use rudder or aileron trim without hydraulic power. In the absence of hydraulic power, rudder or aileron trim should not be attempted as actuator motor damage could result. Both rudder and aileron trim have split switches for safety.

Stabilizer Trim (bus B1)
Clacker sound when stabilizer moves. Normal deflection of the horizontal stabilizer is +2º to -10º. Limited to -4º nose up above 210 KIAS (info from ADC #1). TO range is indicated by a green band from -4º30' to -7º30'.

Normal operation is by split switch on control wheel. Normal trim (and undesired) operation is indicated by clacking sound. Reversing the direction of the trim switch stops runaway trim.

If the stabilizer is out of the takeoff range and a power lever is beyond 84º PLA the **T/O CONFIG** warning light comes on and you hear "no takeoff".

MISTRIM warning light when AP trim coupler has failed

Emergency Pitch Trim (bus A1)
Activation of the emergency trim switch mechanically opens the Normal circuit breaker, interrupting normal trim circuits. Clacker sound when stabilizer moves-not trim switch activation.

Yaw Damping
Yaw damping does not affect pilot rudder control.

MACH Trim
As mach numbers increase, center of pressure moves aft causing the nose to tuck. Mach trim is used to prevent any mach tuck problems. The Mach trim system is normally activated before takeoff by pressing the Mach Trim button on the autopilot controller. It becomes active above Mach .775. Failure of the system or system off is indicated by the **MACH TRIM** light.

Flaps (bus B2)
Inboard and outboard segment on each wing. Hydraulic motor powered by Hydraulic System #2. ***Flaps will not extend without outboard slats extending first***. Flaps always stay where they are because of a large flap brake in hydraulic motor. **FLAP ASYM** illuminates when asymmetry 3-5º for 0-20º flaps and 5-8º for 20-40º flaps and the flap CB pops. Flaps extended beyond 22º and PLA >84º illuminates the **T/O CONFIG** light.

Slats (normal-bus A1)
Slats operate in three modes: Normal, Automatic, and Emergency. Outboard slats have three actuators, two for normal extend and retract and one for emergency extend only. Inboard slats have one extend and retract actuator. Normal operations use #1 hydraulic, emergency outboard slat extension is via #2 hydraulic.

Emergency slats are outboard slat extension only via the #2 hydraulic system (battery bus). It is activated by the guarded emergency slats switch. . Green slat light flashes indicating outboard slats only.

↕ Red arrow is a disagreement of slat/flap handle position with slats. It also means slats are moving. You will see this with outboard slats only + flaps.

Automatic slat operation is controlled by AOA (***stall warning and prevention***). As AOA reaches 11º (left vane-right vane waits for 12.2º) and is increasing in a **clean configuration**, outboard slats are deployed, ignition comes on, and a stall horn is heard. **Green** slat light flashes indicating outboard slats only. Decreasing below 11º reverses this. In a configuration with the slats already extended, warnings and ignition occur and airbrakes automatically retract at 16.5º and inboard slats retract at 23º. Automatic slat operation is operative up to 265 KIAS. Failure of the system illuminates the **AUTO SLATS** light. This failure light is triggered by a 5º split in the left and right stall vanes, a proximity switch failure, or and ADC 1 or 2 speed switch failure. ***Flight above 265 KIAS with this light on is prohibited.***

Testing of auto slats is via STALL 1 or STALL2 test buttons on the pedestal. We test them twice. 1st time verifies deployment of OB slats(11º or 12.2º) and retraction of Air Brake panels(16.5º). 2nd test verifies retraction of IB slats (23º)

Slat Flap Handle (no slat only position)

Clean	
Slats + 7º	200 KIAS Max
Slats + 20º	190 KIAS Max
Slats + 40º	180 KIAS Max

Dassault restricts flap deployment and retraction to one detent at a time. Protection against flaps without outboard slats only occurs in the S+7 position.

Minimum Recommended Speeds For Maneuvering Per Configuration

Clean	190 KIAS Min
Slats + 7º	170 KIAS Min
Slats + 20º	150 KIAS Min
Slats + 40º	$\mathbf{V_{ref}}$+10 Min

ICE AND RAIN PROTECTION

The anti-iced areas of the 900 include nacelle lips, #2 engine S duct, PT2TT2 probes, the ECU heat exchanger ram air inlet, slats, the fixed leading edge sections of the wings, the main windshields, the cockpit side and aft windows, the air data systems, and the water drains.

Wing Anti Ice (bus A1)

Wing anti-ice valve is operated by wing anti-ice switch. Also causes HP1 bleed valve to open when switch is on and temp<192C. PRV valves regulate as necessary unless temp<192C at which time they fully open. The wing anti-ice valve is a motor valve that fails in position. Do not use wing anti ice when TAT>10 degrees C.

NEVER USE WING ANTI ICE ON THE GROUND. It could warp the slats. Earliest approved use is after gear retraction. Turn off before landing.

Engine Anti Ice (#1 bus A1, #2 bus B1 ,#3 bus A2)

Operated by appropriate engine anti-ice switch. #2 engine anti-ice switch also activates S duct anti-ice. The S duct valve is a solenoid valve that fails closed as all solenoid valves do. #1 engine anti-ice switch also activates ram air inlet heat.

Engine Anti Ice Switch ON:

1. Heats PT2TT2 probe via electricity.
2. Opens valve to allow HP bleed air to go directly to nacelle lip.
3. #1 heats ram air inlet. #2 heats S duct (from all 3 engines unless isolated).

Engine Anti Ice should be on anytime TAT=<10 degrees C and in visible moisture.

Airframe and Engine Anti-Ice Indications

Eng 1,2,or 3

Green Light: 4 psi>pressure<90 psi
Amber Flashing Light: pressure >90 psi
also over temp in S Duct
Amber Steady Light: pressure < 4psi

Wing

Green Light: proper temperature and pressure >4psi
Amber Flashing Light:over temperature
Amber Steady Light: pressure drop

Windshield Heat (**Pilot** A3 powered, **A1** controlled, **Copilot** B3 powered, **B2** controlled)

OFF, NORM, MAX. Heats windshield plus half of center panel to between 77-86 F. MAX heats smaller area to same temperature and no center windshield. THUS, ALWAYS USE MAX ON BOTH SIDES to keep from heating only half of the windshield.

XFR Either pilot or copilot windshield is defective and detection and regulation is transferred

Side Windshield (DV bus A2, Aft bus B1)
Operated by SIDE switch.

Air Data
Air data anti-ice includes both pitot tubes, both static port pads, both stall warning vanes, the standby pitot tube, and the OAT sensor.

Pilot Pitot Heat Switch	Pilot pitot tube	bus A1
	Pilot Static port	bus A1
	Copilot Static port	bus A1
	Pilot stall vane	bus A1
	Rosemont Probe	bus A1
	AOA hat	bus A1
Copilot Pitot Heat Switch	Copilot pitot tube	bus B2
	Copilot Static port	bus B2
	Copilot stall vane	bus B1
	Pilot Static port	bus B1
Standby Pitot Heat Switch	Standby pitot tube	bus A2

No heat is provided to the standby static ports.

Windshield Wipers (LH bus A2, RH bus B1)
Do not operate when windshield is dry. OFF, SLOW, FAST switch positions. OFF parks wipers. Park until below embellisher--no takeoff outside of embellisher.

Waste Water Drain (bus A2)
Continuous anti-icing is provided for the drain mast via two heating elements. Requires at least one generator supplying the bus.

Takeoffs in Snow or Slush
Leave the gear down for 15 seconds to allow the wheels to spin down by themselves to get rid of the snow and slush. If you put the gear up, autobraking occurs in the main wheels.

AVIONICS

Honeywell SPZ-8000 Digital Integrated Flight Control System

First generation 5 tube EFIS system with 2 CDU's (FMS input boxes), 2 ID802's (AP and message annunciators), IRS (inertial reference system, usually 2 or 3), as well as DME/DME and GPS position sensors, dual flight guidance (autopilot) computers and the associated servos, dual digital air data computers, and radar altimeter. Pilot and copilot ON/OFF switches control power to EFIS and FMS. FMS have glass screens, however the EFIS tubes are covered with a film that is damaged by "finger acid" so don't touch. 3 signal generators supply power to the EFIS tubes, one for the 2 pilot tubes, one for the MFD, and one for the 2 copilot tubes. The MFD signal generator is capable of running 4 tubes.

The proper equipment suffix is /E. (dual FMS, multisensor,FD/AP,dual IRU, data base)

FGCS - Flight Guidance Computers

Consists of 2 autopilot computers, 2 ID802 annunciator panels, and 1 controller head. The FGCS is "fail operational" which means which means that if the computer fails, it is backed up automatically. This compares to "fail passive" which means that action would be required for backup and "fail" which means what it says, namely no backup.

The default mode upon power up is for the left computer to be the default MASTER with the right one being the SLAVE. The AP, YD, and MACH TRIM buttons have chevrons to the right and left indicating which computer is the MASTER. Most function buttons are familiar AP functions except FLC:

FLC stands for Flight Level Change. It is the preferred way for the autopilot to ***climb*** the aircraft. It is similar to IAS / MACH hold (which this doesn't have).

1. Select altitude in ASEL window
2. Select FLC
3. It initially holds your current altitude
4. Add power and it switches to hold your current speed which results in a climb. Rate of climb is now dependent upon your power input.
5. Upon reaching your selected altitude it reverts back to altitude hold.

It is recommended to use VS mode for descents.

Below the AP, YD, and MACH TRIM buttons is the COUPLE button with chevrons on the right and left. The COUPLE button decides who is flying the aircraft via autopilot functions, pilot or copilot. Switching between the two requires reengagement of modes but does not disengage the autopilot.

DADC – Digital Air Data Computers

2 separate units that supply AS/ALT/VSI info independently to the pilot and copilot instruments. If there is a failure, you can borrow information from the other side by pressing the IAS button ("fail passive"). The #1 transponder gets its information from the #1 ADC, #2 xpdr from the #2 ADC, Therefore ADC failure requires switching transponders for altitude readouts.

Radar Altimeter

Used for standard RA stuff.

FMS – Flight Management System
Software version 4.1 uses GPS position 100% of the time. Latest version is 5.2. It still looks at DME/DME and IRS position. Accuracy of position sensors:

GPS	.05nm
DME/DME	.30nm
IRS	1.2nm per hour (9.6nm after 8 hrs)

GPS needs 4 satellites for position info, 5 satellites for enroute RAIM integrity, and 6 satellites for approach RAIM integrity.

The two FMS's can operate in one of three modes:
1. Independent – two separate units
2. Initiated Mode – data is entered into one unit and then cross filled into the other once it is verified correct
3. Dual Mode – data entered into one is automatically entered into the other

IRS—Inertial Reference System
Internal sensors that detect movement of the aircraft and then determine position with no outside references. Requires alignment prior to aircraft movement. During alignment, it figures true north. By measuring the speed of the rotation of the earth, it determines latitude. But since longitude is political, we have to tell it that. We do this by entering our position on the FMS. At middle latitudes, this alignment procedure takes 4-5 minutes.

In addition to providing position information, the IRS's supply information to operate both the EADI's and EHSI's. 900's typically have either 2 or 3 IRS systems.

The IRS control heads (MSU-mode selctor unit) have a knob with four selections:

OFF
ALIGN—Never used
NAV—Aligns IRS and then is ready for navigation (4-5 minutes)
ATT—Emergency attitude information only (destroys alignment)

For quick turn IRS alignment updates, once the aircraft is motionless turn the knob from NAV to ALIGN to NAV. Reinitialize the position on the FMS. This procedure takes 30 seconds. Called "30 second align downmode."

It is only safe to move the aircraft when the MSU is blank.

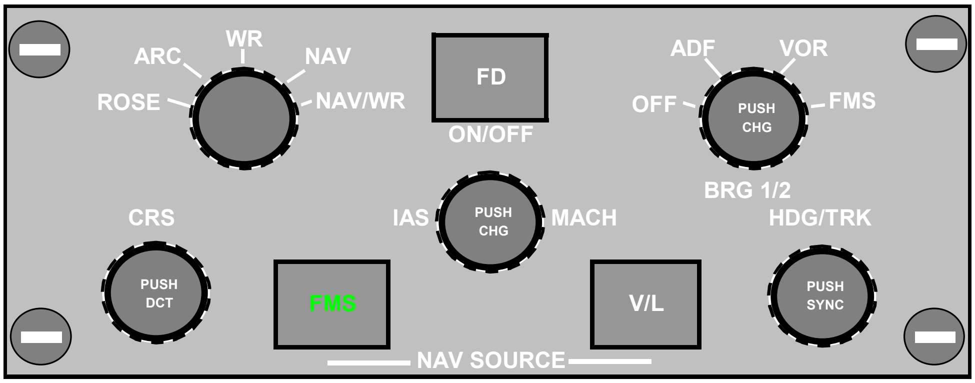
Be sure to turn IRS MSU's off before leaving aircraft or internal batteries will drain.

EFIS
FD button hides flight director bars, not on/off.

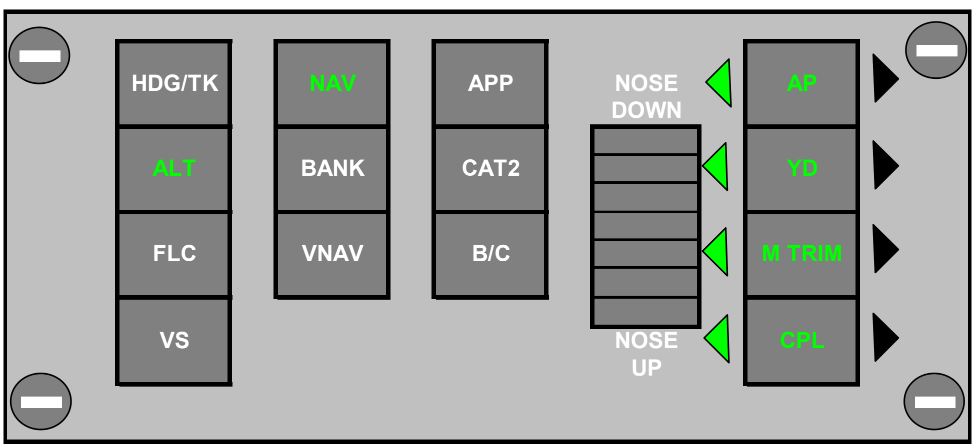
Each pilot has a reversion controller to allow borrowing IRS or ADC from the other side and the signal generator from the MFD.

EADI displays mode of operation selected. Lateral info is left of arrow, vertical info is right of arrow. It is important to verify what you want is what you got. Green is active, White is armed.

Each pilot has separate radar controls. Weather can be displayed on each EHSI. When the two radar control heads ask for different presentations, the antenna sweep in one direction is for the pilot's presentation and the sweep in the other direction is the copilot's presentation.



DISPLAY CONTROLLER



FLIGHT GUIDANCE CONTROLLER

Honeywell FMS NZ-2000 Flight Management System

4.* software has limited data storage
5.* software has everything

Allows complete flight management including routes from SID's (even vector) to STAR's, VNAV (it knows minimum altitudes on each leg including during approaches), and performance of your aircraft (it modifies performance files as you fly the aircraft). It is pretty amazing.

Starting Units:

1. BOTH UNITS:Go to MAINT page to check mode of operation.
   Single-only one unit installed
   Independent-operates independently of other units

Dual-one FMS with two keyboards
Initiated Transfer-cross filling of data after input (always use this)

2. BOTH UNITS: Go to POS INIT page to initialize position. IRS uses this info for alignment.
3. COPILOT UNIT: Go to FLT PLAN page, always select USE RECALL or CREATE
   6-10 letters for name
   Use convention ORIGIN-DEST, ie KCMI-KTEB
4. COPILOT UNIT: Input planned route
5. COPILOT UNIT: Activate flight plan
6. COPILOT UNIT: Go to PERF INIT page to enter performance, initial cruise altitude and weights as a minimum.
7. Select MAP and the FMS2 on MFD to display route.
8. If route is correct, initiate transfer from copilot unit to pilot unit. Select FLT PLAN, PREV to get to the initiate transfer page quickly.
9. Copilot dials in first initial altitude in ASEL
10. Pilot pushes go around button and selects FMS and NAV and you are ready to go.

Tips:

1. Line selecting a waypoint puts it in scratch pad so it can now be entered elsewhere.
2. KCMI//30 makes a temporary waypoint on your route of flight (assuming you are already going to KCMI) 30 miles from KCMI.
3. RBS/180/50 makes a temporary waypoint 50 miles from RBS on the 180 degree radial
4. VEALS/136/15 makes a temporary waypoint and extends the runway centerline. Then selecting this new waypoint as the FROM waypoint allows vectoring to the final approach course.
5. Line selecting the runway waypoint automatically puts in the bearing so that all you need to put in is the distance. I.E. RWY32l//136/?? This is easier than doing #4 above.
6. Multiple flight plans to same destination names:KCMI-KDET1, KCMI-KDET2 etc. Character limit is 10.
7. Normal input progression during initialization is bottom right line input button (R4) and is usually prompted.
8. Build route. NDB's require "NB" as suffix. Airways are entered as AIRWAY DOT ENDPOINT, ie V3.MXE. Last waypoint "via…" must be destination to end flight plan.
9. The MFD joy stick can be used to enter coordinates of a waypoint for weather deviation.
10. Waypoints ***(5 characters max)*** exist one of three ways: Nav Data Base waypoints, Pilot defined waypoints, and temporary waypoints. Temporary waypoints are "temporary" and are created in the active flight plan by defining a point in space. The FMS adds either an asterisk (*), ampersand (&), or a pound sign (#) as the first character of the temporary waypoint.

    Temporary waypoints can be defined as follows:

Lat/Long	N4002.2/W08816.7
Place/Bearing/Distance (P/B/D)	CMI/090/20
Place/Bearing/Place/Bearing (P/B/P/B)	CMI/090/DNV/180
Place/Distance (along your route) (P/D)	CMI/30

    TEMPORARY WAYPOINTS CAN ONLY BE PLACED IN THE **ACTIVE FLT PLAN**! You can not place temporary waypoints in a stored flight plan.
11. Runway Extension Waypoints: selecting the runway waypoint into the scratch is displayed in the format AIRPORT.RUNWAY/BEARING/. Enter distance and insert this new waypoint into flight plan for a runway extension.

12. **The FROM waypoint (AMBER for color CDU's) is always the *first* displayed on flight plan page. You can change FROM waypoints in flight, but make sure FCS is in heading mode since this impacts current leg.**
13. **The TO waypoint (MAGENTA for color CDU's) is always the *second* displayed.**
14. For a waypoint in space (crossing of 2 airways with no defined intersection), the proper entry is CMI/090/DNV/180
15. When you use the DIR key to go direct, all previous waypoints disappear from the active flight plan. To get them back, press the DIR key followed by the PREV key.
16. Climb and descent constraints: 10000A means **AT or ABOVE**, 10000B means **AT or BELOW**.
17. To proceed back to the airport of departure, place the airport ID in the destination field and then select it and paste it to the final waypoint. Then select DIR to the airport. All approaches and runways will now be available.
18. You can use the Direct To function for altitudes if in VNAV mode.
19. When selecting the approach to be used, if you need a course reversal or a procedure turn, select an initial approach fix that would require the course reversal or procedure turn, then go direct to the original fix. If you don't do this, the FMS assumes you don't need the holding pattern or course reversal.
20. ***To extend the final approach course***, go direct to the final approach fix or other fix on the course, select direct again, put "intercept" in the scratch pad (it is prompted), and paste it over the fix you want the course line drawn from. Fill in the course and select hdg.
21. Even when doing raw data approaches, set up the FMS for the approach to that you can use the missed approach feature in the event you need to miss. Otherwise, you're on your own.
22. In order to set up the FMS for an ILS, a ghost course must be set up. Tune in the ILS frequency and turn the course knob to the final approach course. A ghost course line appears on the HSI. Make sure the AP/FD is armed for the approach. The FMS will automatically switch to the ILS once the course becomes active.
23. **Scratchpad Edit Mode**. Pressing "-" and then "PREV" puts the scratchpad into edit mode. You will see an inverse highlight. The "NEXT" and "PREV" key moves the inverse highlight. Pressing "CLEAR" deletes the highlighted item. You can type new into the highlighted item. Pressing "DEL" deletes the entire scratchpad line. When the scratchpad entry is moved to a line by pushing a line select key, edit mode is exited.
24. **Deleting Scratch Pad Entry**. Pressing "-" and then "DEL" will delete the current scratch pad entry.
25. **VNAV Offset Definition.** Line select the place from the flight plan into the scratchpad. Enter "/" if a bearing is known or "//" if the bearing is unknown or on your current route of flight. Enter the distance. IE KCMI//20 is 20 miles from KCMI***. Enter this information into the flight plan either before or after the place (KCMI). Then enter the altitude constaint.***
26. To delete the entire flight plan, select "delete" and paste is over the first waypoint.

DIRECT / PATTERN / INTERCEPT

Accessed through the DIR key.

Allows DIRECT (going direct to a fix in your flight plan or any other fix), PATTERN (selecting holding patterns and procedure turns), INTERCEPT (intercepting courses such as the final approach course when on a heading)

> ***DIRECT*** Pushing the line select key next to the waypoint or entering a waypoint into scratchpad and inserting into dashed lines of DIRECT engages direct-to.

PATTERN Allows HOLD, PROCEDURE TURN, FLYOVER, ORBIT, and RADIAL
INTERCEPT Used to define an intercept waypoint inserted between two other waypoints. Can be used:

- Define a waypoint via two radials, or
- To fly a heading out of one waypoint to intercept a course into another
- This does not create a discontinuity because the FMS disengages when the heading select leg is sequenced.

Direct-To Recovery is used to recover waypoints deleted by sequencing or waypoints deleted when a DIRECT-TO was entered. Push the DIR key and then the PREV key to display them.

VERTICAL NAVIGATION

General VNAV Rules:

- Vertical flight level change is denoted as VFLCH
- PERF INIT must be completed
- VNAV is available for all phases of flight
- Climbs are flown using VFLCH only
- Descents are flown using VFLCH or VPATH
- VNAV never passes through the altitude selector
- The ASEL should be set only to ATC cleared altitudes
- VNAV keeps the aircraft high as long as possible
- VPATH angles are from 1-6 degrees
- If ASEL is set above or below current altitude, FMS commands autopilot to climb or descend
- VNAV is selected by depressing VNAV
- LNAV must be engaged

PROCEDURE TURNS AND HOLDS
The DIR button also gives you the option of selecting holds, procedure turns, and course reversals. Pretty self explanatory. The waypoint selected for holding will have an inverse H next to it. When you enter the hold, an exit prompt appears.

LATITUDE / LONGITUDE FORMATS

Entry	Display
N12W12	N12000.00W12000.00
N1234W1234	N12340.00W12340.00
N12345.67W12345.67	N12345.67W12345.67

Oceanic Waypoints: (Shorthand according to ARINC 424 specification)

Southern hemisphere uses the letter designators **S** or **W**
Northern hemisphere uses the letter designators **N** or **E**
Latitude always precedes longitude
Only the last two digits of longitude is used
Placement of the letter designator (**N**, **S**, **E**, **W**) indicates the value of the longitude one-hundredth digit:

- The letter in the last position indicates longitude <100
- The letter in the third position indicates longitude >100

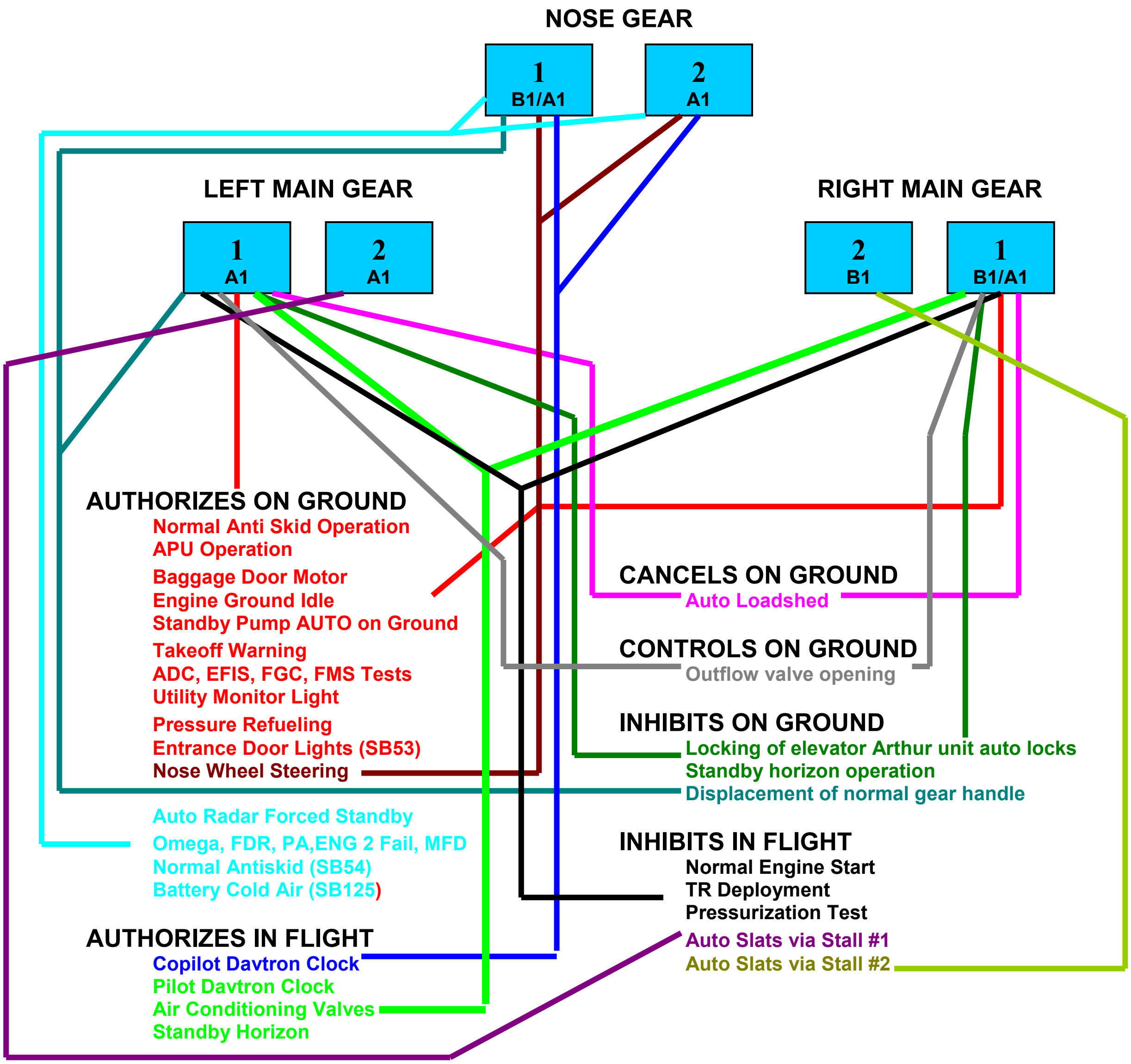
Lat/Long	Letter Designator
N/W	**N**
N/E	**E**
S/E	**S**
S/W	**W**

Examples:

Lat/Long	ARINC 424 Entry
N 52 00/W 075 00	5275**N**
N 75 00/W 170 00	75**N**70
S 50 00/E 020 00	5020**S**
N 50 00/E 020 00	5020**E**
S 52 00/W 075 00	5275**W**

PROXIMITY SWITCHES

Proximity Switches are really transistors looking at magnets. Perform same function as squat switches. 900 has no squat switches. Each gear has two detectors, 1&2.



OPERATIONAL CONSIDERATIONS

Takeoff Briefing Contents:

1. Told card review and airspeed call outs.
2. Departure review and confirm setup. Discuss continuation of the DP if applicable or return to the airport. Discuss obstacle avoidance.
3. Abort Briefing:
   <80 kts Any light on the warning panel or abnormality.
   <V1 Any stabilizer movement, engine failure, any fire, thrust reverser deployment, or loss of directional control
   >V1 No actions will be taken other than flying the plane until at least 400 ft AGL altitude. Be sure to state accelerate altitude to be used.

BFATS Gouge

Parking Brake Off
Flaps 7º or 20º /Slat Light Green
Air Brake In
Trims Set 6,0,0
Speeds Reviewed

COCKPIT PROCEDURES TRAINING NOTES

1.43 Vs clean config is best L/D

Put engine covers on to keep fan from moving--it turns the planetary gear without lubrication. Do not use engine anti-ice above 10 degrees C.

Slats+20º Takeoff Rotation Angle is about 14 degrees
Slats+7º Takeoff Rotation Angle is about 15 degrees
Both need to be computed for non-standard takeoffs because the rotation angle range varies from 14 to 19 degrees depending upon weight and climb gradient.

Autopilot limitations:

300 ft minimum height during FMS approach
50 ft minimum height Radio Altimeter Operative
150 ft minimum height Radio Altimeter Inoperative
200 ft minimum decision height
1,000 ft minimum height except during approach

Go Around Sequence (2 or 3 engines)

Flaps 20º
Gear Up
At Vref + 25, Flaps and Slats Up

Normal Traffic Pattern

Downwind	190 kts clean
Downwind	170 kts slats + 7º
Downwind	150 kts slats+20º, gear down, landing checklist
Base	150 kts slats+20º
Final	Vref +10 slats+40º
Fence	Vref + wind correction

V_{ref} Additions for Configurations Less Than Slats + 40:

:

Clean Wing	+30kts	Outboard Slats	+25kts
Slats Only	+20kts	OB Slats +7º	+20kts
Slats + 7º	+15kts	OB Slats +20º	+10kts
Slats + 20º	+5kts	OB Slats +40º	+5kts

V_{ref} wind correction is half steady rate plus full gust not to exceed 20K.

Stall Speeds

Clean w/ Air Brakes Extended	119 kts
Clean	117 kts
S+7	102 kts
S+20	96 kts
S+40	94 kts

Maximum Weights in Level Flight at <u>ISA +10</u>

	L/R Cruise	.75 Mach	.80 Mach	.84 Mach
35,000ft	Not Limited	Not Limited	Not Limited	40,130#
37,000ft	Not Limited	Not Limited	44,710#	36,360#
39,000ft	43,610#	42,990#	39,740#	31,500#
41,000ft	38,510#	38,250#	35,340#	27,200#
43,000ft	34,170#	34,120#	31,530#	----
45,000ft	30,310#	30,410#	28,110#	----
47,000ft	28,460#	26,670#	24,350#	----
49,000ft	23,043#	23,400#	----	----

Landing Field Length Corrections for Inop Airbrakes or Anti Skid

Airbrakes	add 10%	to landing field length
Anti Skid	add 50%	to landing field length

Climb Schedule For Long Range (used for all performance charts .80 cruise and slower)

Below 10,000’	250 KIAS
10,000’ and above	260 KIAS to .72M

High Speed Climb Schedule (used for performance charts greater than .80 cruise)

Below 10,000’	250 KIAS
10,000’ and above	300 KIAS to .80M

The 280kts/.76Mach turbulent air penetration speed keeps you right in the middle ground between stall and high speed buffeting (gives largest safety margin in coffin corner)

Reducing Available Runway Length to Satisfy 135.379 *(should you choose to use this method)*

DP Gross Gradient Required	Reduce Available Runway By
2.4%	1,458 ft
2.7%	1,296 ft
3.3%	1,060 ft
4.0%	875 ft
5.0%	700 ft
6.0%	583 ft
7.0%	500 ft
8.0%	438 ft

Maximum Holding Speeds

Up to 6,000 ft	200 KIAS
6,001 to 14,000 ft	230 KIAS
14,001 ft and above	265 KIAS

Slow to holding speed within 3 minutes of pattern entry.

Approach Categories and Circling Protected Airspace Radii

Category	Max Speed	Radius *(from runway end)*
A	90 KIAS	1.3 nm
B	120 KIAS	1.5 nm
C	140 KIAS	1.7 nm
D	165 KIAS	2.3 nm

Altimeter Setting Meanings

QFE	Height above airport	Reads zero on ground
QNE	Altimeter set to 29.92"	1013 mb
QNH	Height above sea level	Local baro setting

Angle of Attack System

The angle of attack system is a Teledyne unit consisting of a heated AOA probe (witch's hat) that measures the pressure differences between the slots in the probe to determine AOA, and AOA indicator in the cockpit with a settable reference, two indexers mounted on each side of the glare shield, and a flap/slat position sensor. Setting 1.3 on the left side of the AOA indicator gauge selects approximately .6 AOA (.592). 0.6 represents 60% of the lift the airfoil is capable of. 1.0 represents 100% of the lift the airfoil is capable of (this is where the stall occurs) and 0.0 represents 0% of the lift the airfoil is capable of. The AOA is derived by the following formula:

$AOA=1/(V/Vs)^2$

The small tick at approximately .28 on the indicator is the AOA for max specific range. Setting the rotatable reference to 1.43 V/Vs will give the best L/D, or max endurance. The AOA system can be used for all flight regimes EXCEPT TAKEOFF.

Other Nice Stuff To Know

Total fuel burn for an immediate return to landing is 700-1000 lbs.

Take the 900B above FL430 and its costs fuel. The TAS falls off more than fuel flow decreases.

.78 Mach is nearly as efficient as.75 Mach for long range cruise

If the temperature warms 10º C when the aircraft is at its alt/temp limit for a given mach, it will be necessary to descend 2,000' to maintain the same cruise mach. For NAT operations where altitude/mach assignments are rigid, plan to cruise at an altitude 2,000' below the altitude permitted by the forecast temperatures and aircraft performance data. This way an unanticipated 10º C temp increase can be handled without mach/altitude deviations.

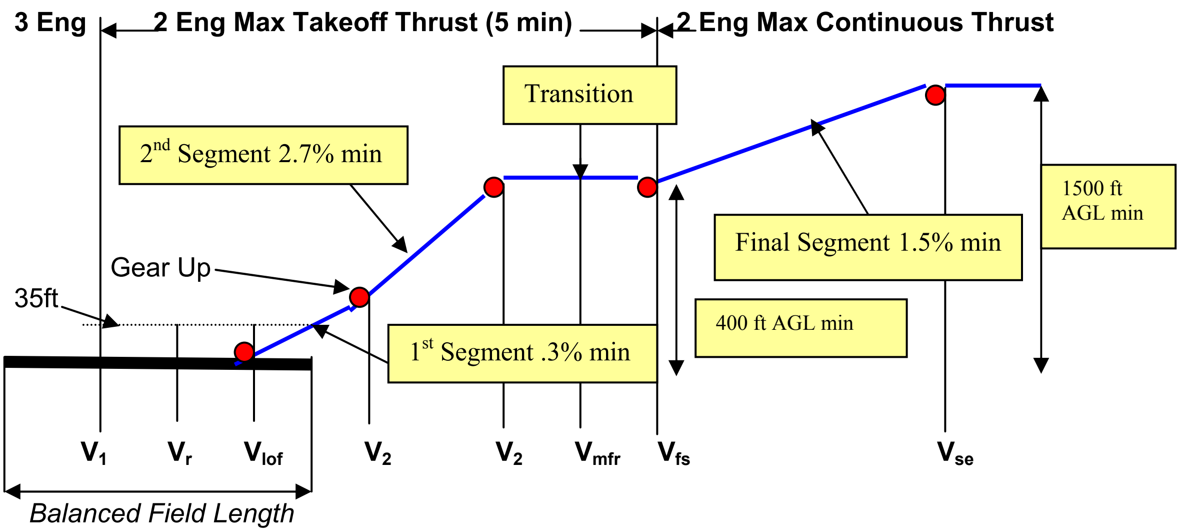
Runway lights are spaced 200' apart. They are white ◯ except the last 2000' which are yellow. ◯

Runway centerline lights are spaced 50' apart beginning 75' from the end of the runway. They are white ◯ except for the last 3000' which are white and red ◯ ● ◯ ●

and the last 1000' which are red. ● ● ● ●

FALCON 900B PERFORMANCE

TAKEOFF PERFORMANCE CERTIFICATION REQUIREMENTS
FOR 3 ENGINE FAR 25 AIRCRAFT



V_{mcg} Minimum controllable airspeed on the ground. **V_1** must never be less than this.

V_1 Decision speed at which takeoff can be aborted within available runway or continued two engine and be 35 ft in the air at the end of the runway. (Min V_1=V_{mcg}, Max V_1=V_{mbe})

V_{mbe} Maximum brake energy speed. **V_1** must never exceed this.

V_r Speed at which rotation is begun. Never less than 1.05 V_{mca}

V_{lof} Speed at which aircraft lifts off runway.

1st Segment Begins on the runway and ends at **V_2** with gear retracted. Aircraft must have minimum climb gradient of .3%.

V_2 = 1.2 V_s or 1.1 V_{mca} gives minimum 2.7% steady climb gradient (gross climb gradient). Called takeoff safety speed.

2nd Segment Begins at gear up and ends at 400 ft AGL or higher. Minimum 2.7% steady climb gradient.

Transition Segment aircraft is accelerated to V_{fs}

V_{mfr} Speed at which aircraft is cleaned up (flaps and slats). Equals V_2 + 25kts

V_{fs} = 1.43 V_s gives minimum 1.5% gross climb gradient (based on max power for 5 min.)

Final Segment Ends at 1500 ft AGL

V_{se} = V_{fs}=1.43 V_s = best L/D (in Falcon 900B) best endurance, best glide speed

V_{ref} = 1.3 V_{so} (slats+40)

BFL (Balanced Field Length)
Adjustment of $\mathbf{V_1}$ to make accel/stop equal accel/go. Accelerate stop distance is the distance required to accelerate to $\mathbf{V_1}$, abort the takeoff, and stop on available runway. Accelerate go distance is the distance required to accelerate to $\mathbf{V_1}$, lose an engine, continue the takeoff, and be 35' in the air at the end of the accelerate go distance. BFL is a combination of both.

These performance requirements for Part 25 aircraft must be met for each takeoff. It must be emphasized that the 2.7% minimum climb gradient for the second segment climb does not guarantee any obstacle clearance. It will give you a climb of 162' per nautical mile two engine. Obstacle clearance procedures are not even published unless the obstacle identification plane touches or penetrates the 152' per nautical mile line in which case a 200' or more per nautical mile climb would be necessary for safe obstacle clearances.

The **takeoff weight** of the aircraft is limited by the most restrictive of the following requirements:

1. Climb gradients required
   a. 2nd segment limitation is always the limiting factor for the 900
   b. Obstacle clearance climb gradients
2. Balanced field length (runway limited takeoff)
3. One engine out go around climb gradient
4. ***Maximum brake energy speed-- not limiting for Slats +20 takeoffs***
5. Maximum tire rotation speed

Takeoff Considerations:

Do the ops specs allow it?
Can the runway support it?
Can the aircraft do it that day and at what weight?

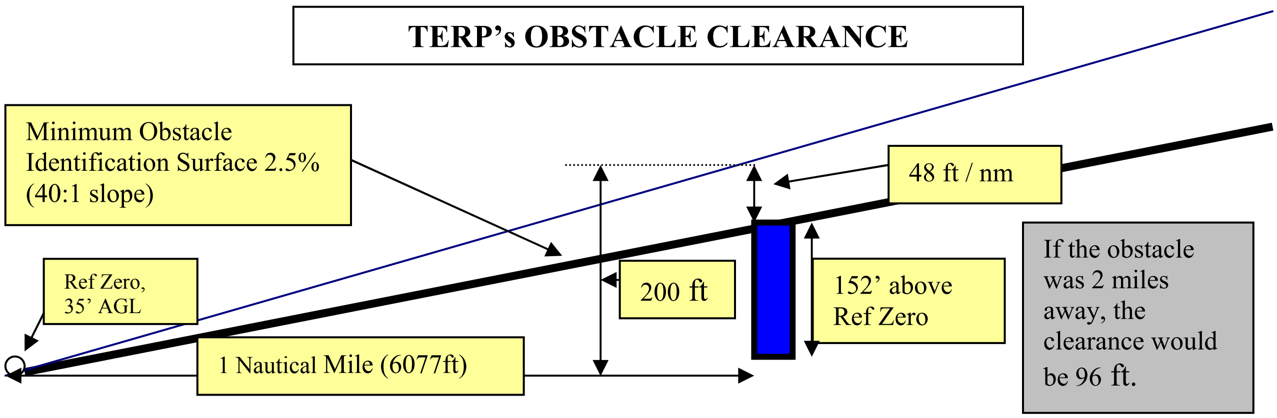
OBSTACLE CLEARANCES
Three things needed to check for obstacles:

1. Notams
2. Charts
3. IFR Departure Procedures

900B TAB Data is predicated upon the chart which gives weight based upon a 2.7% gross climb gradient which is the minimum required for every takeoff ***due to aircraft certification***. If you need more than 2.7%, you need to use the charts which give gross takeoff weight based upon higher than 2.7% gross climb gradients. It is important to understand that the 2.7% second segment climb gradient is merely an airplane certification requirement and that ***it does not provide obstacle clearance***. In fact, the obstacle identification surface the FAA uses to determine whether a procedure needs to be published is never less than 2.5%; often it is higher. **You are not told about obstacles that require less than a 3.3% gradient of climb to clear them.**

Instrument Departure Procedures w/ Obstacle Clearance Climb Gradients
The FAA surveys all airports that have instrument approaches for obstacle clearance during departures. They survey the departure paths from the end of the departure runway to see if any obstacles penetrate that path at a 40:1 slope or greater (2.5% gradient or greater). Their 40:1 slope measurements could begin from the runway surface or as high as 35'. If such an obstacle exists, an obstacle departure procedure is published. The FAA uses a safety factor of 48' / nm. Therefore with a 152' obstacle (35' above ref zero) 1 mile from the end of the runway, the FAA would publish a required climb gradient of 200' per nautical mile. This equals a 3.3%

(200'/6077') climb gradient (**GROSS**). Many airport Instrument Departure Procedures specify much steeper climb gradients and or other procedures such as turns for avoiding obstacles.

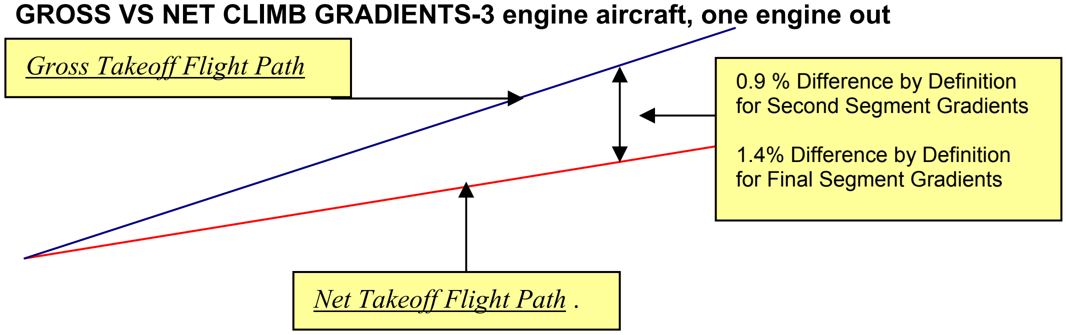


Transport Category Aircraft (FAR 25) have performance charts that allow you to calculate the one engine out <u>*steady gradients of climb*</u> you can expect under different density altitude and takeoff weight conditions. The steady gradient of climb (*called <u>gross climb gradient</u>*) is what the aircraft has demonstrated it will do if flown at $\mathbf{V_2}$ (for the second segment climb portion) at the appropriate takeoff weight by a pilot of average skill (just like every other performance chart).

When a known obstacle is involved in the departure path and no DP is published for that obstacle (which tells you what gross climb gradient is needed to safely clear it), you need to calculate a gross climb gradient that will safely clear that obstacle. 900 performance charts provide both close in and distance obstacle clearance charts that do just that. What these charts essentially do is compute an obstacle identification surface derived from the distance and height of the obstacle, add .9% to that OIS slope, and then tell you to fly that computed gradient. It is interesting to note that the TERPS people will tell you to fly a 3.3% gradient to safely clear a 152' obstacle (187 ft true obstacle height—152+35) 1 mile from the runway and if you compute it yourself using the close in obstacle clearance charts you come up with a 4.6% gradient.

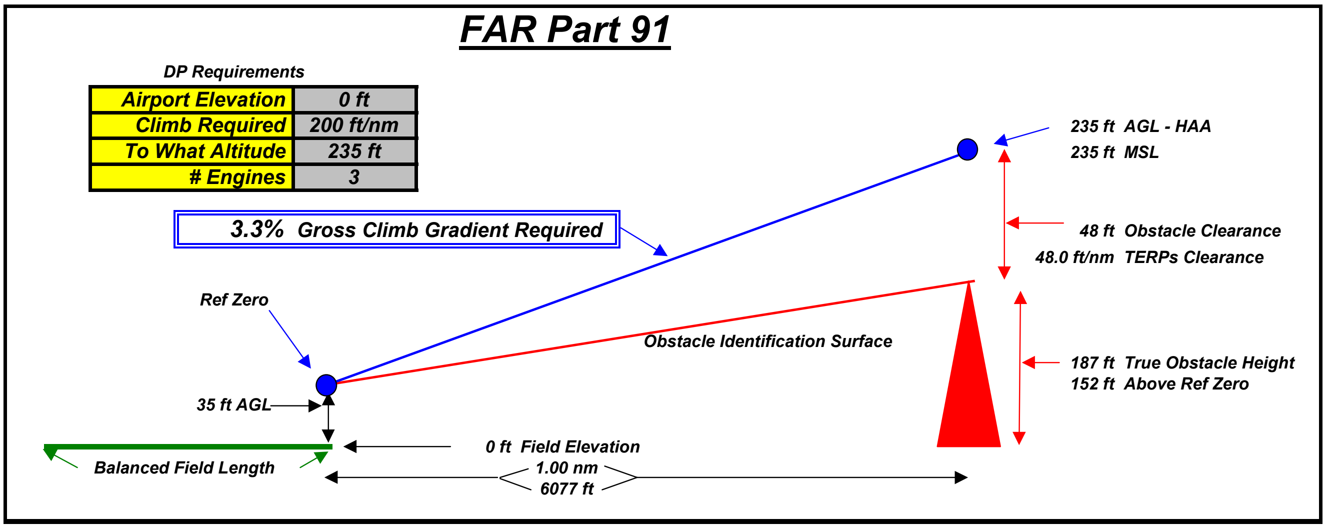
In FAA terminology, this obstacle identification surface derived from the distance and height of the obstacle (rise over run) is called *Net Takeoff Flight Path*. . Net takeoff flight path is defined as gross takeoff flight path minus .9% (2nd segment). Thus if the net takeoff flight path is known or can be calculated, adding .9% to it gives you the gross climb gradient needed.

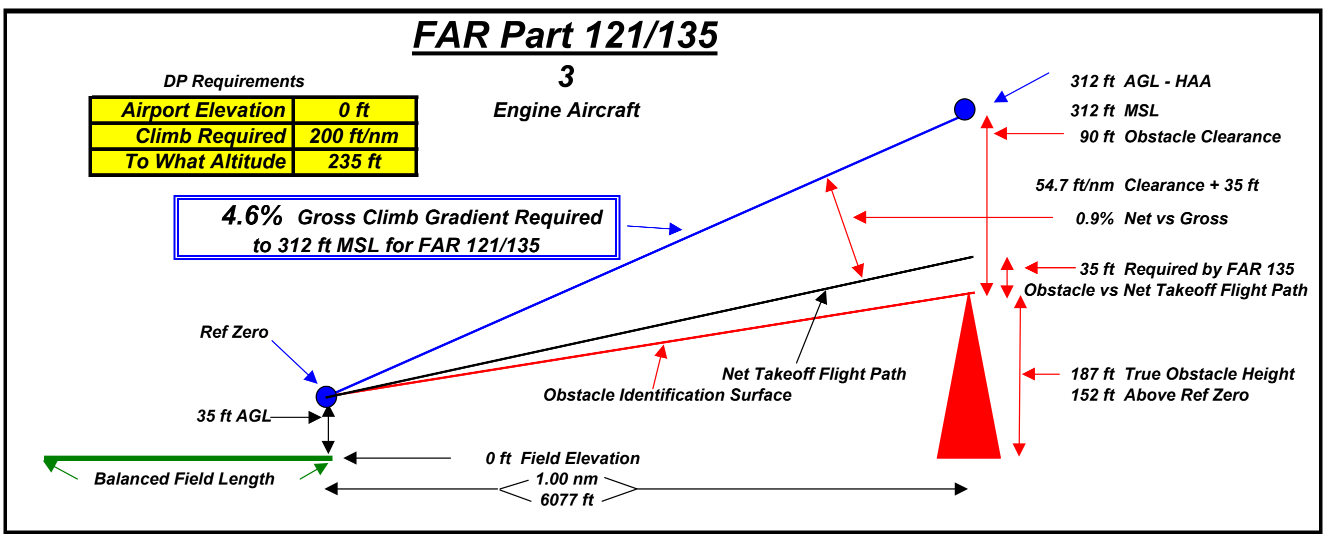
GROSS VS NET CLIMB GRADIENTS-3 engine aircraft, one engine out



COMMERCIAL OPERATIONS

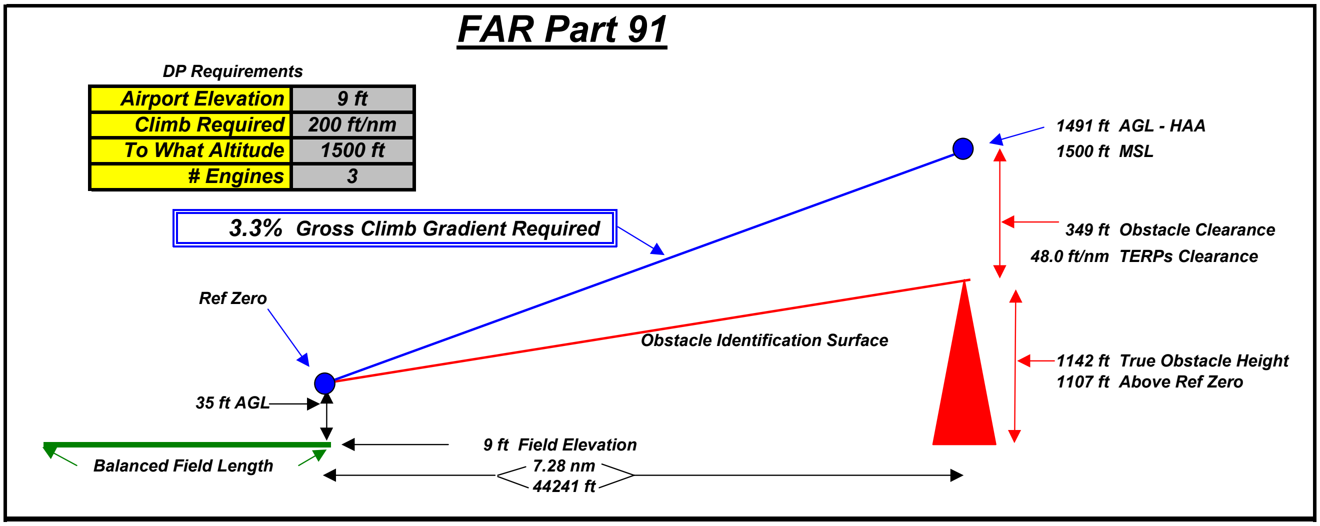
By regulation all commercial operators (135/121) must be able to clear all obstacles vertically by 35' *Net Takeoff Flight Path*. Therefore, 121/135 operators must have an additional 35' obstacle clearance margin to meet this requirement over and above what the TERPS people give you in a DP. In effect, 121/135 operator's *Net Takeoff Flight Path* must parallel the TERPS obstacle identification surface 35' above it. Since the DP does not give you actual obstacle range and true height, one way to do this without expensive surveys is by artificially reducing the runway length available (or increasing BFL needed) to give you that extra 35' at the beginning of your climb (70' instead of 35'). Another way is to fly a steeper gradient and since you don't how much steeper, you could use .9% steeper, essentially the difference between gross and net. This is commonly called "flying net instead of gross". (Be advised that adding .9% ***does not work for close in obstacles***!!!! You will know it is a close in obstacle when the DP tells you to climb 200 ft/nm up to only 235 ft). Below is an example when adding .9% doesn't work.

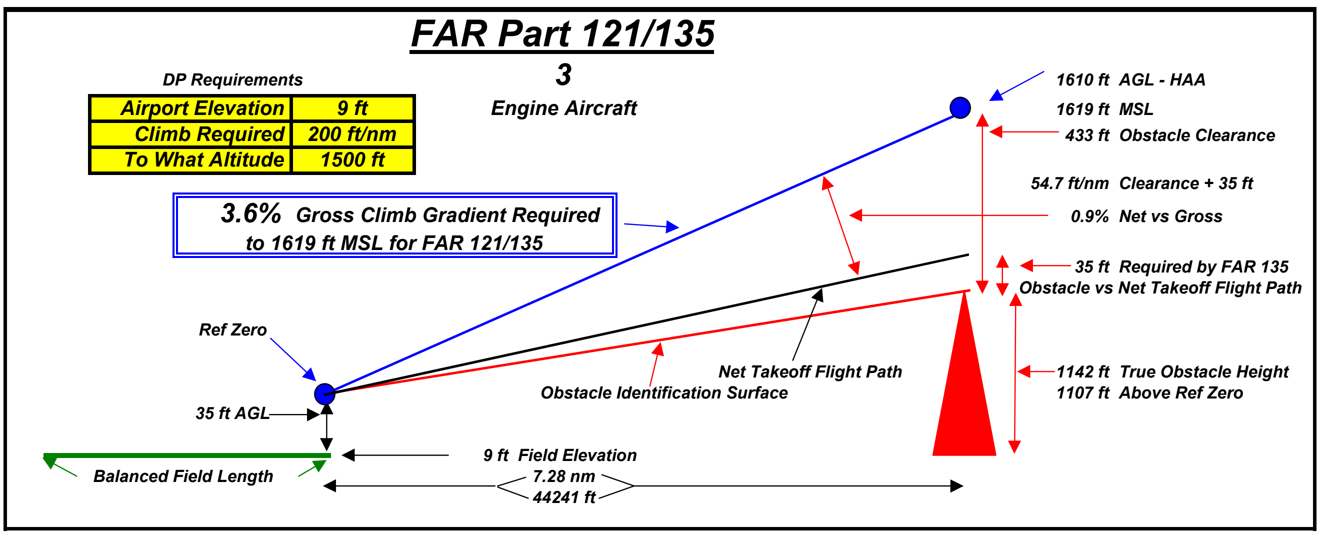




As you can see, simply adding .9% would have resulted in only 4.2% instead of the required 4.6%.

Here is an example of the Teterboro 4 departure and the net takeoff flight path required for 121/135. As you can see, adding .9% to the DP required climb gradient (4.2%) results in a rather severe weight carrying penalty that may not be necessary to satisfy 135.379. It must be noted that I have assumed that the obstacle is located at the end of the climb and this may not be necessarily true.





In this example, adding .9% again gives you 4.2% when in the above case only 3.6% would have been required for commercial operations.

The least restrictive (weight—read FUEL-- carrying wise) way to satisfy 135.379 is by reducing the available runway. Higher climb gradients require weight reductions (under identical density altitude conditions) which automatically reduce your balanced field length (because of the reduced weight).

The following chart shows how much to reduce the available runway to be at 70 ft at the end of the balanced field length and what gradient is required to satisfy 135.379. If you are operating PT 91, you don't need to do any of this except to fly the DP as published.

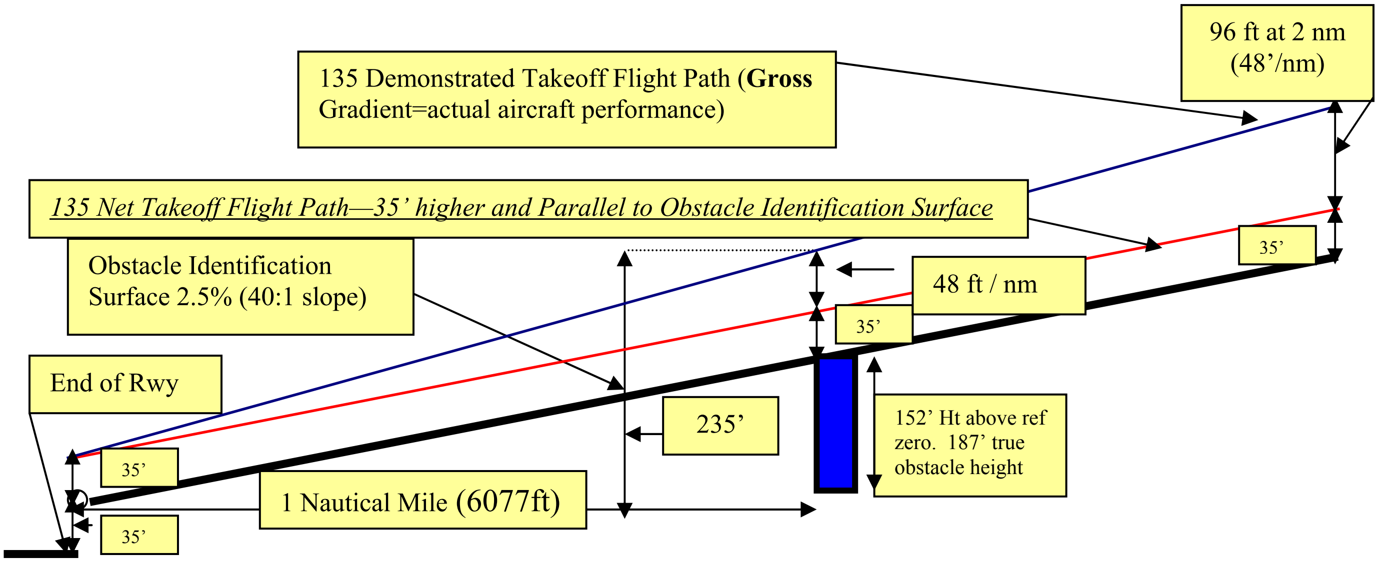
Required Climb Gradients Part 91 and Part 135

Part 135 Climb Gradients Require Reducing The Available Runway To Allow A Height Of 70 Feet At The End Of The Balanced Field Length To Satisfy 135.379

Part 91		Part 135			
DP Required Climb	DP Required Gradient	Reduce Available Runway By	4 Engine Aircraft Plus .2%	3 Engine Aircraft Plus .1%	2 Engine Aircraft Plus 0%
200 ft/nm	3.3%	1063 ft	3.5%	3.4%	3.3%
210 ft/nm	3.5%	1013 ft	3.7%	3.6%	3.5%
220 ft/nm	3.6%	967 ft	3.8%	3.7%	3.6%
230 ft/nm	3.8%	925 ft	4.0%	3.9%	3.8%
240 ft/nm	3.9%	886 ft	4.1%	4.0%	3.9%
250 ft/nm	4.1%	851 ft	4.3%	4.2%	4.1%
260 ft/nm	4.3%	818 ft	4.5%	4.4%	4.3%
270 ft/nm	4.4%	788 ft	4.6%	4.5%	4.4%
280 ft/nm	4.6%	760 ft	4.8%	4.7%	4.6%
290 ft/nm	4.8%	733 ft	5.0%	4.9%	4.8%
300 ft/nm	4.9%	709 ft	5.1%	5.0%	4.9%
310 ft/nm	5.1%	686 ft	5.3%	5.2%	5.1%
320 ft/nm	5.3%	665 ft	5.5%	5.4%	5.3%
330 ft/nm	5.4%	645 ft	5.6%	5.5%	5.4%
340 ft/nm	5.6%	626 ft	5.8%	5.7%	5.6%
350 ft/nm	5.8%	608 ft	6.0%	5.9%	5.8%
360 ft/nm	5.9%	591 ft	6.1%	6.0%	5.9%
370 ft/nm	6.1%	575 ft	6.3%	6.2%	6.1%
380 ft/nm	6.3%	560 ft	6.5%	6.4%	6.3%
390 ft/nm	6.4%	545 ft	6.6%	6.5%	6.4%
400 ft/nm	6.6%	532 ft	6.8%	6.7%	6.6%
410 ft/nm	6.7%	519 ft	6.9%	6.8%	6.7%
420 ft/nm	6.9%	506 ft	7.1%	7.0%	6.9%
430 ft/nm	7.1%	495 ft	7.3%	7.2%	7.1%
440 ft/nm	7.2%	483 ft	7.4%	7.3%	7.2%
450 ft/nm	7.4%	473 ft	7.6%	7.5%	7.4%
460 ft/nm	7.6%	462 ft	7.8%	7.7%	7.6%
470 ft/nm	7.7%	453 ft	7.9%	7.8%	7.7%

Part 91		Part 135			
DP Required Climb	DP Required Gradient	Reduce Available Runway By	4 Engine Aircraft Plus .2%	3 Engine Aircraft Plus .1%	2 Engine Aircraft Plus 0%
480 ft/nm	7.9%	443 ft	8.1%	8.0%	7.9%
490 ft/nm	8.1%	434 ft	8.3%	8.2%	8.1%
500 ft/nm	8.2%	425 ft	8.4%	8.3%	8.2%
510 ft/nm	8.4%	417 ft	8.6%	8.5%	8.4%
520 ft/nm	8.6%	409 ft	8.8%	8.7%	8.6%
530 ft/nm	8.7%	401 ft	8.9%	8.8%	8.7%
540 ft/nm	8.9%	394 ft	9.1%	9.0%	8.9%
550 ft/nm	9.1%	387 ft	9.3%	9.2%	9.1%
560 ft/nm	9.2%	380 ft	9.4%	9.3%	9.2%
570 ft/nm	9.4%	373 ft	9.6%	9.5%	9.4%
580 ft/nm	9.5%	367 ft	9.7%	9.6%	9.5%
590 ft/nm	9.7%	361 ft	9.9%	9.8%	9.7%
600 ft/nm	9.9%	354 ft	10.1%	10.0%	9.9%
610 ft/nm	10.0%	349 ft	10.2%	10.1%	10.0%
620 ft/nm	10.2%	343 ft	10.4%	10.3%	10.2%
630 ft/nm	10.4%	338 ft	10.6%	10.5%	10.4%
640 ft/nm	10.5%	332 ft	10.7%	10.6%	10.5%
650 ft/nm	10.7%	327 ft	10.9%	10.8%	10.7%
660 ft/nm	10.9%	322 ft	11.1%	11.0%	10.9%
670 ft/nm	11.0%	317 ft	11.2%	11.1%	11.0%
680 ft/nm	11.2%	313 ft	11.4%	11.3%	11.2%
690 ft/nm	11.4%	308 ft	11.6%	11.5%	11.4%
700 ft/nm	11.5%	304 ft	11.7%	11.6%	11.5%
710 ft/nm	11.7%	300 ft	11.9%	11.8%	11.7%
720 ft/nm	11.8%	295 ft	12.0%	11.9%	11.8%
730 ft/nm	12.0%	291 ft	12.2%	12.1%	12.0%
740 ft/nm	12.2%	287 ft	12.4%	12.3%	12.2%
750 ft/nm	12.3%	284 ft	12.5%	12.4%	12.3%

Reducing the available runway in accordance with the climb gradient required puts you at 70' agl at the end of your balanced field length instead of 35' agl. You now can parallel the obstacle identification surface with your net takeoff flight path.



The bottom line is this: **If there is an obstacle departure procedure and you cannot avoid obstacles visually, compute your max takeoff weight based upon the gross gradient required to fly that procedure either 91 or 135. If no DP is published but there is a known obstacle of known height and distance (very rare!), use the obstacle clearance charts to determine the gross takeoff flight path required. The obstacle clearance charts satisfy both 91 and 135 requirements.**

Remember, if *no* procedure is published, the FAA assumes a 200' per nautical mile gross climb gradient for all departures (3.3%) all the way up to the MSA, or MOCA.

EXAMPLE TAKE-OFF & OBSTACLE DEPARTURE PROCEDURE

	Rwy 6			Rwy 24	Rwy 19
	With Min Climb of 240' / NM to 1500'		Other		
	Adequate Vis Ref	STD			
1&2 Eng	RVR 16	RVR 50 or 1	300-1	300-1	500-1
3&4 Eng	Or 1/4	RVR 24 or 1/2			
OBSTACLE DP: Rwy 6 turn left, climb on 040° heading to 1500', then climbing left turn to 300 heading before proceeding as directed. Rwy 19 climb rwy heading to 800' then climbing right turn to				a 300° heading before proceeding as directed. Rwy 24 climb rwy heading to 1500' before proceeding on course	

Our ops specs allow us to do lower than standard takeoffs under certain conditions. It is our understanding that the climb gradients required for takeoffs on the above runways is as follows:

RUNWAY 19

Weather VFR	2.7% (aircraft certification)	See & Avoid
Weather IFR >= 500-1	3.3% (min IFR gradient)	200'/nm minimum
Weather < 500-1	Not Authorized Pt 135	

RUNWAY 24

Weather VFR	2.7% (aircraft certification)	See & Avoid
Weather IFR >= 300-1	3.3% (min IFR gradient)	200'/nm minimum
Weather < 300-1	Not Authorized Pt 135	

RUNWAY 6

Weather VFR	2.7% (aircraft certification)	See & Avoid
Weather IFR >= 300-1	3.3% (min IFR gradient)	200'/nm minimum
Weather < 300-1	3.9% gross gradient (+.1% 135)	240'/nm minimum

See & Avoid **means what it says. If you feel you can't See and Avoid up to the MSA or MOCA regardless, fly 3.3% or the published DP gradient, whichever is higher.**

DP's (Instrument Departure Procedures)

To accept an Instrument Departure Procedure that requires a climb gradient, the aircraft must be able to climb at the gradient required. These procedures publish a minimum climb necessary in feet per nautical mile and also publish a minimum rate of climb necessary for particular ground speeds. To compute what your single engine climb rate will be, multiply climb gradient by $\mathbf{V_2}$ to find ft/min climb rate (i.e. 2.7(%) X 120 = 324 ft/min). A quick way to determine the percent climb gradient needed is to look at the 100 knot column. 917 ft/min under the 100 knot heading approximates a 9.17% climb gradient needed for this DP. An example of this is:

LINDZ THREE DEPARTURE (LINDZ3.LINDZ)
(PILOT NAV)

This DP requires a minimum climb rate of 550' per nautical Mile to 10,000'

Grd speed - Kts	75	100	150	200	250	300
550' per NM	688	917	1375	1833	2292	2750

Does the aircraft need to do this climb gradient with all engines operating or with an engine out? This is a gray area as far as regulations are concerned. The TERP's people who design these procedures do not care how many engines you have. They just tell you what is required and you have to figure out how to comply with the gradient. Aircraft certification requirements make no mention of obstacle clearances, just minimum performance requirements one engine out. Air Carrier regulations (121/135) do require a vertical obstacle clearance of a minimum 35' from the net takeoff flight path which by definition means with one engine out but they also allow you a horizontal clearance.

So can you accept this DP if your one engine out performance will be less than the gradient required?

The answer is, IT DEPENDS.

1. Are you ***sure*** the aircraft can make the gradient with all engines operating? Part 25 transport category aircraft typically do not have climb gradient charts for all engines operating with the exception of the landing climb gradient charts (all engines, full flaps (and slats), gear down, speed $\mathbf{V_{ref}}$-5) and the time to climb charts from which you can calculate estimated all engine climb rates. Using the time and distance to climb charts, here are those gradients:

FALCON 900 ALL ENGINE OPERATING CLIMB GRADIENTS

Uses Average Climb Rates From 1,500 to 15,000 ft, 250kts<10K, 260kts=>10K

	GTOW	46000 lbs	44000 lbs	42000 lbs	40000 lbs	38000 lbs	36000 lbs	34000 lbs	32000 lbs
ISA-15	Gradient ft/nm	12.3% 750 ft/nm	13.1% 794 ft/nm	13.9% 844 ft/nm	14.8% 900 ft/nm	14.8% 900 ft/nm	15.9% 964 ft/nm	17.1% 1038 ft/nm	18.5% 1125 ft/nm
ISA-10	Gradient ft/nm	11.7% 711 ft/nm	12.3% 750 ft/nm	13.1% 794 ft/nm	13.9% 844 ft/nm	14.8% 900 ft/nm	15.9% 964 ft/nm	17.1% 1038 ft/nm	18.5% 1125 ft/nm
ISA	Gradient ft/nm	10.1% 614 ft/nm	11.1% 675 ft/nm	11.7% 711 ft/nm	12.3% 750 ft/nm	13.1% 794 ft/nm	13.9% 844 ft/nm	14.8% 900 ft/nm	15.9% 964 ft/nm
ISA+10	Gradient ft/nm	8.5% 519 ft/nm	9.3% 563 ft/nm	9.7% 587 ft/nm	10.1% 614 ft/nm	11.1% 675 ft/nm	11.7% 711 ft/nm	12.3% 750 ft/nm	13.9% 844 ft/nm
ISA+20	Gradient ft/nm	6.5% 397 ft/nm	7.2% 435 ft/nm	7.7% 466 ft/nm	8.2% 500 ft/nm	8.5% 519 ft/nm	9.3% 563 ft/nm	10.1% 614 ft/nm	10.6% 643 ft/nm

Keep in mind these are average gradients from 1,500' msl to 15,000' msl. Thus at 6,750' msl you should attain these gradients all engines operating. Lower and you will have higher gradients. Higher and you will have lower gradients.

2. Do you have an ***alternate plan*** of action should you experience an engine failure at $\mathbf{V_1}$ or beyond that will ensure obstacle clearance other than following the DP? This depends upon the terrain around the airport, the weather conditions (runway, ceiling and visibility), and what you have briefed you will do in your takeoff briefing should you have to take an engine failure condition airborne.

If the answer to both of these questions is YES, then you may consider accepting this DP. If the answer to *either* of them is NO, then you may not accept the DP. Remember that an engine failure is an emergency situation allowing the pilot to deviate as necessary and to employ all tools available to him to get the aircraft on the ground safely. Just keep in mind that relying **solely** on ATC for obstacle clearance after declaring an emergency ***is not a very wise thing to do***. You need your own plan of action if you do this. Keep in mind there are airports such as Aspen that have DP's with climb gradients that due to terrain leave you no options other than to fly the DP.

LANDING

The landing weight is limited by the more restrictive of the following certification requirements:

1. One engine out go around approach climb gradient (2.4 %)
2. The all engine go around landing climb requirement (3.2%)
3. Landing distance and field length requirements.

Approach Climb Gradient required is **2.4%** (one engine out) gross climb gradient.
This is most restrictive for S+20º approaches / S+40º landing config

Landing Climb Gradient required is 3.2% gross climb gradient (all engines operating, gear down, full flaps, V_{ref}-5).
The landing climb gradient is usually never a factor unless you had to do the approach at S+7º and have now configured to S+40º.

A good rule of thumb is that you can return to the airport of departure immediately and land on the same runway in the *same configuration you took off with* and meet both of these requirements.

Landing Field Length

LFL assume 50' at threshold (at V_{ref}) and wasting approx 1000' of runway touching down at V_{ref} to V_{ref} -5.. Can be reduced by touching down sooner when obstacles allow. LFL=1.667 times landing distance. . This length provides you with a safety factor. This must be used for all 135 calculations. 135 ops also require an additional 15% added to LFL for wet runways and 15% for visibility less than ¾ mile. There are also additional add ons for anti skid inop (add 50% to LFL) and air brake inop (add 10% to LFL).

Performance Charts

All Falcon performance charts start with the input data (such as temp, press alt, wt, gradient, etc) and then proceed to REF lines to adjust for different conditions or parameters. When using the charts, follow these rules:

Going from TOP down on the chart: go down to the reference line and then follow the slope of the correction. ***DOWN=REFERENCE***

Going from BOTTOM up on the chart: go up to the slope of the correction and then follow the slope to the reference line. ***UP=SLOPE***

Minimum Turn-Around Times

Brake cooling times must be calculated for quick turns. After a normal landing with thrust reverse and minimum braking at a NON hot and high airport, 15 minutes is a safe rule of thumb. Anything other than that will require brake cooling calculations.

Engine Out Drift Down Fuel Consumption Rule of Thumb

Once you have drifted down to the one engine out service ceiling, the fuel consumption will be the same as it was at the higher altitude with three engines plus you will burn an additional 1# of fuel for each nautical mile to go.

Take-Off Noise Reduction Procedure

1. Use S+20 configuration
2. Maintain takeoff thrust up to a height of 1,700 AGL in S+20º configuration
3. Maintain V_2 +10 to 1,700 AGL
4. At 1,700 AGL, accelerate to V_{mfr} , clean the wing, and then reduce N1 to calculated cut-back value

The calculated cut-back power setting will ensure 4.8% climb gradient all engines or level flight one engine inoperative.

WEIGHT AND BALANCE

MRW 46,700 lbs MTOW 46,500 lbs MLW 42,000 lbs
Cabin and aisle floor limits are 40.96 lb/sq ft. Baggage compartment is 123 lb/ sq ft
The length of the MAC is 113.69 inches

Forward CG Limit 14% MAC Aft CG Limit is 31% MAC
Center of gravity is expressed in % MAC:

$$\_\_\_\_\_\% = 25 + \frac{\text{Sum of Moments (lb in)}}{\text{Airplane Weight (lb)}} \times \frac{100}{\text{MAC (113.69 in)}}$$

Excessive forward CG decreases aircraft performance.
Excessive aft CG decreases aircraft stability.

Falcon 900B Weight and Balance

ITEM	**Limit**	**Weight**	**Arm**	**Moment /1000 in-lbs**
Basic Empty Weight		25800	1.3	34.0
Pilots		385	-311.2	-119.8
3rd Crew Member			-261.2	0.0
Baggage and Documents		92	-278.3	-25.6
Coat Rack and Jepps	132 lbs	55	-278.8	-15.3
Right Galley			-258.3	0.0
Left Galley			-222.5	0.0
Passengers 1-2			-191.2	0.0
Passengers 3-4			-139.7	0.0
Forward Low Profile Cabinet		45	-100.0	-4.5
Passengers 5-6			-88.2	0.0
Passengers 7-8			-44.1	0.0
Center Low Profile Cabinet		45	-40.0	-1.8
Aft Low Profile Cabinet		25	-17.5	-0.4
Passengers 9-10			5.3	0.0
Passengers 11-12			30.9	0.0
Passengers 13-14			55.9	0.0
Life Rafts		139	28.8	4.0
Water		88	88.6	7.8
Front Baggage Compartment	1213 lbs		122.8	0.0
Rear Baggage Compartment	1653 lbs		157.0	0.0

ZERO FUEL WEIGHT	30870 lbs	**26674**	SUBTOTAL	**-121.7**
		ZFW %MAC	21.0%	
Fuel	19065 lbs	0		0.0
TAKEOFF WEIGHT	46500 lbs	**26674**	TOTAL	**-121.7**
CG POSITION		**Takeoff %MAC**	21.0%	
		14%-31% MAC		

Hydroplaning

The formula for determining hydroplaning speed is 6.3 times the square root of the tire pressure (197 psi). For the 900B this is approximately 88 knots.

Dassault Special Ops Bulletin #1 - Ops on "non-dry" runways

Non dry runway is defined as any runway having up to 1/8" (.125") equivalent water depth covering 25% or more of the runway. No aileron into wind. Forward pressure on yoke a must for effective steering. Landing distance and field length increased by 15%.
More than .125" constitutes a contaminated runway. Max equivalent water depth .5" by recommendation. Consider this a limit even though the flight manual says .75". Max crosswind 15 kts. Takeoff with S+7 prohibited. Antiskid required. No landing on wet runway if antiskid fails final test before landing.

Contaminated Runways (slush, snow)

1. Landing distance x 2
2. LFL x 2 x 1.15
3. Apply brakes below $\mathbf{V_h}$ (89 kts)
4. Reverse ASAP
5. On takeoff:
   $\mathbf{V_1=V_r}$
   Precip Takeoff chart distance + double the landing distance
   Do not retract gear for 15 seconds, then cycle 3 times

ISA ESTIMATE COMPUTATION FOR ALTITUDE (900 FMS computes this for you)

Temperature drops 2ºC per thousand feet until approximately 37000. Therefore, to compute ISA at FL340:

Drop zero	34
Double it	68
Subtract 15	15
ISA	-53ºC

For FL 390 (use 370 since temp is theoretically constant above that level):

Drop zero	37
Double it	74
Subtract 15	15
ISA	-59ºC (this is within a couple of degrees accuracy)

RAT Ram Air Temperature (used in Falcon 10's and 20's)
TAT Total Air Temperature (used in Falcon 900)
Hotter than SAT by 2.8º C per 100 kts speed increase
OAT Outside Air Temperature
SAT Static Air Temperature
RAT and TAT are always within a few degrees of each other
OAT and SAT are always within a few degrees of each other
RAT equals OAT if the aircraft is not moving
SAT equals TAT if the aircraft is not moving

FAR 135 REGULATION REVIEW

All flights must operate in controlled airspace and use airports with instrument approach procedures.

If weather is at or above T/O minimums but lower than landing minimums, we need a **takeoff alternate** within 1 hour at normal cruise power. If the takeoff alternate airport has two ILS's in different directions, you only need regular landing minimums, not alternate minimums.

You may take off under our ops specs when the weather is at or above the straight in landing minimums. Lower than that requires special crew training and conditions.

No **landing alternate** is required if:

a. There is a standard Instrument Approach
b. The weather +/-1 hour of the ETA indicates:
   1500' above lowest circling approach minimums, or;
   if no circling approach is available, 1500' above the lowest straight-in landing minimums, or;
   2000' above airport elevation, whichever is higher, and
   and visibility of 2 miles above the highest landing minimums or 3 miles, whichever is greater.

You cannot file to an airport unless there is approved weather reporting at that airport.

You may not begin an instrument approach unless the weather reported is at or above landing minimums. If weather goes below landing minimums and you are inside the final approach fix, you may continue and land if the weather is actually at minimums at the missed approach point.

New PIC's must increase their minimums 100' and ½ mile for the **whole CREW** until the PIC has 100 hours PIC. High mins do not count at T/O or LDG Alternates.

You may not takeoff unless the weather indicates that at the ETA the weather will be at or above landing minimums.

You may not designate an alternate unless the weather indicates that at the ETA it will be at or above alternate landing minimums (standard 600-2, 800-2, must check individual airport alternate minimums).

If visibility is less than ¾ mile, add 15% to landing field length.

If runway is wet, add 15% to landing field length.

OPS SPECS REVIEW

Our Operations Manual states that the net take-off flight path for turbine powered transport category aircraft must clear all obstacles either by a height of at least 35 feet vertically, or by at least 200 feet horizontally within the airport boundaries and by at least 35 feet vertically and 300 feet horizontally after passing the airport boundaries. This is straight out of FAR 135.379.

Our Ops Specs relieves us of this requirement providing the following is true:

1. Airport elevation is 4000' msl or less.
2. The runway length is 150% of the required runway (150% balanced field length)
3. The weather conditions are equal to or greater than straight in Category I landing minimums for the runway being used.

COMPANY 135 TAKEOFF MINIMUMS

Standard takeoff minimums are 1 mile for aircraft with 2 engines or less
Through our ops specs, we are authorized to operate with "lower than standard takeoff minimums"

Single Pilot King Air:

1. The lowest possible weather for takeoff is ½ mile / RVR 2400
2. If a takeoff minimum is published for the runway that is higher than ½ mile / RVR 2400, the higher minimum must be used.
3. If no takeoff minimum is published for the runway, the lowest landing visibility for that airport may be used.

Two pilot King Air or Falcon:
Above 2 through 3 apply. To go lower than ½ mile / RVR 2400:

1. The pilot making the takeoff must have 100 hours in type and both pilots must be 135 qualified in the aircraft.
2. Lower minimums must be published for the runway.

For runways published for ¼ mile / RVR 1600 takeoffs:

At least one of the following visual aids must be available:

- ❖ HIRL, centerline lights or centerline markings
- ❖ If the above are not available, adequate visual reference to continuously identify the takeoff surface.

For runways published for RVR 1200 takeoffs:

All of the following must be available:

- ❖ Centerline lights
- ❖ Two RVR systems

For runways published for RVR 600 takeoffs:

All of the following must be available:

- ❖ Centerline lights
- ❖ Centerline markings
- ❖ Two RVR systems