

# CRJ 700 AIRCRAFT SYSTEMS STUDY GUIDE

**A Complete Systems Oral Exam Guide  
for the CRJ 700 Pilot**

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**Aviation Study Made Easy**

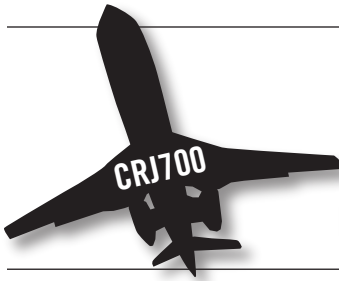
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# Air Conditioning and Pressurization

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## **What part of the engines supply bleed air to the packs?**

Bleed air is supplied from either the engine compressor 6th or 10th stage.

## **Where are the two air conditioning packs located?**

They are located in the aft equipment bay.

## **What is the maximum operating altitude for single pack?**

31,000 feet

## **What monitors and controls the air conditioning and bleed air systems?**

Operation is controlled by two dual channel air conditioning system controllers (ACSC). The left side is controlled by ACSC 1 and the right side by ACSC 2.

## **Are both channels of the dual channel ACSC required for operation?**

Only one is active at any one time. There is no indication as to which channel is active.

## **Which pack does ACSC 2 control?**

ACSC 1 controls the left pack and ACSC 2 controls the right pack.

### **What does ACSC 1 control?**

The left engine bleed system is controlled by ACSC 1 and the right engine bleed system is controlled by ACSC 2. The ACSC control the pack operations, pneumatic valves and temperature control.

### **Explain the AUTO position of the BLEED VALVES selector.**

All aspects of bleed air operation and management is done by the air conditioning system controller (ACSC).

### **Explain the MANUAL position of the BLEED VALVES selector.**

The MANUAL position activates the BLEED SOURCE rotary selector and the ISOL switch.

### **What does the BLEED SOURCE selector do?**

The BLEED SOURCE rotary knob selects the source of bleed air.

### **Does the low-pressure air cart supply air to the packs for the aircraft cooling?**

No, the air is sent to the bleed air manifold and then travels to all the outlets.

### **Where is the connector for external ground air located?**

The external ground air connector is aft of the aft cargo bay door.

### **How do the pilots know when low pressure external ground air is connected?**

There is no indication of the external ground air connector on the ECS page. When the air is connected the air pressure readout on the ECS page will indicate pressure to show the air is connected.

### **What must be done before the low-pressure air can be turned on?**

The main cabin door or avionics bay door must be open.

### **How are the pack heat exchangers cooled?**

The scoop at the base of the vertical stabilizer takes in ram air for cooling. When the aircraft is on the ground a fan pulls air into the scoop. There are two exhaust vents on the rear of the fuselage where the air is discharged.

### **Where are the temperature sensors located in the cabin?**

One monitor is in the front and one in the rear.

### **What happens when there is a 10°C difference or greater between a temperature sensor and the selected temperature?**

The pack is automatically set to high airflow to meet the heating or cooling selection.

### **After a pack high temperature shutdown can the pack automatically restart?**

When the temperature cools the pack will automatically restart.

### **What does the RECIRC FAN switch do?**

This switch controls the recirculation fan in each exhaust duct.

### **Are both cargo bays pressurized?**

Yes, but the aft cargo bay is the only one ventilated with re-circulated cabin air.

### **What happens when the cargo COND AIR is selected?**

An electric heater in the supply duct is activated to keep the aft cargo compartment better suited for animals. The ACSC regulates conditioned air temperature to the aft cargo bay.

### **How many smoke detectors are located in the front and aft cargo compartments?**

The aft cargo bay has two smoke detectors and the forward cargo bay has three.

### **Is overheat protection provided in the forward cargo compartment?**

No, overheat protection is just in the aft.

### **Explain the OFF position of the cargo switch.**

In the off position ventilation to the aft cargo bay is turned off by closing the intake and exhaust valves.

### **Explain the AIR position of the cargo switch.**

Ventilation to the aft cargo bay is provided by opening the intake and exhaust valves. The aft cargo area is ventilated by the ECS system controlled by ACSC 2.

### **What does an amber CARGO OVHT on the EICAS indicate?**

This EICAS message will only occur if the conditioned air option is installed. If the aft cargo bay temperature reaches more than 40° C and conditioned air is selected, an overheat condition is detected. The heater is de-energized and the AFT CARGO OVHT is displayed. The CARGO COND AIR switch should be selected to FAN.

### **When there is an AFT CARGO OVHT with the condition air option, and the cargo fan switch is selected from COND AIR to FAN, what does this do?**

This takes the power away from the over temperature circuitry and removes the indication from the EICAS display. This cargo intake and exhaust SOVs are still open so there is suitable airflow. It matches the condition since the heater is automatically turned off.

### **Explain an AFT CARGO SOV status message?**

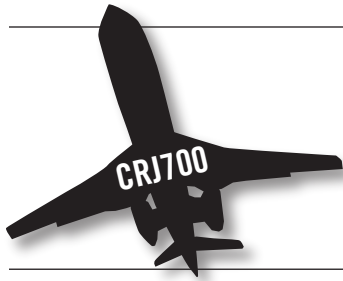
The SOV for inlet air has failed closed or open.

### **How is the outflow pressurization valve controlled?**

The outflow valve is electrically operated by three DC motors that drive a gearbox and actuator to move the valve.

### **How many outflow valves are installed?**

One



# Auxiliary Power Unit (APU)

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## **What type of APU does the CRJ 700 have?**

Allied Signal RE220RJ.

## **Where is the APU located?**

The APU is located in the tail cone in a fireproof compartment.

## **What is the range of the APU exhaust hazard area?**

There is none.

## **What fuel tank does the APU draw fuel from?**

The left collector tank.

## **Where is the APU intake door located?**

It is on the right side of the tail cone area.

## **What controls the position of the APU air inlet door?**

The APU ECU controls the position of the APU air inlet door.

## **When will the APU door open during flight?**

The APU door will open when the START/STOP switchlight is pressed. This is to prevent spin up from air flow.

**What is the maximum operating altitude of the APU?**

41,000 feet

**What is the maximum altitude to start the APU?**

37,000 feet

**What is the maximum altitude to extract bleed air for air conditioning?**

25,000 feet

**What is the maximum altitude to use the APU for an in-flight engine start?**

21,000 feet

**Under a full load how much fuel does the APU burn?**

The fuel burn is approximately 280 lbs. an hour.

**Normally how is fuel supplied to the APU?**

Pressurized fuel is supplied via a 28-VDC electric fuel pump.

**What will happen if the APU fuel feed pump fails when the APU is operating?**

The APU will still operate by getting fuel past the pump through an internal bypass valve.

**What are the three methods to stop fuel flow to the APU?**

- APU FIRE PUSH switchlight.
- The START/STOP switchlight on the APU panel.
- ECU automatic shutdown.

**Does the EICAS APU door position correspond to the actual door position?**

The EICAS only has two positions, open and closed. The APU door position does vary in flight with positions other than just open.



**What is the limitation if the APU door is failed open and not operating, or the door position is not known?**

The airspeed is restricted to 220 KIAS or the APU must remain operating

**What is the primary purpose of the APU?**

The primary purpose of the APU is to provide electrical power.

**What is the KVA rating of the APU AC generator and up to what altitude will it provide this KVA?**

Up to 41,000 feet the AC generator will provide 40 KVA.

**What is the normal position of the APU generator switch?**

For all normal operations the switch is to remain in AUTO.

**What does the AVAIL light in the APU START/STOP switchlight indicate?**

The APU is ready for electrical loading.

**Can the APU be used for anti-icing bleed air?**

No

**Can the APU bleed air and another source of bleed air be used at the same time?**

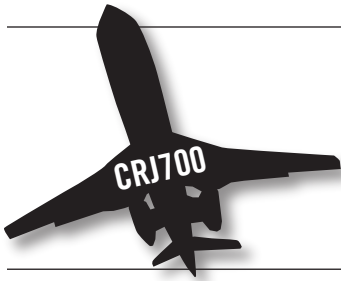
No

**When does the bleed air source switch to and from the APU if operating?**

Bleed air extraction will switch from the APU to the engines automatically when the TO bit is set. When the approach bit is set the bleed air source will switch back to the APU for landing.

**What battery is needed to start the APU?**

Both the MAIN and APU battery are needed to start and operate the APU.



# Automatic Flight Controls

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## **Explain the optimized pitch of the flight director (FD) for takeoff.**

The pitch of the flight director (FD) is based on the flap setting and the ratio of VR to V2. This produces a pitch angle that is unique for that set of conditions.

## **What speed is the takeoff pitch of the FD optimized for?**

The pitch is between 11-18 degrees and is optimized to obtain  $V2 + 10$ .

## **What would you do if the FD were deferred?**

Refer to the Supplemental Procedures to determine pitch attitudes.  
Refer to the MEL and follow your company procedures.

## **What occurs to the FD if an engine fails on takeoff?**

The FD pitch will change to about 10 to 14 degrees for optimum pitch attitude to maintain V2.

## **What conditions will cause the FD bars to not appear when the TOGA button is pressed for takeoff?**

- If the pilot enters VR and V2 and the difference is greater than 24 knots between both settings.
- If the flaps were not set to 8 or 20 degrees for takeoff.

All of these conditions will display a red FD flag on the PFDs.

### **Is the go-around pitch of the FD optimized?**

No, the pitch is set to 8 degrees.

### **What two systems are integrated by the automatic flight control system (AFCS)?**

Flight director and the autopilot systems.

### **What four systems does the AFCS supply information to?**

- Dual flight directors
- Two axis autopilot
- Automatic pitch trim
- Two yaw dampers

### **What are the four system components of the AFCS?**

- Flight control panel (FCP)
- Two flight control computers (FCC)
- Two autopilot servomotors
- Two yaw dampers

### **What are the main AFCS microprocessors and where are they located?**

Flight control computers (FCC) 1 and 2. They are located in the IAPS.

### **What systems do the FCCs provide instructions to?**

- FCP
- FDs
- Yaw dampers
- AP servo motors

### **The flight director receives its position on the primary flight display (PFD) from what systems?**

FCCs

## **What is the IAPS?**

The integrated avionics processing system. This system contains many computers and components and provides the means for them to communicate.

## **Are both FDs always active?**

During most modes, one flight director is supplying guidance information to both PFDs. The other FD is in standby but they do continue to continuously cross talk. During the following modes, both FDs are active and providing outside information:

- Takeoff mode
- Approach mode
- Go around mode

## **What occurs if the active FD fails?**

A white FD1 or FD 2 FAIL EICAS status message will be displayed. Also a red FD in a box will appear on the PFDs.

## **Where is the vertical and lateral mode selections of the FD displayed?**

On the flight mode annunciator (FMA), located at the top of the PFDs.

## **Explain the two fields of the FMA?**

A vertical cyan line separates the two fields, with the left side the active field and the right side the armed field. The top line of the FMA displays the active and armed FD lateral mode and the bottom line the active and armed FD vertical mode. The active side is green text and the armed side is white text.

## **What information do the FCCs process to figure the flight of the aircraft?**

The information needed comes from the attitude and heading reference system (AHRS) and the air data computer (ADC).

### **What happens if information in the FMA field is invalid?**

If any information is invalid, it is indicated by a red line where the text would be.

### **When can only one FD command bar be removed from the PFDs and when will both FD command bars be removed by a selection of the FD button on the FCP?**

Selection of the FD FCP button on the side that is not active will remove the FD command bars from that side only. Selection of the FD FCP button on the side that is active will remove both FD command bars.

### **If the autopilot (AP) is engaged, will deselecting the FD button on the active side disengage the AP?**

No, the onside FD button is inactive and deselecting it will not disengage the AP. If the off-side FD button is pressed, the FD bars on the off-side will be removed and will not disengage the AP.

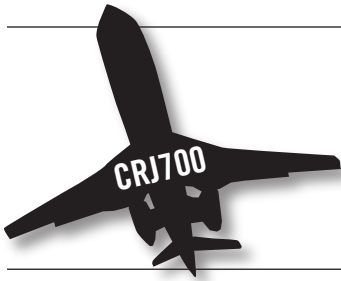
### **What is the purpose of the XFR button on the FCP?**

This button selects the active FD in some modes. It can also be stated that it selects which FCC will command the FDs in some modes. Remember that some modes, the onside FCC will command only the onside FD. (Example: APPR mode)

### **What FD modes are both FDs active and display information received from the onside FCC?**

- Takeoff mode (TOTO)
- Approach mode (APPR)
- Go around mode (GAGA)

FCC 1 controls FD 1 only and FCC 2 controls FD 2.



# Electrical System

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## **What are the sources of AC electrical power for the aircraft?**

- The primary sources of AC electrical power are two engine driven integrated drive generators (IDGs).
- The APU has an AC generator mounted on it.
- An air driven generator (ADG) can provide AC power if there is a total loss of AC power.
- On the forward right side of the fuselage there is a receptacle for AC ground power.

## **What provides power if there is a total loss of AC electrical power in flight?**

On the right side of the forward fuselage is an air driven generator (ADG) that can be deployed to provide AC power.

## **What is the kilo volt-amperes (KVA) rating of the integrated drive generators (IDG)?**

The IDG rating is 40 KVA up to 41,000 feet.

## **What type of power do the IDGs supply?**

The IDGs supply 115-volt AC, 400-hertz 3-phase electrical power.

### **Does the IDG RPM vary with engine RPM?**

No, the generator must turn at a constant RPM to produce a steady 400-Hz. The constant speed drive (CSD) unit accomplishes this task.

### **How does the CSD accomplish a constant RPM?**

The CSD is a hydro-mechanical unit and uses an integral oil system to drive the generator at a constant RPM. The CSD is driven by the engine accessory gearbox, which turns at a variable speed based on engine speed.

### **How is the internal oil of the CSD cooled?**

The oil in the CSD is cooled by an air/oil heat exchanger. The air used to cool the oil is from the N1 fan.

### **How many batteries does the aircraft have?**

The aircraft has two nicad batteries. One is located in the nose and one in the aft equipment bay.

### **What are the AC buses?**

- AC service bus
- AC essential bus
- AC bus 1
- AC bus 2

### **What are the different ways the IDG can disconnect from the engine gearbox?**

- Pressing the associated IDG DISC switch.
- When CSD internal temperature raises to a certain temperature the IDG will automatically disconnect.
- An over torque condition of the CSD will cause the shearing of the IDG drive shaft.

### **What does the white DISC in the IDG switchlight indicate?**

The IDG was successfully disconnected from the engine accessory drive.

## **When will the engine generator automatically be tripped off line and removed from the bus system?**

When any of the following occur:

- Generator or bus over current
- Over or under frequency
- Over or under voltage

## **What monitors the generator system?**

Each generator has a generator control unit (GCU) that controls and monitors the related generator system. The GCU provides protection and voltage regulation for the associated generator.

## **What does the FAULT light in the IDG switchlight indicate?**

This light will illuminate when the IDG oil overheats or oil pressure drops below limits. This FAULT light will also illuminate an IDG caution message on the EICAS.

## **Where is the external AC receptacle located?**

The external AC connection is on the forward right side of the fuselage.

## **What does the green AVAIL light on the flight deck electrical power services control panel and the external service panel indicate?**

When external AC power is attached to the aircraft, the external monitor checks the AC ground power for proper voltage, frequency, and phase relationship. If it is good power and available for use these two AVAIL lights will illuminate.

## **There is external AC power supplying the aircraft power, what will happen if an engine generator is selected on?**

The buses will be supplied AC power from the engine generator and no longer from the AC external power. The green AVAIL lamp on the electrical control panel will illuminate and the white IN USE will extinguish, even if the switchlight is still selected in.



**What occurs when the AC switchlight on the flight deck electrical power services panel has the green AVAIL light illuminated and is pressed?**

If there is no other AC electrical power available, the external AC power will supply power. The white IN USE of the switchlight will illuminate and the green AVAIL will extinguish.

**What buses are powered when external AC power is connected and the green AVAIL switchlight on the external services panel is pressed?**

Only the AC service bus will be powered.

**Explain a SERVICE CONFIGURATION message?**

The AVAIL switchlight on the external AC service panel is activated and AC external power is connected.

**What other bus does AC BUS 1 supply power to?**

Normally to the AC ESS BUS.

**Which other buses does AC BUS 2 supply power to?**

Normally to AC SERV BUS.

**What bus normally powers the AC ESS BUS and what would happen if there was a fault with this bus?**

AC BUS 1 normally powers the AC ESS BUS. If AC BUS 1 fails, the ESS BUS will automatically transfer to AC BUS 2 for a power source.

**If AC BUS 1 fails, what would you do if the ESS BUS did not automatically transfer to AC BUS 2?**

The ESS BUS could be manually transferred to AC BUS 2 by the AC ESS XFER switchlight on the electrical power services panel. This will cause the AC ESS XFER switchlight to illuminate white and there will be a white status message AC ESS ALTN on the status page. This electrically connects the ESS BUS to AC BUS 2.

**Will the AC ESS XFER switchlight illuminate if pressed for manual transfer?**

Yes

**After selecting the battery master to ON with no other power source, what does an illuminated AC ESS XFER switchlight indicate?**

The AC ESS is not power by AC BUS 1. At this point neither AC BUS 1 nor 2 are powering the AC ESS BUS.

**What would occur to the AC ESS BUS if total AC power were lost in flight?**

The air driven generator (ADG) would automatically deploy and the AC ESS BUS would be powered. The ADG BUS is powered by the ADG and this bus is connected to the AC ESS BUS.

**Aircraft generator power is re-established after a total AC power loss and ADG deployment. Will the aircraft generator now power the AC ESS BUS?**

To de-energize the relay between the AC ESS BUS and the ADG BUS, the PWR TXFR OVERRIDE button on the ADG AUTO DEPLOY CONTROL panel must be pressed. This will connect the AC ESS BUS to AC BUS 1.

**What bus powers the AC SERV BUS?**

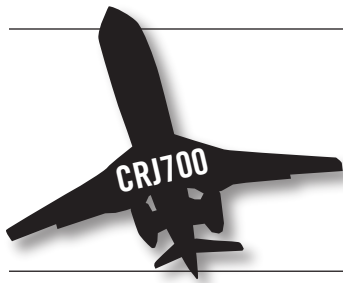
The AC BUS 2 supplies 115-volts AC to the AC service bus.

**What does the AC ESS BUS power?**

It powers equipment essential for flight and powers ESS TRU 1.

**The cleaning crew needs to clean the aircraft, how would you power only the buses needed for cleaning?**

External power available: If the AVAIL lamp in the EXT AC PUSH switchlight on the external services panel is illuminated, the switchlight can be pressed and if no other AC power is available to the aircraft, the AC SERV BUS will be powered with no other buses being powered.



# Fire and Overheat Protection

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## **What areas do the fire detection and extinguishing (FIDEEX) monitor?**

- Engine
- Main landing gear
- APU
- Cargo compartments

## **Where does the FIDEEX unit provide fire extinguishing?**

- APU
- Cargo compartments
- Engine

## **What does the FIDEEX control?**

- Smoke detection
- Overheat detection
- Fire protection system
- Fire extinguishing systems

## **What areas have smoke detection systems?**

- The two cargo bays
- The two lavatories

### **What compartments provide fire and overheat detection?**

The APU and the engine have fire and overheat detection.

### **What area only has overheat protection?**

The main landing gear bays only have overheat detection.

### **What in the engine actually detects the fire or overheat condition?**

Two detection loops that are connected to FIDEEX detect the fire or overheat condition. As there is an increase in temperature i.e. fire, the electrical resistance of the insulator decreases with an increase in temperature to a trip point at which there will be a fire or overheat indication generated.

### **What are the two benefits of the dual loop detection systems?**

- Minimize false fire warnings because both loops must sense the fire or overheat condition before a fire is detected.
- The aircraft can be dispatched with a loop that is inoperative and still provide fire and overheat protection.

### **Explain the operation of the fire detection control unit.**

This unit monitors the electrical resistance of the loops. Both loops must sense the same decrease in electrical resistance at the same time for the fire detection control unit to send the signal to the EICAS. This unit also monitors the loops for malfunctions and if a malfunction is detected in a loop, the second loop maintains the capability of detecting an overheat condition or fire. The failed loop will no longer be used.

### **What do the engine fire extinguisher bottles contain?**

The bottles contain Halon and are pressurized with nitrogen.

### **Where are the engine fire extinguishers located?**

The extinguishers are located in the aft equipment bay.

**Will the left engine fire bottle only discharge into the left engine?**

No, both bottles can be discharged into a single engine. This is determined by which fire switch is pressed. Both bottles have a left and right squib that allows the bottle contents to be used in either engine.

**What happens when the LH or RH FIRE PUSH switchlight is pressed?**

- Fuel SOV closes.
- Bleed air SOV is closed.
- Hydraulic SOV is closed.
- Engine driven generator is taken off line.
- Squibs on both engine fire extinguishing bottles arm. Both BOTTLE ARMED PUSH TO DISCH switchlights illuminate.

**What is indicated by the BOTTLE 1 and 2 ARMED PUSH TO DISCH switchlights being illuminated after pressing a LH or RH FIRE PUSH switchlight?**

When illuminated it indicates the squib is armed and charged.

**What does an illuminated BOTTLE 1 and 2 ARMED PUSH TO DISCH switchlight during the test of the fire warning system?**

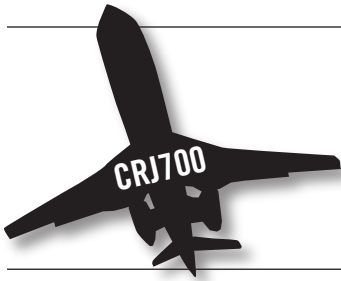
The applicable squib will operate normal.

**What will happen if a LH or RH FIRE PUSH switchlight is pressed out after activating the switchlight?**

The systems affected by pressing the switchlight the first time will return to normal operation and fire alerting is returned to normal.

**What happens when a BOTTLE ARMED PUSH TO DISCH switchlight is pressed after being activated by the FIRE switchlight?**

An electrical current fires the squib on the selected bottle. The Halon is directed into the engine nacelle on the side of the selected fire switch.



# Hydraulics

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## **How are the thrust reversers powered?**

The right reverser is powered by hydraulic system 2 and the left is powered by hydraulic system 1.

## **If hydraulic system 3 is lost, what hydraulic system is used to lower the nose gear?**

Hydraulic system 2 is used to release the over center lock when the alternate gear extension is used.

## **What hydraulic system powers the nose doors?**

No hydraulic power is used to operate the nose doors.

## **How many PCUs power the multi-function spoilers (MFS)?**

Each is powered by a single PCU from a single hydraulic system. With this setup the other panel will still operate with a single hydraulic system failure.

## **On the hydraulic shutoff valve panel, what do the switchlights operate?**

The switchlights close the respective hydraulic shutoff valve. When selected closed the switchlight will illuminate a white CLOSED. This switchlight will isolate an engine driven pump from the hydraulic system without having to shutdown the engine. This is the same SOV controlled by the engine fire switchlight.

**When the right hydraulic SOV switchlight is selected, what pump will this isolate?**

The right engine driven hydraulic pump will be isolated. The electric hydraulic pump can still pressurize the system.

**After pressing a hydraulic SOV switchlight, can the valve be opened again?**

Yes, reselect the switchlight to open the valve.

**When only one engine driven generator is operating, will a hydraulic B pump be shed?**

No

**When a hydraulic valve fails to attain the commanded position, what color will it turn?**

Amber

**How many hydraulic systems does the CRJ700 have?**

The CRJ700 has a total of three hydraulic systems, which are identified as system 1, 2 and 3.

**Which hydraulic pumps are engine driven?**

Hydraulic system pump 1A and 2A is engine driven.

**What is the normal PSI of the hydraulic systems?**

3000 PSI

**What is the only difference between hydraulic system 1 and 2 other than what they operate?**

The reservoir capacities are different; system 2 is larger due to powering more equipment.

**When do system 1A and 2A main hydraulic pumps operate?**

Any time the respective engine is operating.

**Which hydraulic pumps are electrically driven?**

All backup pumps (B pumps) and the system 3A pump are all alternating current motor pumps. These are 1B, 2B, 3A, and 3B.

**What is the color of Skydrol hydraulic fluid?**

It is a purplish color and should not be touched, as it is highly corrosive.

**Is there any kind of fluid exchange between hydraulic system 1 and 2?**

No

**In general, what systems are powered by at least one hydraulic system?**

- Primary and secondary flight controls
- Wheel brakes
- Landing gear
- Nose wheel steering
- Thrust reversers

**Specifically what systems do hydraulic system 1 power?**

- Rudder
- Elevators
- L aileron
- OB MFS on each wing
- OB ground spoilers on each wing
- L thrust reverser