B737 NG CBT - HYDRAULICS

COURSE OUTLINES

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COURSE START

1-The material contained in this training program is based on the information obtained from current state, local and company regulations and it is to be used for training purposes only. At the time of designing this program contained then current information. In the event of conflict between data provided herein and that in publications issued by the authority, the authority shall take precedence.

HYDRAULICS SYSTEM DESCRIPTION

2-Welcome to Hydraulic System course. In this course we will cover the following topics. * Introduction * Controls and Indications * System Description * System A and System B * Overview * Operation * Leakage * Power Transfer Unit (PTU) * Landing Gear Transfer Unit * Standby system * Overview * Operation * Leakage * Hydraulic System Controls and Indications Review

INTRODUCTION

3-The purpose of the hydraulic system is to assist the pilot in accomplishing mechanical tasks that would otherwise be impractical or impossible because of the level of force, work, or power required. Airplane systems powered by the hydraulic system are flight controls, leading edge flaps and slats, trailing edge flaps, landing gear, wheel brakes, nose wheel steering, thrust reversers and autopilots.

SYSTEM DESCRIPTION

4-The airplane is equipped with three hydraulic systems designated as system “A”, system “B” and Standby system. System A and system B operate independently, either “A” or “B” hydraulic system is capable of powering all flight controls without any decrease in airplane controllability. The standby system is used if: system “A”, system “B” or both system “A” and “B” pressure is lost. Each hydraulic system has a reservoir located in the main wheel well compartment, which stores hydraulic fluid. Bleed air from the pneumatic system is used to pressurize system “A” and “B” reservoirs. The standby system reservoir is pressurized through system “B” reservoir. Pressurization of the reservoirs is necessary to maintain a positive supply of fluid to all hydraulic pumps at all altitudes. First let’s take a look at hydraulic system “A” and “B”.

5-If the reservoirs are not properly pressurized, hydraulic fluid tends to foam at higher altitudes because of decrease in pressure. Foaming causes pressure fluctuations and can be recognized by the blinking of the related LOW PRESSURE lights. The MASTER CAUTION and hydraulic annunciator lights may also illuminate momentarily.

6-Both “A” and “B” hydraulic systems are equipped with two hydraulic pumps, an engine–driven pump and an AC electric motor–driven pump. Note that the engine–driven hydraulic pump supplies a larger volume of the fluid than the related electric motor–driven hydraulic pump. The system “A” engine–driven pump is powered by the No. 1 engine and its electric motor-driven pump is powered by the No.2 engine generator under normal conditions. The system “B” engine–driven pump is powered by the No. 2 engine and its electric motor-driven pump is powered by the No.1 engine generator under normal conditions.

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7-System “A” supplies hydraulic power to No.1 thrust reverser, rudder, ailerons, elevator and elevator feel unit, two flight spoilers on each wing, ground spoilers, alternate brakes, autopilot “A”, landing gear, normal nose wheel steering, and power transfer unit (PTU). Components powered by hydraulic systems “B” are autoslats, and leading edge flaps and slats No.2 thrust reverser ailerons, rudder, elevator and elevator feel unit, two flight spoilers on each wing, yaw damper, normal brakes, trailing edge flaps, autopilot “B”, landing gear transfer unit and alternate nose wheel steering.

8-Some hydraulic fluid is used for cooling and lubrication of the system A and system B pumps. This fluid is cooled with heat exchangers in the main fuel tanks before it is routed back to the reservoirs. Note that the minimum fuel for ground operation of electric motor-driven pumps is 760 Kgs in the related main tank. Thus you must ensure that there is enough fuel in the main tanks before operating those pumps.

9-Pressure switches are fitted in the engine–driven and electric motor–driven pump outlets. Each pump output line also incorporates a check valve. If the pump output pressure is low, pressure switch transmits a signal to illuminate the related LOW PRESSURE light. The check valve then isolates the related pump from the system to prevent hydraulic backflow.

10-System “A” and system “B” are also fitted with pressure transmitters which send the combined pressure of the engine–driven and electric motor–driven pump to their respective hydraulic system pressure indications. Now, it is time to look at system “A” and system “B” indications and controls.

11-System “A” and system “B” hydraulic indications are presented on upper or lower display unit. The indications provide the pressure of system “A” and system “B”. There is no pressure indication for the standby system. Normal operating range is shown in white. Amber indicates the caution range. The indication turns to red when maximum operating limit is reached. The quantity of system “A” and system “B” hydraulic fluid is also indicated digitally in percentage of full quantity. For instance, 95 indicates that the reservoir is 95 percent full. If the hydraulic fluid quantity is low, letters “RF”, or refill, illuminate next to the quantity indication. Note that this is valid only when airplane is on ground with both engines shutdown or after landing with flaps up during taxi–in.

OTHER CONSIDERATIONS

12-You may observe variations in hydraulic quantity indications during normal operation. These variations occur when system gets pressurized after engine start or when you raise or lower the landing gear or leading edge flaps and slats due to fluid volume absorbed or released by system components. In addition cold soaking of aircraft which can result from being exposed to low temperatures during long periods of cruise may also cause variations in hydraulic fluid indications. Note that those variations have little effect on systems operations.

13-System “A” and System “B” controls are on the hydraulic control panel which is located on the forward overhead panel. System “A” pump controls are at the left and system B pump controls are at the right.

A AND B HYDRAULIC SYSTEMS

14-System “A” ENG 1 ON/OFF switch controls the system A engine-driven pump and system “B” ENG 2 pump ON/OFF

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switch controls the system “B” engine–driven pump. The low pressure lights illuminate when output pressure from the related pump is low. When the switches are in the “ON” position, the engine-driven pumps supply hydraulic pressure to the systems components provided that the engines are running. When the switch of an engine-driven pump is positioned to “OFF”, the fluid flow from this pump to the system components stops and its low pressure light illuminates on the control panel. However, the engine–driven pump continues to rotate as long as the engine is operating.

15-System “A” ELEC 2 ON/OFF switch controls the system A electric motor-driven pump and system B ELEC 1 ON/OFF switch controls the system “B” electric motor–driven pump. Low pressure lights illuminate when output pressure from the related pump is low. When the switches are in the “ON” position, the electric motor-driven pumps supply hydraulic pressure to the systems components. When the switch of an electric motor-driven pump is positioned to “OFF”, fluid flow from this pump to the system components stops and its low pressure light illuminates on the control panel.

16-If an overheat is detected in either system, the related OVERHEAT light illuminates.

17-If an engine-driven hydraulic pump is lost and there is a high demand on the system, the LOW PRESSURE light for the remaining electric motor-driven hydraulic pump may illuminate intermittently. The flight control LOW PRESSURE light, Master Caution light, and (7) the FLT CONT and (8) HYD system annunciator lights also illuminate.

18-During an engine fire, pulling the fire switch causes the corresponding hydraulic shut-off valve to close and the fluid supply to the respective engine-driven pump is cut off. The related LOW PRESSURE light is also deactivated, so there is no LOW PRESSURE indication on the control panel.

System Leakage

19-Let’s take a look at the effect of a hydraulic leak on system “A” and system “B”. First, we will discuss a hydraulic leak in system “A”.

20-In system “A”, the electric motor-driven pump is fed through a pipe from the bottom of the reservoir. The engine-driven pump draws its fluid through a standpipe which is located at a higher level. If a leak develops in the system “A” engine–driven pump or its related lines, fluid level starts to lower in the reservoir. The higher level of standpipe prevents a total system fluid loss and ensures adequate fluid is left for operation of electric motor-driven pump. With fluid level at the top of the standpipe, indicated reservoir fluid quantity is approximately 20% full. System “A” hydraulic pressure is maintained by the electric motor–driven pump.

21-If a leak occurs in the system, the system “A” electric motor–driven pump or its related lines, or components common to both the engine and electric motor–driven pumps, the fluid quantity in the reservoir steadily decreases to zero since the pump draws its fluid from the bottom of the reservoir and all system “A” pressure is lost.

22-In system “B”, both engine-driven pump and electric motor-driven pump draw its liquid from a common standpipe. If a leak develops in either pump, line or component of system “B”, the fluid quantity decreases until it reaches at the top of

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the standpipe. With the fluid level at the top of the standpipe, the indicated reservoir fluid quantity is approximately zero and system B pressure is lost. The fluid remaining in the system “B” reservoir is sufficient only for the power transfer unit operation. Note that a leak in system “B” does not affect the operation of the standby hydraulic system.

POWER TRANSFER UNIT (PTU)

23-The function of power transfer unit (PTU) is to provide additional hydraulic pressure needed to operate the autoslats and leading edge flaps and slats at the normal rate when system B engine–driven hydraulic pump pressure is low. The PTU incorporates a hydraulic motor-driven pump which uses system “A” pressure to pressurize system “B” hydraulic fluid. There is no fluid transfer between system “A” and system “B”.

24-The power transfer unit (PTU) operates automatically by opening of a PTU control valve when all of the following conditions exist: System “B” engine-driven pump pressure is low, the airplane is in flight and the flaps are less than 15 but not up.

LANDING GEAR TRANSFER UNIT

25-Landing gear is normally powered by system “A”. When system “A” engine–driven pump volume is lost, the landing gear transfer unit provides a backup hydraulic power to raise the landing gear at the normal rate. The landing gear transfer unit is pressurized by the system “B” engine–driven pump when all of the following conditions exist: the airplane is in flight, No. 1 engine RPM drops below a limit value, landing gear lever is in UP position and either main landing gear is not fully up and locked.

STANDBY HYDRAULIC SYSTEM

26-The purpose of the standby hydraulic system is to provide backup if system “A” and/or system “B” pressure drops below limits. The system is fitted with an AC electric motor-driven pump which can supply hydraulic power needed to operate leading edge flaps and slats (only extend), thrust reversers, rudder and standby yaw damper.

27-The standby hydraulic system controls are on the flight control panel which is located on the forward overhead panel. The Flight Control LOW PRESSURE lights illuminate when hydraulic system A or system “B” pressure to ailerons, elevator and rudder is low. Standby hydraulic LOW QUANTITY light is always armed and illuminates to indicate low quantity in standby hydraulic reservoir. Standby hydraulic is armed only when standby pump operation has been selected or automatic standby function is activated. It illuminates when output pressure of standby pump is low. Now, let’s discuss the operation of standby hydraulic system.

Operation

28-The standby hydraulic system can be operated manually or automatically. It can be manually activated in two ways: using either flight control switch or using ALTERNATE FLAP switch. Let’s start with manual operation using the flight control switch.

29-For instance, if the flight control panel indicates that both system “A” and system “B” pressure are lost. System “A”

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flight control switch or system “B” flight control switch allows you to control the standby hydraulic pressure that goes to the rudder. When either flight control switch, say system “A” switch, is positioned to standby, the followings occur: the standby electric motor–driven pump starts to operate, related flight control shutoff valve closes and shuts off the related hydraulic system pressure to the ailerons, elevators and rudder; and the standby rudder shutoff valve opens. The related flight control LOW PRESSURE light extinguishes when the standby rudder shutoff valve opens. Now standby system is available to power the rudder and thrust reversers.

30-Standby hydraulic system is also activated via the ALTERNATE FLAPS switch. When the ALTERNATE FLAPS switch is positioned to ARM the standby electric motor–driven pump starts to operate, the trailing edge flap bypass valve is closed and the standby system is available to power the leading edge flaps, slats and thrust reversers.

31-Standby hydraulic system automatic operation is activated when the following conditions exist: Loss of system A or B and, (3) airplane is in the flight or wheel speed is greater than 60 kts and, flaps are extended and flight control switch A or B hydraulic system is ON; or main rudder PCU Force Fight Monitor (FFM) trips.

32-When the standby hydraulic system is activated automatically the standby electric motor–driven pump starts to operate and the standby rudder shutoff valve opens. Now standby system is available to power the rudder and thrust reversers.

System Leakage

33-Stand-by electric motor-driven pump draws its fluid from the bottom of the standby reservoir. If a leak develops in the standby system, the fluid quantity in the standby reservoir starts to decrease. When the standby reservoir is almost half empty, the LOW QUANTITY light on the flight control panel illuminates. The standby reservoir quantity eventually drops to zero and all standby system pressure is lost. Note that a leak in the standby system does not affect the normal operation of the System “B”; however, fluid level in the system “B” reservoir decreases until it stabilizes at approximately 72% full.

HYDRAULIC SYSTEM CONTROLS AND INDICATIONS REVIEW

34-Hydraulic panel is on the forward overhead panel. On the top of the hydraulic panel are the “Electric Hydraulic Pump Overheat Lights”, one for each system. The related warning light illuminates when an overheat condition is detected in the electric motor-driven pumps. The overheat condition can result from overheating of the pump cooling fluid or overheating of the pump.

hydraulic Pump Low Pressure Lights

35-The next row of lights is the “Hydraulic Pump Low Pressure Lights”. There are four lights which illuminate in amber if the pressure from the indicated pump is low. There is one light for each of the electric motor driven and engine-driven pump on each system. Note: If one of the “Engine Fire Switches” is pulled, it deactivates the low pressure light for that system.

hydraulic Pumps Switches

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36-The bottom row on the hydraulic panel consists of four toggle switches. There are two “Engine-Driven” hydraulic pump switches and two “Electric Motor-Driven” pump switches. In the “ON” position, electric power is supplied to the Electric Motor-Driven pump and in the “OFF” position the electric power is not supplied to the pump. When the Engine-Driven pump switch is in the “ON” position, the switch allows hydraulic pressure to enter the appropriate hydraulic system by de-energizing the blocking valve. In the “OFF” position, the blocking valve is energized and blocks fluid from the system. Note: when the engine is shutdown the Engine-Driven pump switch should remain in the “ON” position to extend the life of the solenoid.

UPPER DISPLAY UNIT

37-Hydraulic indications on the lower display unit show fluid quantity and system pressure. The quantity of the hydraulic is indicated in digital percentage from a range of 0% to 106% of full quantity. This information is also available at the hydraulic reservoir.

38-When the fluid quantity in a reservoir is less than 76% a white “RF” indication appears by the applicable system indicator. Note that this indication is valid only on the ground with both engines shutdown. Additionally, if the aircraft flaps are up during taxi to the parking area, the indication is also valid.

39-The next row shows the hydraulic pressure on each system. Normal pressure is 3000 psi with a maximum pressure of 3500 psi. When both hydraulic pump switches for a system are off the pressure indicators can still show the system pressure but usually less than 100 psi.

flight Control Panel

40-Flight control switches on the flight control panel are guarded to ON position. This is the normal operating position. With the switch in OFF position, related flight control shutoff valve closes removing the hydraulic pressure from the ailerons, rudder and elevators. The STANDBY RUDDER position is used to activate the standby pump and open the standby rudder shutoff valve which will pressurize the standby rudder power control unit.

41-Flight Control LOW PRESSURE lights come on when hydraulic system A or system B pressure to ailerons, elevator and rudder is low. When the FLIGHT CONTROL switch is placed in the “STBY RUD” position the standby rudder shutoff valve opens and deactivates the light.

42-The standby hydraulic low quantity light illuminates to indicate that standby hydraulic reservoir is low on hydraulic fluid. This light is always in the armed position.

43-The standby hydraulic low pressure light illuminates when the standby hydraulic pump output pressure is low. The light is armed only when standby pump operation has been selected manually or automatic standby function is activated.

44-If the amber light is illuminated it indicates the standby hydraulic system is on in order to pressurize the “standby rudder power control unit”.

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45-The standby rudder ON light illuminates when the standby rudder power control unit is pressurised either automatically or manually. The standby rudder ON light is not available on some configurations.

46-The ALTERNATE FLAPS master switch is guarded in the “OFF”” position for normal operating. The “ARM” position will close the trailing edge flap bypass valve, activates the standby pump, and arms the “ALTERNATE FLAPS” position switch.

COURSE END

47-End of the course.

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