Pump and hydraulic fluid engineering essay

Introduction:

This assignment mainly talks about the hydraulic system in an aircraft. The hydraulic system in an aircraft is use for operating various services such as landing gear, wheel brakes and power flight controls etc. Each system has its own hydraulic circuit within the system. These independent circuits are connected to the common pressure and return lines of the hydraulic power circuit. A complete power hydraulic system consists of the following;

A power or delivery circuit,

A number of service circuits,

Emergency circuits.

Below is the diagram of basic hydraulic system;

http://www. ustudy. in/sites/default/files/images/hydraulic-system. gif

Task Two:

Pump:

Pump provides pressurise hydraulic fluid to the system by comprising the fluid which comes from the reservoir. Pump can pressurise the fluid up to 5000 psi. depends on different pumps.

Pressure Reducing Valve:

The Pressure Reducing valve reduces the system output pressure to a pressure suitable for operating a specific system or component.

Pressure Relief Valve:

Whenever there is excessive pressure in the system the pressure relief valve reliefs the extra pressure.

Reservoir:

The function of reservoir in the hydraulic system is to store the hydraulic fluid and delivers the hydraulic fluid to the pump which then gives the pressurise fluid to the system. The reservoir also pressurise the fluid up to 40psi in order to not get cavitation.

Motor:

The function of Motor is to help in engaging the pump and also help in starting the system.

Strainer:

Strainer is a filter. It filters out the dirt before the fluid goes to the pump. There are high and low pressures strainers, normally the high pressure strainer are after the pump and low pressure are before the pump.

Task Three:

B767

HYDRAULICS SYSTEMS

INTRODUCTION:

This airplane has three independent hydraulics systems which are;

Left Hydraulic system

This hydraulics system powers the;

Flight controls

Left side engine Thrust reversal

It consists of;

Reservoir,

Engine Driven pump, and

Electric motor driven pump

Right Hydraulic system

This system is similar to Left hydraulic system and it consists of same;

Reservoir,

Engine driven pump, and

Electric motor driven pump

This system powers the;

Flight controls,

Right side engine Thrust reversal,

Normal brakes, and

Pitch enhancement

Centre hydraulics system

The system consists of;

Reservoir,

Two Electric motor driven pumps,

An Air driven demand pump, and

RAT (Ram Air Turbine) pump

It powers the;

Flight controls,

Nose wheel steering,

Flaps and slats,

Alternate brakes,

Landing gear,

Hydraulic driven generator, and

Tail skid

So basically the hydraulic system of this aircraft powers the;

Flight controls,

Leading edge slats,

Trailing edge flaps,

Landing gear,

Wheel brakes,

Nose wheel steering,

Autopilot servos,

Thrust reversals, and

Tail skid

Flight control system components are distributed so that any hydraulic system can provide adequate airplane controllability. All hydraulic reservoirs supplies fluid to pumps and these pumps pressurized the system and the reservoirs are pressurized by bleed air system.

Below figure shows three independent system what they consist of and to what they power. It also display there switches in the cockpit.

HYDRAULIC SYSTEM SCHEMATICS

FLUID SUPPLY

Hydraulic fluid is supplied to each pump from a reservoir. Reservoirs are pressurized from bleed air system.

There is fluid quantity measured device in all the reservoirs which provides information on EICAS status display. When RF illuminates on the EICAS status page then the reservoirs requires refilling prior to dispatch. Valid only when airplane is on ground with both engines shutdown or after landing with flaps up during taxi-in. As shown in figure below;

The QTY (1) light illuminates and the EICAS advisory message e. g. L HYD QTY displays which means that left side reservoir fluid quantity is low. SYS PRESS (2) illuminates when the system pressure is less.

ENGINE DRIVEN PUMP:

The primary hydraulic system pump is engine driven pump. As there are two engines on this aircraft it has two engines driven pump left and right. It runs with the engine and pressurized the system.

When the pump output pressure is low the primary pump PRESS light illuminates on the hydraulic overhead panel and a warning display on the EICAS e. g. (if it is right side) R HYD PRIM PUMP. When the pump temperature is high OVHT light illuminates on the hydraulic overhead panel and again a warning display on the EICAS e. g. (if it’s left side) L PRIM HYD OVHT

ELECTRIC MOTOR DRIVEN PRIMARY PUMP:

The two centre electric motor driven primary pumps are identical to the left and right systems electric motor driven pumps. The C2 pump may be load shed automatically to reduce electrical loads. As you can see the figure above it has also the same PRESS low pressure and over heat OVHT warnings on hydraulic overhead panel. The associated EICAS messages for low output pressure C HYD PRIM 1 or C HYD PRIM 2 and for over heat C HYD 1 OVHT or C HYD 2 OVHT.

ELECTRIC MOTOR DRIVEN DEMAND PUMP:

An electric motor driven demand pump provides an additional hydraulic power either on demand or continuously for periods of high system demand.

The demand pump also provides a backup hydraulic power source for the engine driven primary pumps.

To reduce electrical load, the electric demand pump is inhibited on the ground during engine start of either engine, when only one electrical generator is operating. The demand pump PRESS and SYS PRESS lights illuminates when starting engines on the ground. As shown in the figure below the overhead hydraulic panel with warnings. The warnings will also display on the EICAS e. g. R HYD DEM PUMP.

AIR DRIVEN DEMAND PUMP:

An air driven demand pump also provides additional hydraulic power either on demand or continuously for periods of high system demand. This pump provides the backup hydraulic power for electric motor driven primary pumps. As shown in picture above it shows the warnings on the hydraulic panel PRESS when it’s low pressure and OVHT when the pump come over heat. The warning can also be seen in EICAS.

RAT (RAM AIR TURBINE) PUMP:

This pump is used in emergency conditions it provides hydraulic power to the flight control portion of the centre hydraulic system. The RAT provides adequate hydraulic power at the speed above 130 knots. In flight, the RAT deploys automatically when both engine fails. The RAT is inhibited from auto deployment on the ground.

The RAT can be deployed manually by pushing the RAT switch. The UNLKD light illuminates and the EICAS advisory message RAT UNLOCKED displays when the RAT is not stowed and locked. Once the RAT is producing the

pressure the PRESS lights illuminates. The SYS PRESS light illuminated if RAT is only the source of centre system pressure. Once the RAT is deployed then it cannot be stowed in flight.

SYSTEM PRESSURE INDICATIONS:

The SYS PRESS lights illuminates and the EICAS caution message e. g. (for left hydraulic system) L HYD SYS PRESS when the left side hydraulic system pressure is low same for the right side and centre system.

HYDRAULIC DRIVEN GENERATOR:

Hydraulic driven generator is automatically powered by the centre system when electrical power is lost from both main AC buses. The centre air demand pump then operates continuously to ensure sufficient hydraulic pressure to drive the generator.

HYDRAULIC PANEL:

System Pressure (SYS PRESS) Lights:

Illuminated (amber) – system pressure is low.

Reservoir Low Quantity (QTY) Lights:

Illuminated (amber) – reservoir quantity is low.

Left/Right Engine (L/R ENG) Primary Pump Switches:

ON – the engine driven hydraulic pump pressurized when engine rotates.

OFF (ON not visible) – the engine driven hydraulic pump is turned off and depressurized.

Pump Pressure Lights (PRESS) :

Illuminated amber – Pump output pressure is low.

Pump Overheat (OVHT) Lights:

Illuminated amber – pump temperature is high.

Centre 1/2 Electric (C1/2 ELEC) Primary Pump Switches:

ON – the electric motor driven pump pressurized the centre hydraulic system.

OFF – the electric motor driven pump is turned off and is not pressurizing the system.

Left/Right Electric and Centre Air (L/R ELEC and C AIR) Demand Pump Selectors:

ON – continuous operation

AUTO

Left/Right electric pumps operate when engine pump pressure is low.

Centre air demand pump operates when both centre electric pump pressure is low.

Centre AIR demand pump operates when heavy load items are selected.

OFF – Pumps are turned off

LANDING GEAR:

Introduction:

The airplane has two main landing gear and single nose gear. The nose gear is a steerable with two wheel unit. Each main gear has four wheels in tandem pairs.

Hydraulic power for retraction, extension, and steering is supplied by the centre hydraulic system. An alternative extension system is also provided.

Below is the schematic of the landing gear system;

Air Ground Sensing System:

The air ground sensing system receives air ground logic signals from tilt sensors located on each main landing gear. These signals are used to configure the airplane system to the appropriate air or ground status.

A nose air ground system receives signals from nose gear strut compression sensors. These signals are for controlling stall warning and portions of the caution and warning system.

LANDING GEAR UNDER NORMAL OPERATION:

The landing gears are normally controlled by the landing gear lever.

On the ground, the lever is held in DN position by an automatic lever lock controlled by the main gear tilt sensor.

The lever lock can manually overridden by pushing and holding the landing gear lever LOCK OVRD switch. In flight, the lever lock is automatically released through the air ground sensing of main gear tilt sensor.

Landing Gear Retraction:

When the landing gear lever is positioned to UP, the tilted landing gear begins to retract. The landing gear doors open and the gear retract to up position. Automatic wheel braking occurs during gear retraction. The landing gear lever is placed in the OFF position to depressurize the landing gear system.

Landing Gear Extension:

When the landing gear level is moved to DN, the landing gear door opens, the gear are unlocked, and the GEAR and DOORS light illuminates.

The gears are hydraulically powered to the down and lock position. The down locks are powered to the lock position, all hydraulically actuated gear door close, and the main gear trucks hydraulically tilt to the flight position.

When all gears are down and locked, the gear down light illuminates and the GEAR and DOOR light extinguish.

Landing Gear Alternative Extension:

The alternative landing gear extension system uses an electric motor to trip the locking mechanism for each gear. Selecting DN on the ALTN GEAR EXTEND switch releases all the door and gear up locks, the landing gear then free fall to the down and locked position.

TASK FOUR:

HEALTH & SAFETY REGULATION:

Introduction:

The Workplace (Health, Safety and Welfare) Regulations 1992 cover a wide range of basic health, safety and welfare issues and apply to most workplaces (with the exception of those workplaces involving construction work on construction sites, those in or on a ship, or those below ground at a mine). They are amended by the Quarries Regulations 1999, the Health and Safety (Miscellaneous Amendments) Regulations 2002, the Work at Height Regulations 2005, and the Construction (Design and Management) Regulations 2007.

These Regulations aim to ensure that workplaces meet the health, safety and welfare needs of all members of a workforce, including people with disabilities. Several of the Regulations require things to be suitable.

Followings are the Health and safety regulations which should be followed in the working place;

HEALTH:

Ventilation

Workplaces need to be adequately ventilated. Fresh, clean air should be drawn from a source outside the workplace, uncontaminated by discharges from flues, chimneys or other process outlets, and be circulated through the workrooms. Ventilation should also remove and dilute warm, humid air and provide air movement which gives a sense of freshness without causing a draught. If the workplace contains process or heating equipment or other

sources of dust, fumes or vapours, more fresh air will be needed to provide adequate ventilation. Windows or other openings may provide sufficient ventilation but, where necessary, mechanical ventilation systems should be provided and regularly maintained.

Temperatures in indoor workplaces

Environmental factors (such as humidity and sources of heat in the workplace) combine with personal factors (such as the clothing a worker is wearing and how physically demanding their work is) to influence what is called someone's ' thermal comfort'. Individual personal preference makes it difficult to specify a thermal environment which satisfies everyone. For workplaces where the activity is mainly sedentary, for example offices, the temperature should normally be at least 16 °C. If work involves physical effort it should be at least 13 °C (unless other laws require lower temperatures).

Work in hot or cold environment

This includes risk to workers' health from working in either a hot or cold environment needs to consider both personal and environmental factors. Personal factors include body activity, the amount and type of clothing, and duration of exposure. Environmental factors include ambient temperature and radiant heat; and if the work is outside, sunlight, wind velocity and the presence of rain or snow.

Lighting:

Lighting should be sufficient to enable people to work and move about safely. Lighting and light fittings should not create any hazard. Automatic

emergency lighting, powered by an independent source, should be provided where sudden loss of light would create a risk.

Cleanliness and waste material

Every workplace and the furniture, furnishings and fittings should be kept clean and it should be possible to keep the surfaces of floors, walls and ceilings clean. Cleaning and the removal of waste should be carried out as necessary by an effective method. Waste should be stored in suitable receptacles.

Room dimensions and space:

Workrooms should have enough free space to allow people to move about with ease.

Workstations and seating:

Workstations should be suitable for the people using them and for the work they do. People should be able to leave workstations swiftly in an emergency. If work can or must be done sitting, seats which are suitable for the people using them and for the work they do should be provided. Seating should give adequate support for the lower back, and footrests should be provided for workers who cannot place their feet flat on the floor.

SAFETY:

Maintenance:

The workplace, and certain equipment, devices and systems should be maintained in efficient working order (efficient for health, safety and welfare). Such maintenance is required for mechanical ventilation systems; equipment and devices which would cause a risk to health, safety or welfare

if a fault occurred; and equipment and devices intended to prevent or reduce hazard.

The condition of the buildings needs to be monitored to ensure that they have appropriate stability and solidity for their use. This includes risks from the normal running of the work process (e. g. vibration, floor loadings) and foreseeable risks (e. g. fire in a cylinder store).

Floor:

The surfaces should not have holes or be uneven or slippery, and should be kept free of obstructions and from any article or substance which may cause a person to slip, trip or fall. Criteria for defects such as subsidence, unevenness, pot holes, collection of surface water, cracks and ruts should be determined and set, and maintenance systems developed to undertake repair when these limits are exceeded.

Windows:

Open able windows, skylights and ventilators should be capable of being opened, closed or adjusted Safely and, when open, should not pose any undue risk to anyone.

FATIGUE TESTING MACHINE:

Fatigue testing machine test and determines the useful working life of a component which is subjected to repeated load. Fatigue testing machine applies pre-defined loads or alternating loads to the sample component and records fatigue life indicated by the number of cycles required to product failure.

Health & Safety Issue:

Followings are the health and safety issues with fatigue testing machine;

As Fatigue-testing machines produce heavy vibration so it requires a strong foundation.

Safety guidelines provided by the metal fatigue-testing equipment manufacturers should be followed before starting a fatigue test.

Proper controls and accessories should be installed for fatigue-testing machine to prevent accidents.

Task Five:

Maintenance Procedure for Landing Gear:

Landing Gear is the most rugged part of an aircraft and should be maintain properly in order not have accidents.

In order to increase the life span and minimising the accidents regularly inception should be made for inspecting the landing gear because of the force hitting the runway upon landing stresses the entire system no matter how gentle the landing is.

Following is the procedure to maintain the landing gear;

Place the aircraft on jacks in the approved manner as detailed in the manufacturers maintenance manual.

Interconnect a manual pump (complete with a one gallon reservoir and a 3000 p. s. i. pressure gauge) into the system at the service tee fitting. This fitting is located downstream of the pump check valve.

Deactivate the pump and motor by disconnecting the plug on the pressure switch.

Disconnect the pressure relief valve and the thermal relief valve from the system and cap off the lines.

Disconnect the accumulator from the system and cap off the line.

Pressurise the system to 3000 p. s. i.

When the pressure reaches 3000 p. s. i., the system must remain within 50 p. s. i. of this pressure for one minute without additional pumping.

Reconnect the THERMAL relief valve and pressurise the system until the valve opens. The cracking pressure of the valve should be 2200 + or – 50 p. s. i.*

With the gear doors disconnected, select ‘ gear up’ and retract using the hand pump. Take the gear up slowly and check the flex lines for clearance and signs of chafing.

When the gear reaches the up position, increase the pressure to 3000 p. s. i. The system must again remain within 50 p. s. i. of this pressure for one minute.

Pull the 5 amp L/G control breaker, reconnect the pressure switch plug and reset the 5 amp breaker. Extend the gear with the normal system.

Reconnect the pressure relief valve and pressurise the system until the valve opens. The cracking pressure for this valve is the same as the thermal relief valve, 2200 + or – 50 p. s. i.*

Disconnect manual pump from service tee and cap tee.

Check emergency nitrogen bottle is charged to 1500 p. s. i.

With gear in down position and system pressurised, open manual nitrogen valve in the cockpit and check for leaks between the valve and the actuators. Maximum leakage rate, 50 p. s. i. in ten minutes.

Close the manual nitrogen valve and bleed off the pressure in the emergency system by loosening the line at the bleed valve in the nose wheel well. Prior to re-connecting the line, check that the bleed valve is open. Blow air gently into the bleed valve fitting and check the top of the valve for a flow of air.

Charge the accumulator to 1250 p. s. i. Re-connect to the system.

Recharge the emergency nitrogen bottle to 1500 p. s. i.

http://www. business. com/images/divider. gif

Tasks

Yes

No

Jack is placed on right position

Aircraft is put on jack according to maintenance manual

Connect manual pump into the system at service tee fitting. Fill it to one gallon reservoir with 3000 psi.

Pump De-activated

Pressure relief valve and thermal valve dis-connected

Accumulator dis-connected

Pressurise till 3000 psi

System remain at 50 psi for a minute

Thermal relief valve re-connected and system pressurise until the valve opens

Gear doors dis-connected

Gear up selected

Retract using the hand pump and check the flex lines for clearance and signs of chafing.

On the gear reaches the up position, increase the pressure to 3000 p. s. i. The system must again remain within 50 p. s. i. of this pressure for one minute.

System remained within 50 p. s. i. for one minute.

5 amp L/G control breaker pulled.

Pressure switch plug reconnected and reset the 5 amp breaker reset

Gear extended with the normal system.

Pressure relief valve reconnected and pressurise the system until the valve opens

Manual Pump dis-connected

Emergence Bottle check

Leakage check between the valve & actuator

Emergency system check

Emergency Bottler recharge to 1500 psi.