



Problem Analysis of Hydraulic Accumulators on Airbus A320 Aircraft

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ABSTRACT

This study investigated the hydraulic system on Airbus A320 aircraft, focusing on the problems that often occur with hydraulic accumulators as well as the maintenance steps required. The Airbus A320 hydraulic system consists of three main systems, namely the Green, Yellow, and Blue hydraulic systems, which play an important role in the operation of vital systems in the aircraft. Periodic checks of nitrogen pressure in hydraulic power accumulators, in accordance with AMM guidelines, are key in preventing hydraulic system problems. Common hydraulic accumulator problems, such as hydraulic leaks, pressure drops, and internal leaks, are often caused by insufficient prefill pressure or too high a fill pressure. Necessary maintenance measures include pressure checks in accordance with AMM standards and pressure adjustments if required. By understanding common hydraulic accumulator problems and their maintenance, aircraft technicians can maintain hydraulic system performance in optimal conditions, ensuring the safety and optimal performance of the aircraft during operation.

Keywords: *Airbus A320, AMM (Aircraft Maintenance Manual), dan Hydraulic Accumulator*

1. INTRODUCTION

Airbus A320 has three main hydraulic systems, namely Green, Yellow, and Blue hydraulic systems. These three systems are responsible for operating various critical systems in the aircraft, such as wheel braking, operation of the wing grille system, and aircraft steering. (1)

The Green hydraulic system on the Airbus A320 is one of the three main hydraulic systems. This system is responsible for driving several important systems in the aircraft, such as the flight control system, landing gear, brakes, reverser engine 1(2).

The Yellow hydraulic system on the Airbus A320 is the second main hydraulic system. This system has a function, to drive the flight control system,

brakes, parking brakes, nose wheel steer, reverser engine 2.

The Blue hydraulic system on the Airbus A320 is the third main hydraulic system. This system is also responsible for driving the flight control system, constant speed, motor/generator.

These three hydraulic systems work separately, but are interconnected through pipes and valves. This allows these three hydraulic systems to replace each other if one system fails. For example, if Green's hydraulic system fails, Yellow and Blue's hydraulic system can take over and provide the hydraulic power needed to run critical systems on board. This ensures that the aircraft remains able to operate safely and effectively in emergency situations (3)

Hydraulics has several important components, which are as follows:

- A. The reservoir serves as a storage area and ensures adequate supply of hydraulic fluid into the hydraulic system. The reservoir can also accommodate volume changes such as thermal expansion (increased fluid volume caused by temperature changes), from piston and rod motion (elongation and shrinkage of cylinder rods), and refilling of fluid lost through leakage
- B. The filter is as a filter to clean hydraulic fluid from dirt, dust, prevent foreign particles. A clean and well-functioning hydraulic filter can prevent damage to other hydraulic components.
- C. Hydraulic Pump or hydraulic pump serves to move hydraulic fluid from the hydraulic tank into the aircraft hydraulic system(2). There are three types of hydraulic pumps used on the Airbus A320, namely:
 1. Engine Driven Pump (EDP) or Hydraulic Pump driven by an engine, this type of hydraulic pump is driven by an aircraft engine when the aircraft is operating.
 2. Electric Motor Driven Pump (EMDP) atau Pompa Hidrolik Yang Digerakkan Oleh Motor Listrik Pompa hidrolik jenis ini digerakkan oleh motor listrik. Pompa hidrolik jenis ini biasanya digunakan pada saat pesawat terbang sedang melakukan aktivitas yang membutuhkan tekanan hidrolik yang rendah.
 3. Hand Pump, this type of hydraulic is used when the aircraft is on the ground and the power source or air pressure is not available. This type of hydraulic pump is usually used as a backup when the main hydraulic system is damaged or malfunctions.
- D. Ramp Air Turbine (RAT) serves to provide backup hydraulic pressure in the event of a major hydraulic system failure How RAT works. The way the RAT works on the Airbus A320 is as follows: when the main hydraulic system fails, the RAT will be activated automatically and start rotating using power from air currents passing through the aircraft. Then, the RAT will drive the backup hydraulic pump connected to the hydraulic system, thus providing the required backup hydraulic pressure
- E. The Power Transfer Unit (PTU) on the Airbus A320 hydraulic system is an important component that functions to transfer

hydraulic pressure from one hydraulic system to another

- F. Valve or valve is as controlling and direction of fluid flow in hydraulic system
- G. Accumulators serve as a pressure immersion in the hydraulic system to keep it stable, aiding or adding to the power of the pump when multiple units are operating at once by supplying extra power from accumulating, or storing, power Hydraulic accumulators on aircraft are often tubes filled with high-pressure gases, such as nitrogen, which are used to store hydraulic energy(4).

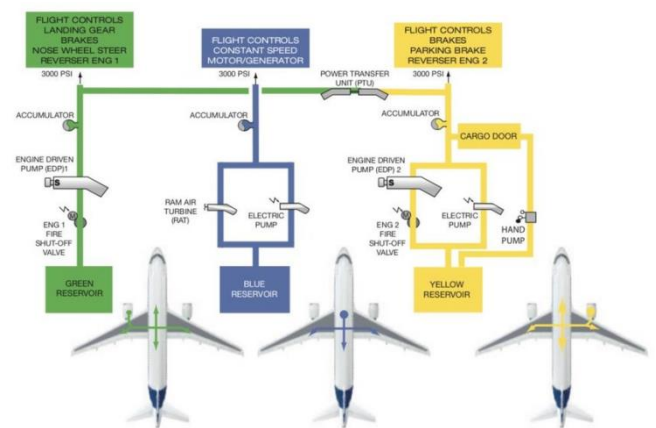


Figure 1. Airbus A3202 Hydraulic System

The Airbus A320 green, yellow and blue hydraulic system has a pressure of 3000 psi. Hydraulic fluid (fluid cannot be transferred from one system to another). Each system has a pressurized hydraulic reservoir that is useful for preventing cavitation in the pump Hydraulic green and yellow systems get pressure from the engine driven pump (EDP1 on green) and (EDP 2 on yellow). PTU (power transfer unit) can make the green system get pressure from the yellow system and vice versa where by transferring hydraulic power but not transferring hydraulic fluid (5)

Fire shout off valve is between the engine driven pump and the reservoir Which works to isolate the system if there is an engine fire Hydarauic blue system gets pressure from the blue electric pump where the blue electric pump is the main pump or the main pump of the blue system, the main pump will work if one of the engine is turned on (the first engine start). In an emergency blue system gets a pressure Ramp Air Turbine (RAT), RAT can move automatically or manually, RAT can provide pressure of 2500 psi. The hydraulic system can provide to every user (6)

2. METHODOLOGY

In the hydraulic system of the Boeing 777 aircraft there is maintenance to prevent problems with the hydraulic system, namely checking the Nitrogen Charge Pressure on Hydraulic Power Accumulators based on AMM(7). The following are the stages of the process, namely:

2.1. Preparatory Steps (Job Set-up)

A. Aircraft Maintenance Configuration

- 1) pastikan bahwa hidrolik sistem tanpa bertekanan dan tempatkan pada di konfigurasi maintenance
- 2) tempatkan WARNING NOTICE(S) di pada posisi untuk memberi tahu orang agar tidak memberi tekanan pada sistem hidrolik green, blue dan yellow

B. Open safety and tag the circuit braker(s)

C. Open access

- 1) Open Access on 195BB and 196BB panels
- 2) Open one door from the main landing gear

Note: Can open the left or right door of the Main Landing Gear, but better access from the left

2.2 Employment Procedures

A. Perform Nitrogen Filling Pressure Check of green, blue and yellow system accumulators

Tabel 1 Tekanan Nitrogen Accumulator

Deg. C	Deg. F	“P” bar	“P” psi
-20	-4	108	1570
-10	14	112	1620
0	32	118	1710
10	50	124	1800
20	68	130	1890
30	86	136	1970
40	104	142	2060
50	122	147	2130
60	140	153	2220

Then wait an hour to make the measurement more accurate due to the temperature compensation of the Accumulator

- 1) If the accumulator pressure is within the given limit, between "P" and "P" minus 15 bar (217.5566 psi), no more steps are needed
- 2) If the accumulator pressure is more than the correct pressure "P". Adjust accumulator pressure as necessary Ref. AMM TASK 12-14-29-614-001
- 3) If the accumulator pressure is "P" minus more than 15 bar (217.5566 psi), adjust the accumulator pressure to the correct nominal value "P" Ref. AMM TASK 12-14-29-614-001(4)

Filling the accumulator pressure with nitrogen

- B. Check the accumulator indicator (pressure gages) before filling nitrogen
- C. If the pressure shows less than the predetermined limit, it is indicated by filling the pressure, namely:
 - 1) Remove the blanking cap from the charging valve
 - 2) Connecting the nitrogen fill unit, with a max pressure of 2248.08 for pressure can enter through the charging valve
 - 3) Loosen the charging valve nut, open the control valve slowly and fill the hydraulic power with nitrogen
 - 4) Wait 1 minute to confirm that the incoming pressure has stabilized
 - 5) When the pressure has stabilized in accordance with the limit, tighten the charging valve nut (charging valve torque not 50 - 60 lbf.in)
 - 6) Ensure that the pressure seen in the pressure gages is appropriate
 - 7) If the pressure filled is appropriate, stop the supply and remove the filling system from the charging valve, then install the blanking cap on the charging valve (blanking cap torque between 5 -10 lbf.in)
 - 8) Wait up to 20 minutes to confirm whether the accumulator pressure has decreased or not then check the accumulator pressure
- D. If the accumulator pressure is already right with "P", or approximately 7 bar (101.5264 psi): - there is no next step.
- E. If accumulator pressure "p" is greater than 7 bar (101.5264 psi): - Reduce accumulator pressure to the correct "P" value
- F. If the accumulator pressure is "P" minus more than 7 bar (101.5264 psi), perform the:
 - 1) Perform a leak check with an oxygen leak detector. Medium Leak Detection Testing-Oxygen System (Material Ref. 14CCB6) on accumulator gas manifold.

- 2) If it is possible to stop the leak, apply pressure to the accumulator
- 3) If the leak cannot be stopped, replace the accumulator, gauge, charging valve, or manifold as necessary
- 4) If there are no external leaks, replace the accumulator and perform the applicable bleeding procedure.

2.3 Final steps

A. Close Access

1. Make sure the work area is clean and clean of tools and other items
2. Close the 195BB and 196BB access panels
3. Close the applicable MLG main door
4. Remove the WARNING NOTICE(S).

B. Remove SAFETY CLIP - CIRCUIT BREAKER and the tag(s), and close circuit breakers

3. RESULTS AND DISCUSSION

3.1. Problems that Often Occur in Hydraulic Accumulators

The hydraulic accumulator system has several problems, including leaks, damage to the inside, or reduction in hydraulic pressure along with data on damage to the accumulator

Table 2. Hydraulic Problems in AirBus

SN	EX-REG	Reason of removal	Shop report
8825	GPO	Hydraulic Leak From Charging Valve	Fault confirmed, accumulator failed bladder function test and internal leakage is out of tolerance
8831	GPO	Hydraulic Leak From Charging Valve	Fault confirmed, leak from outlet assembly, two piece rubber

			ring torn during disassembly, found bladder swelled and damage.
7238	GPK	Alternate Brake Accumulator (B) Drop From 1500 Psi To 1100 Psi In 12 Hours Fin No 5426	Fault confirmed, found bladder damage, accumulator unable to hold pressure when performing cycling test during charging and discharging
4680	GPA	Accumulator brake leak.	Fault confirmed, accumulator fail bladder functional test, bladder damage
329	GPF	Accumulator Leak	Fault confirmed, accumulator fail bladder functional test, bladder swelled and damage

1084	GPA	Post. A internal leak, after charging brake accumulator post fin 5426 GG and 5427 GG found leak	Fault confirmed, accumulator fail bladder functional test, bladder damage found bladder swelled and damage.
9117	GPQ	Brake Accumulator Post O/B Side Leak	Fault Confirmed
1864	GPA	Diaphragm Bust	Bladder torn and outlet assembly damage

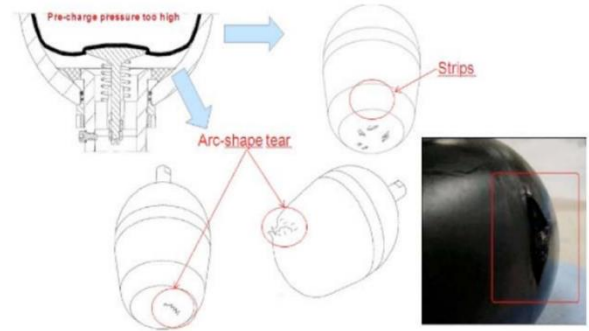


Figure 3. Too high pre-charge pressure

Other damage to the Accumulator caused by pre-filling pressure that is too high can cause the bladder to rub against the internal valve and make tears in the bladder. so that it can cause damage as in figure 2, namely Arc-shape tear and Strips

Based on the above data, the main cause of this case is too high or insufficient pre-fill nitrogen pressure on the brake accumulator. As we can see, the accumulator pressure will be checked based on CAMP 3240010100 every 1A check. If the pressure is not within an acceptable pressure range, service based on the AMM TASK 12 14-32-614-807 task will be performed. The nominal pressure for the associated ambient temperature is shown in the figure below:

3.2 Causes of problems / damage to

Here are some problems or damage that occur in accumulators as follows.:

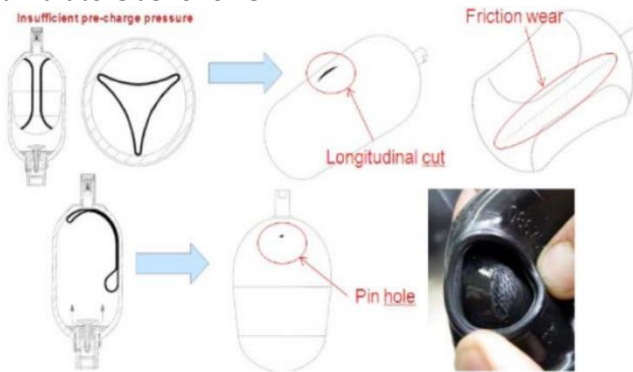


Figure 2 Insufficient Pre-Charge Pressure

Damage to the accumulator caused by insufficient pre-filling pressure can cause the bladder to fold back by itself resulting in wear on the accumulator tube, so that it can cause damage as in figure 2, namely longitudinal cut, friction wear, pin hole

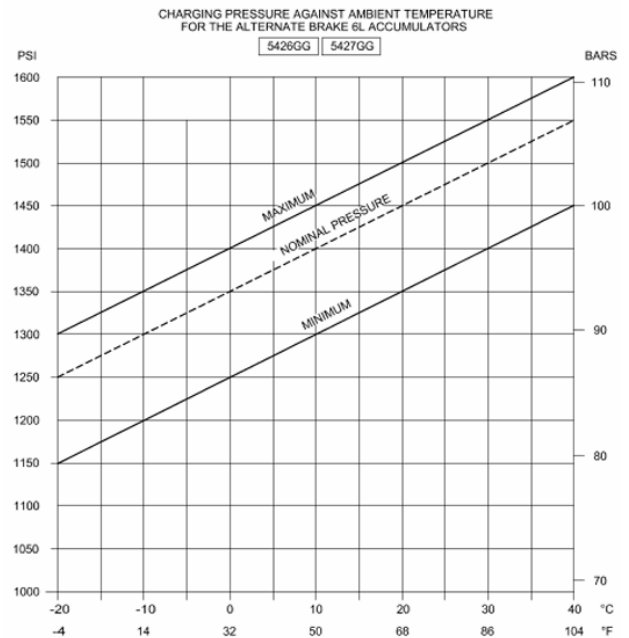


Figure 4. Brake Accumulator Charging Pressure

4. CONCLUSION

Based on the results of the tests that have been carried out, several conclusions can be drawn as follows:

1. Problems that occur in hydraulic accumulators include hydraulic leaks originating from the charging valve, pressure

reduction or reduction, brake accumulator leaks, leaks in accumulators, and internal leaks. 6.

2. The cause of problems that can occur in hydraulic accumulators is generally caused by two, namely inadequate pre-filling so that the bladder folds itself which results in wear on the accumulator tube and is caused by too high a filling pressure so that the bladder rubs against the internal valve and makes a tear in the bladder.
3. The way to maintain the accumulator is to check the pressure on the hydraulic accumulator by following the AMM reference which at that time the hangar temperature was around 29 C ° then the pressure was at 136 bar or 1970 psi with a tolerance of less than 15 bar or 217.5566 psi. if the pressure minus more than 15 bar then it is necessary to adjust the pressure by filling according to AMM standards

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