



Don't Forget to Check the Alternate

Pre-flight checks are essential to detect any hidden failure before the flight.

Standard Operating Procedures (SOPs) for A300, A310, A330, A340-200, A340-300, and certain A320 family aircraft require the flight crew to test the alternate braking system before the first flight of the day, or after a change of flight crew.

This article explains why failing to perform the pre-flight check may prevent the detection of a hidden failure of the alternate braking system. It also includes maintenance recommendations for troubleshooting when the flight crew reports the failure of an alternate braking test.

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CASE STUDY

Event Description

After a transit of 3 hours and 42 minutes, the flight crew of an A330-300 was ready for an early afternoon, 5-hour return flight to their origin airport.

Loss of the green hydraulic system

The takeoff was normal. Five minutes later, while climbing through 10 800 feet, the **HYD G SYS LO PR** and **HYD G RSVR LO LVL** ECAM alerts triggered followed by the **BRAKES NORM BRK FAULT** and **BRAKES AUTO BRK FAULT** ECAM alerts.

The flight crew performed the ECAM procedures and evaluated the situation with the assistance of an onboard maintenance engineer. They contacted the Maintenance Control Center of the airline, and agreed to continue the flight to the destination airport that had a long runway.

The flight crew checked all related FCOM procedures during cruise, and prepared their approach accordingly: Landing gear gravity extension was necessary, autobrake was not available, and the alternate braking system was to replace the normal braking system.

Loss of braking at landing

The aircraft landed in CONF FULL. At touchdown, the PF selected MAX REV and applied full brake pedals. Because no deceleration was felt, the PF applied the **LOSS OF BRAKING** memory items, that requests the PM to set the A/SKID switch to OFF. The PF then reapplied pedal braking, which was not successful. In the end, the PF applied the parking brake 3 times, and the aircraft finally stopped.

Main landing gear wheels burst

All tires of the main landing gear burst **(fig.1)**. Damage occurred to the main landing gear, the main landing gear doors, the forward water drain mast and the left engine.



(fig.1) All wheels of the main landing gear burst during the event (images from the investigation board)

Event Analysis

Takeoff with a hidden alternate braking failure

Recorder data analysis indicated that when the flight crew performed the pre-flight check of the alternate braking system, the pressure only reached a maximum of 416 psi instead of the expected value between 2200 and 2700 psi. Despite this low pressure value, the flight crew proceeded with the flight without seeking maintenance intervention, allowing the aircraft to take off with an inoperative alternate braking system.

In-flight loss of the normal braking system

The loss of the normal braking system during flight was caused by the failure of the green hydraulic system. An overpressure inside the pitch trimmer actuator of the right main landing gear bogie resulted in the crushing of its piston rod, which caused an hydraulic leak (**fig.2**).

This type of damage on the pitch trimmer actuator can result from shocks caused by a damaged runway at the departure airport.

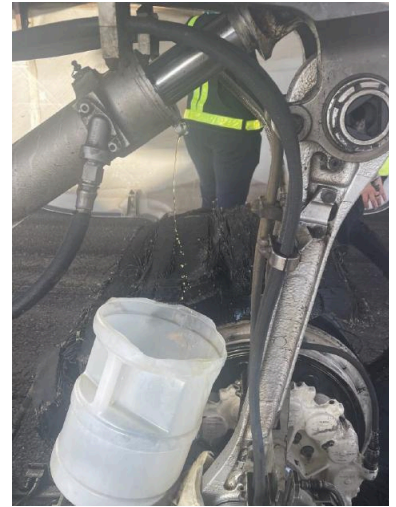


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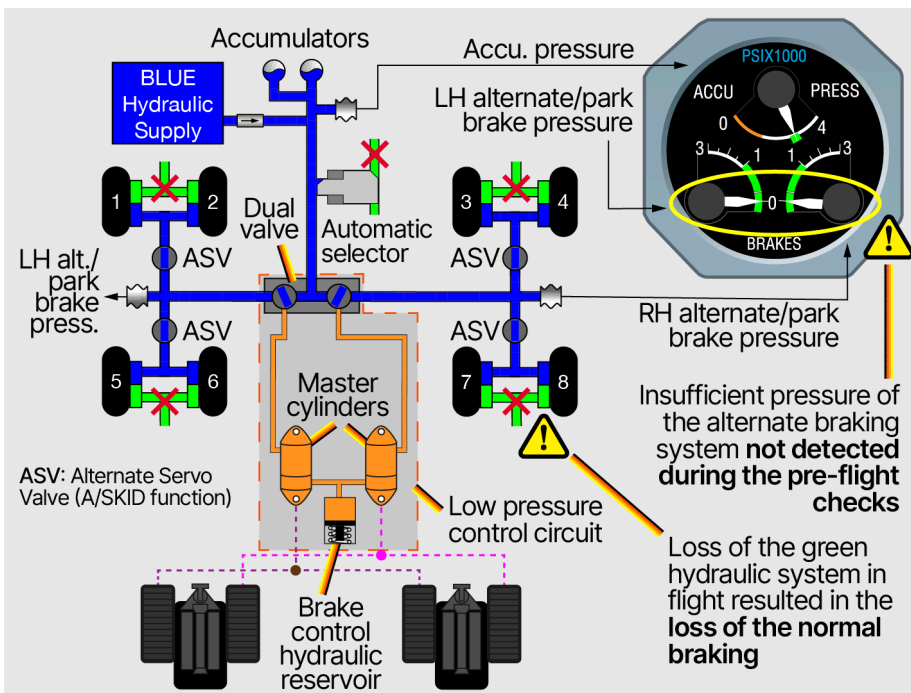
An enhancement of the pitch trimmer actuator is available to prevent this type of damage. Refer to the Technical Follow-Up **TFU 32.11.00.018** available on the AirbusWorld portal for more information.

Loss of braking at landing

The combination of the undetected alternate braking system malfunction during the pre-flight checks, with the in-flight failure of the normal braking system, caused the loss of braking during the landing roll. Consequently, the flight crew could only rely on the parking brake to stop the aircraft during the landing roll.



(fig.2) Visible hydraulic leak on the actuator of the pitch trimmer of the RH main landing gear (photo from the investigation board)



(fig.3) An undetected insufficient pressure of the alternate braking system during the pre-flight checks, combined with a loss of normal braking caused by a leak on the green hydraulic system during flight, are at the origin of the event.

Previous repetitive problems with the alternate braking system with inappropriate corrective actions

Analysis of the aircraft maintenance records indicates that several malfunctions of the alternate braking system were reported during the four months before the event (**fig.4**). Three separate flight crew reports of a low brake pressure indication on the right side during the check of the alternate braking system were recorded, including one with a "spongy" right brake pedal.

Each time either the high-pressure circuit of the alternate braking system at the wheel brakes was bled, or the nitrogen charge pressure of the brake accumulators was adjusted. This did not address the issue.

Application of the appropriate TSM task in the case of reported low alternate brake pressure (TSM 32-43-00-810-807-A "Brakes - Alternate-Braking Pressures Do Not Get to 2200 psi When Brake Pedals Applied (with Blue Hydraulic System Depressurized)") would have helped the maintenance personnel to identify and fix the issue.

Replacement of the right master cylinder

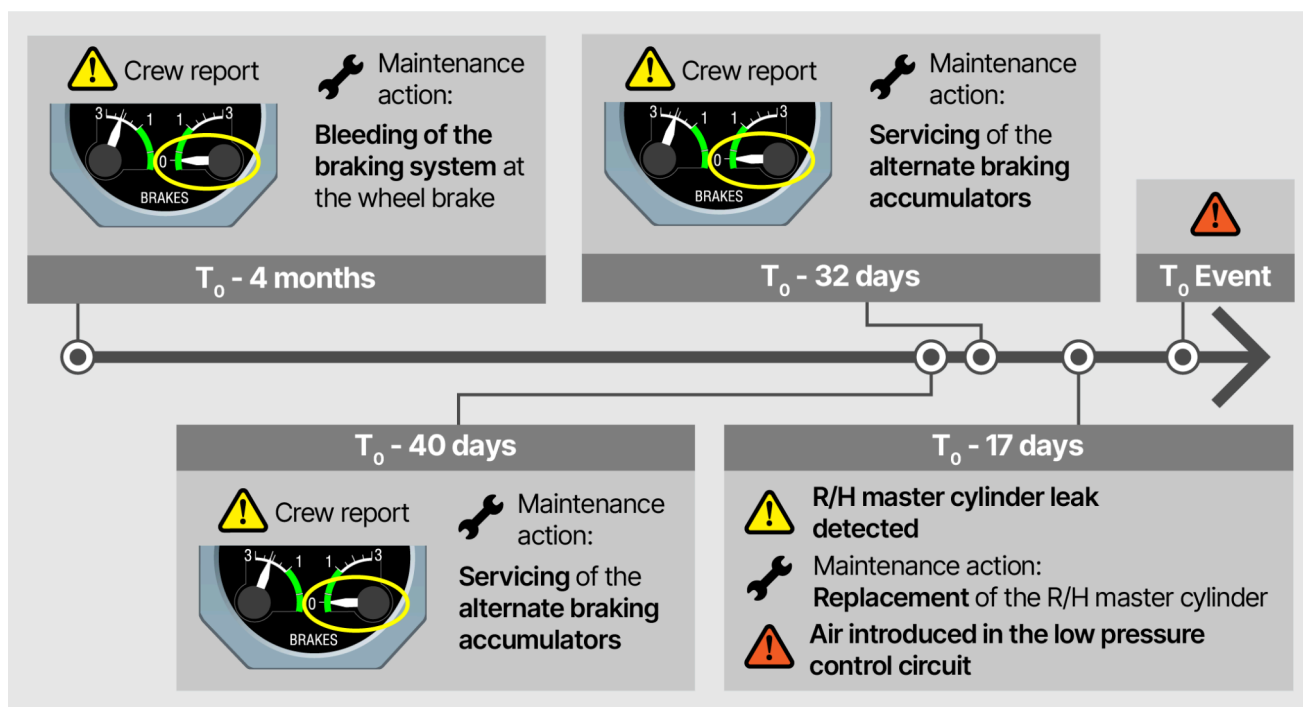
17 days before the event, maintenance personnel found a leak on the right master cylinder, which was probably the root cause of the previous low alternate braking pressure events on the right side. The cylinder was replaced by a new one.

Air introduced in the low pressure control circuit

Investigation revealed the presence of air in the low pressure control circuit of the alternate braking system that caused the insufficient pressure on both sides of the alternate braking system during the event.

An incorrect servicing of the low pressure control circuit after the installation of the new master cylinder is most probably the cause of the introduction of air in the system. ■

(fig.4) Sequence of maintenance actions performed before the event



ALTERNATE BRAKING SYSTEM

There are two types of control for the alternate braking system of Airbus aircraft.

Hydromechanical control

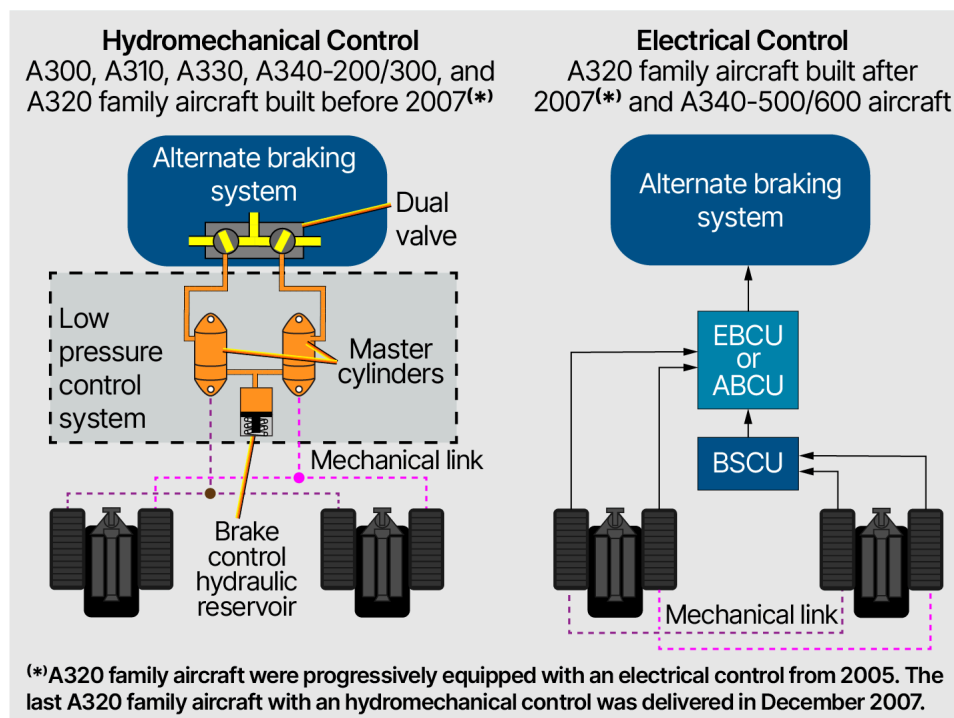
A300, A310, A330, A340-200, A340-300, and A320 family aircraft delivered before 2007 are equipped with a hydromechanical system for alternate braking control.

The brake pedals are mechanically connected to two master cylinders, converting the pedal displacement into a hydraulic pressure that activates the dual valve (**fig.5**). The dual valve regulates the quantity of hydraulic pressure coming from the blue (A330, A340-200/300 aircraft) or the yellow hydraulic system (A300, A310 and A320 family aircraft) to activate the brake pistons.

Electrical control

An electrical control of the alternate braking system was first introduced on the A340-500/600 aircraft, and Airbus decided to also progressively equip A320 family aircraft with this enhanced technology from 2005 (the last A320 family aircraft equipped with an hydromechanical control was delivered in December 2007).

The position of the brake pedals is sent to the Braking & Steering Control Unit (BSCU) and Emergency (or Alternate) Braking Control unit (EBCU or ABCU).



(fig.5) Types of control for the alternate braking system on A300, A310, A320 family, A330, and A340 aircraft

OPERATIONAL CONSIDERATIONS

Check of the Alternate Braking System before the first flight of the day

On aircraft equipped with hydromechanical control of the alternate braking system, (the) SOP requests that the flight crew check the alternate braking system:

- During the preliminary cockpit preparation, before the exterior walkaround of the first flight of the day, or
- If there is a flight crew change.

The test is performed after checking that the brake accumulator(s) pressure is within the green zone on the triple pressure indicator. If this is not the case, the flight crew should switch the blue (A330 & A340-200/300 aircraft) or yellow (A320 family, A300 & A310 aircraft) ELEC PUMP to ON to refill the accumulators.



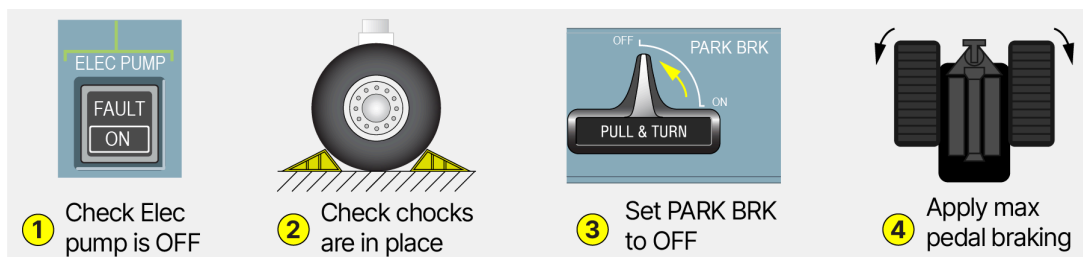
NOTE

On aircraft equipped with an alternate braking system **with electrical control**, the check of the operability of the alternate braking system is performed automatically. Therefore, it is not requested by the SOP to check the alternate braking system before the exterior walkaround on these aircraft. However, operators with a fleet that has aircraft equipped with both hydromechanical and electrical control can request that their crew manually perform the test on all their aircraft for SOP commonality.

Ensuring that the low pressure control circuit is operational

① The flight crew should first check that the blue (A330 & A340-200/300 aircraft) or yellow (A320 family, A300 & A310 aircraft) electrical pump is OFF. ② Then, they should check that the wheel chocks are in position. ③ The flight crew should set the parking brake to OFF. ④ Fully pressing the brake pedals compresses both master cylinders that send hydraulic pressure to open both sides of the dual valve.

(fig.6) Check of the Alternate Braking System (part 1 of 2)



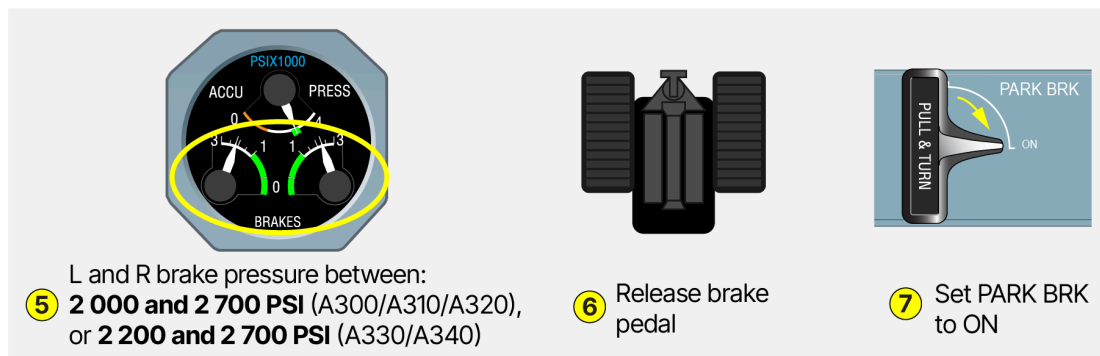
Spongy pedals = air in the low pressure control circuit

The brake pedals have an **artificial feel** that requires some force to activate the brakes. If the flight crew feels that the artificial feel is lost while pressing the brake pedals (brake pedals are "spongy"), **maintenance action must be performed**. This indicates that there is air in the low pressure control system.

Brake pressure must be in the correct range

When the brake pedals are fully pressed, **⑤** the brake pressure must be between 2 000 (or 2 200 PSI) and 2 700 PSI on both sides of the triple pressure indicator. If not, maintenance action must be performed. **⑥** The flight crew must then release the brake pedals and **⑦** set the PARK BRK back to ON, so that they can check the brake wear indicators during the exterior walkaround.

(fig.7) Check of the Alternate Braking System (part 2 of 2)



KEYPOINT

The check of the alternate braking system before the exterior walkaround of the first flight of the day **ensures that the low pressure control circuit accurately transfers the command of the brake pedals to the dual valve.**

MAINTENANCE CONSIDERATIONS

Applying the Appropriate Troubleshooting Task

When the flight crew reports a failed check of the alternate system, the appropriate troubleshooting task must be applied, based on the reported symptoms.

Reported loss of artificial feel (spongy pedals)

If the flight crew reports that one of both pedals feel 'spongy', corresponding to a loss of the artificial feel, one of the following tasks should be applied:

- **A320 TSM 32-43-00-810-805-A** "Loss of the Pedal Artificial Feel on the Two Sides (Auxiliary Low-Pressure System Failure)"
- **A320 TSM 32-43-00-810-806-A** "Loss of the Pedal Artificial Feel on the Right Side (Auxiliary Low-Pressure System Failure)"
- **A320 TSM 32-43-00-810-807-A** "Loss of the Pedal Artificial Feel on the left Side (Auxiliary Low-Pressure System Failure)"
- **A330/A340 TSM 32-43-00-810-802-A** "Brakes - Loss of the Brake-Pedal Artificial Feel or Spongy Pedals"
- **A300/A310 TSM 32-43-00** "Alternate Braking Fault Symptoms"

Brake pressure was not in the correct range

If the displayed brake pressure was not in the correct range during the test, the following task should be applied:

- **A320 TSM 32-43-00-810-805-A** "Loss of the Pedal Artificial Feel on the Two Sides (Auxiliary Low-Pressure System Failure)"
- **A320 TSM 32-43-00-810-806-A** "Loss of the Pedal Artificial Feel on the Right Side (Auxiliary Low-Pressure System Failure)"
- **A320 TSM 32-43-00-810-807-A** "Loss of the Pedal Artificial Feel on the left Side (Auxiliary Low-Pressure System Failure)"
- **A320 TSM 32-44-00-810-801-A** "Loss of the Right Yellow Pressure Indication on the Triple Indicator (Electrical Failure)"
- **A320 TSM 32-44-00-810-802-A** - Loss of the Left Yellow Pressure Indication on the Triple Indicator (Electrical Failure)
- **A330/A340 TSM 32-43-00-810-807-A** "Brakes - Alternate-Braking Pressures Do Not Get to 2200 psi When Brake Pedals Applied (with Blue Hydraulic System Depressurized)"
- **A300/A310 TSM 32-43-00** "Alternate Braking Fault Symptoms".

Correct Servicing of the Low Pressure Control Circuit

Each time one or several components of the low pressure control circuit is replaced, the low pressure control circuit must be serviced to ensure:

- The correct filling of the brake control hydraulic reservoir
- That there is no air in the low pressure control circuit.

Use of an appropriate filling tool

The use of an appropriate tool to do the servicing of the low pressure control circuit is essential to ensure correct filling.

Slow filling of the low pressure circuit

Airbus recommends performing the refilling procedure slowly, to ensure that all the air is removed from the low pressure control circuit.

Prefer refiling with an off-aircraft hydraulic source

As a general rule, Airbus recommends using an off-aircraft hydraulic source for the refilling of the low pressure control circuit. These devices have a deaeration function to remove air from the hydraulic fluid.

If the fluid is obtained from the green hydraulic reservoir, maintenance personnel must observe at least a one hour waiting period before starting the refilling procedure. During this hour, no systems powered by green hydraulics should be operated.

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Pre-flight checks are essential to detect any hidden failure before the flight.

Failing to detect a failure of the alternate braking system during the pre-flight check may lead to a loss of braking situation if combined with a loss of the normal braking during the flight. In this case, the flight crew can only rely on the parking brake to stop the aircraft during the landing roll.

The check of the alternate braking system must be performed on an aircraft equipped with a hydromechanical control system:

- Before the exterior walkaround of the first flight of the day, or
- If there is a flight crew change

This includes A300, A310, A330, A340-200/300 aircraft and also A320 family aircraft delivered before 2007 (with the exception of A320 family aircraft delivered between 2005 and 2007 that were already fitted with an electrically controlled alternate braking system).

This check ensures that the low pressure control circuit of the alternate braking system accurately transfers the command of the brake pedals to the dual valve.

The flight crew must make a report to maintenance if:

- The check indicates 'spongy' brake pedals (a loss of the artificial feel in the brakes), or
- The pressure indicated on the triple pressure indicator is not in the correct range when the brake pedals are fully pressed.

In this case, maintenance action must be performed before the next flight, to restore the correct operation of the alternate braking system.

Maintenance personnel must make sure that the appropriate troubleshooting task is applied on the low pressure control circuit when spongy pedals and/or insufficient alternate braking pressure are reported.

If one of the components of the low pressure control circuit needs to be replaced, maintenance personnel must

- Make sure that the circuit is serviced to refill the brake control hydraulic reservoir.
- Remove air from the circuit before returning the aircraft into service.

To do so, the use of appropriate tools is essential.

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