



Safe Aircraft Parking

Incorrect or incomplete application of the parking procedures at the end of a flight can lead to unexpected aircraft movement potentially resulting in injuries or significant damage from a collision with ground obstacles. Several cases of this type of event during maintenance are reported to Airbus each year.

This article provides an overview of the parking brake architecture and explains the importance of checking accumulator pressure before applying the park brake, and then confirming there is sufficient hydraulic pressure at the brake unit. It also describes the safety enhancement available on A320 family and A330/A340 aircraft and gives recommendations for chock design and placement.

This article applies to A300/A310/A320/A330/A340/A350/A380 aircraft. It does not apply to A220 aircraft as they are equipped with electric brakes.

ANALYSIS OF AN EVENT

After landing and taxi in, the A319 was approaching the parking position at the gate. The pilot applied pedal braking and checked the accumulator pressure value on the BRAKES and ACCU PRESS indicator. The accumulator pressure indication was in the green zone as expected. The pilot set the parking brake handle to ON but did not confirm that there was sufficient brake pressure showing on the indicator. He released the brake pedals and switched off both engines. The aircraft began to roll forward and it collided with the airbridge. After the collision, the flight crew checked the BRAKES and ACCU PRESS pressure indicator. It was now showing that there was sufficient pressure at the brakes. If the accumulator pressure indication was green and the indicator was showing sufficient pressure at the brakes after the collision occurred, then why did the aircraft roll forward after the brake pedals were released with the parking brake on?

Investigation

The crew correctly checked the accumulator pressure indication before setting the park brake to ON but they forgot to confirm the brake pressure indication before releasing the brake pedals and switching off the engines. Decoding the DFDR and troubleshooting identified there was a problem with the Parking Brake Selector Valve (PBSELV) causing it to open very slowly. Even though the park brake handle was set to ON, when the pilot took his feet off the pedals, the parking brake pressure was not yet sufficient and this allowed the aircraft to roll forward. When the Parking Brake Selector Valve finally rotated to its open position the brake pressure indicator was finally showing sufficient pressure at the brake, but it was too late.

The SOP recommends checking the brake pressure on the triple indicator after the parking brake handle is set to ON and before releasing the brake pedals. This would have informed the pilot that the hydraulic pressure at the brake unit was too low to hold the aircraft in its parked position with only the park brake. ■

THE PARKING BRAKE ARCHITECTURE

The parking brake application relies on the hydraulic pressure provided by one or two hydraulic pressure accumulator(s) (depending on the aircraft type) when the engines are not running. The accumulator(s) provide sufficient hydraulic pressure for the parking brake over a 12 hour period without repressurizing.

When the parking brake handle is set to ON, the Parking Brake Selector Valve (PBSELV) opens, allowing hydraulic pressure to apply the brakes and hold the aircraft in its parked position.

Accumulator(s) pressurization

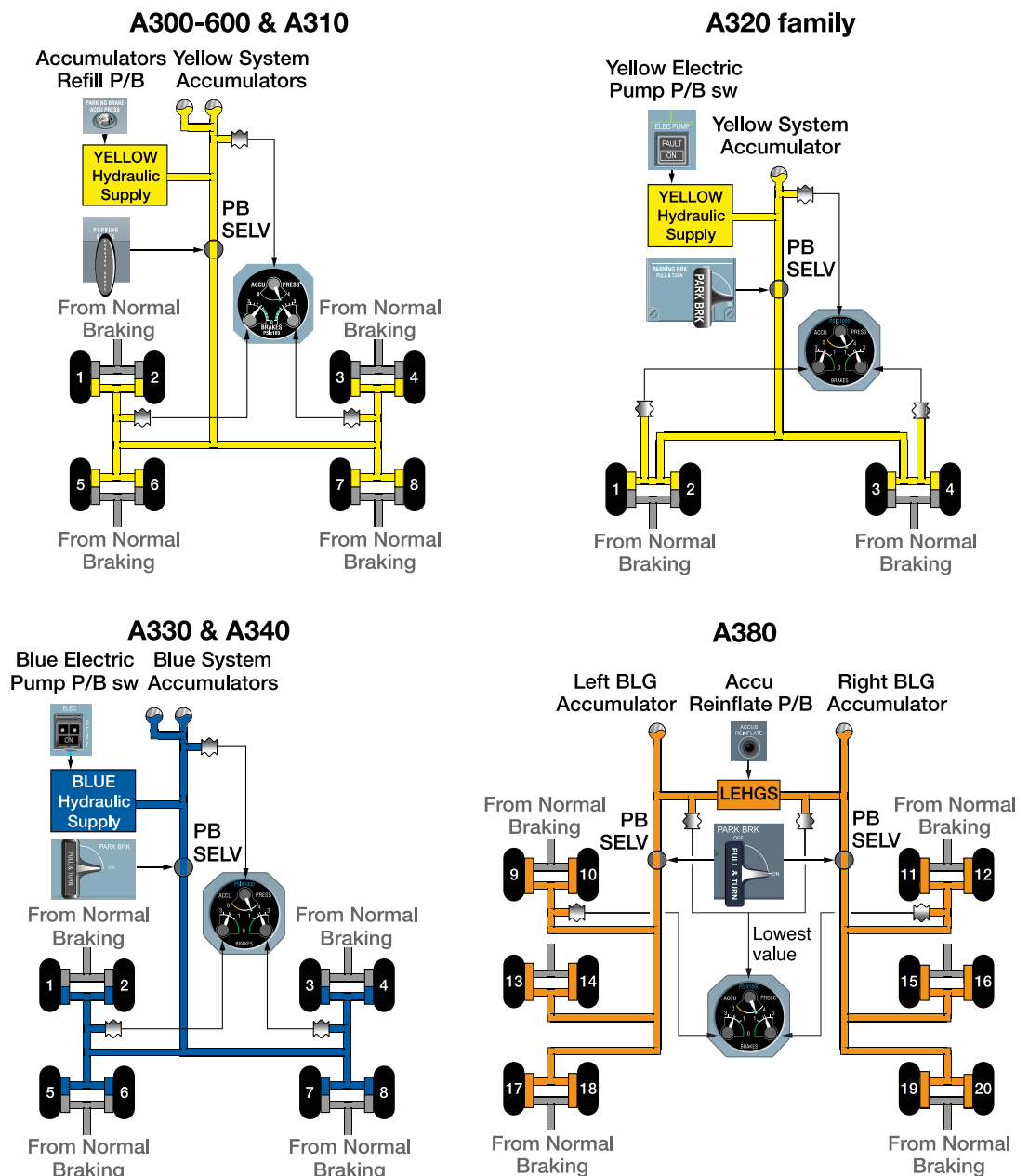
Accumulators are units that are automatically pressurized by their associated hydraulic system when the aircraft's engines are running. They can also be manually repressurized (or refilled) by pressing the Accu refill/reinflate pushbutton (A300-600/A310/A350/A380) or by switching the yellow (A300/A320) or blue (A330/A340) electrical pump to ON on the overhead panel.

The BRAKES and ACCU pressure indicator: An essential indication of a safe parking configuration

On A300-600, A310, A320 family, A330, A340 and A380 aircraft, the BRAKES and ACCU pressure indicator located on the center instrument panel enables the flight crew to quickly check the available accumulator pressure on its upper part and the actual pressure applied to the brakes on its lower part **(fig.1)**.

(fig.1)

Functional schematics of the parking brake system

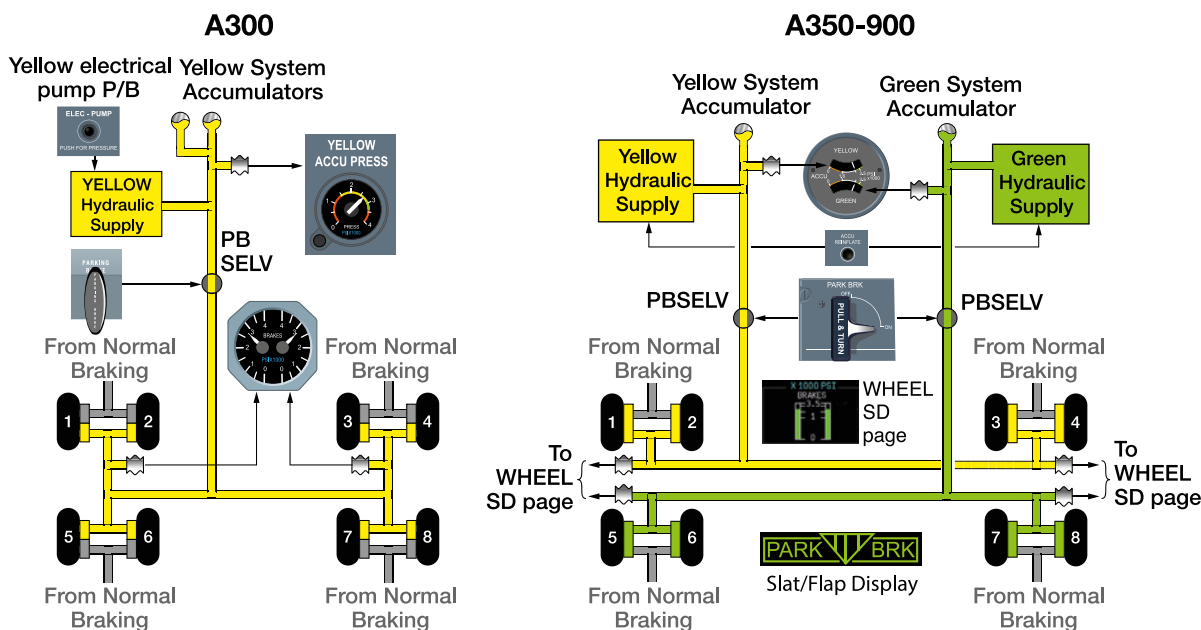


On A300 aircraft, the YELLOW ACCU PRESS indicator located on the overhead panel provides yellow accumulator pressure indication to the flight crew. The brake pressure indicator located on the center instrument panel provides measurement of the actual pressure applied to the brakes **(fig.2)**.

On A350 aircraft, the ACCU pressure indicator provides pressure indication from both green and yellow accumulators. The flight crew can check the pressure applied to the brakes on the SD WHEEL page or check that the PBSELV is open and that sufficient pressure is applied to the brakes when the Slat/Flap display shows the green **PARK BRK** indication **(fig.2)**.

(fig.2)

Functional schematics of the parking brake system for A300 and A350 aircraft (A350-1000 not represented)



Cases of incorrect application of the parking brake reported in service

There are two reasons that were identified as root causes of the incorrect application of the parking brake reported in service:

Incorrect opening of the Parking Brake Selector Valve (PBSELV)

The incorrect opening of the PBSELV does not enable the hydraulic pressure to reach the brakes as expected as it was the case in the event described above.

Insufficient accumulator pressure

Insufficient accumulator pressure limits the friction applied on the brake discs and may lead to unwanted aircraft movement.

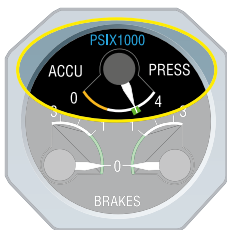
The insufficient pressure may be due to a leak in the hydraulic system or in the brake system itself. It can also be due to a long aircraft stay on ground (more than 12 hours) or following numerous parking brake application and release without accumulator repressurization. ■

RECALL OF THE PARKING PROCEDURE

The correct application of the FCOM parking procedure enables the flight crew to detect if there is a defect that could cause incorrect application of the parking brake.

1

Check that the accumulator pressure is in the green band



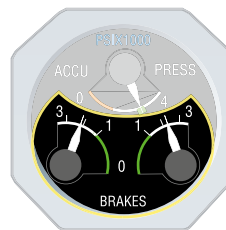
2

Set parking brake selector to ON



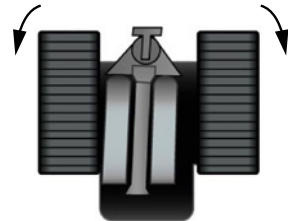
3

Check that sufficient pressure applies to the brakes



4

Release brake pedals and shutdown engines



(fig.3)

Example of the parking procedure on A320 aircraft

Step 1: Accumulator pressure check (Engines running and brake pedals pressed)

The first step is to check the accumulator pressure on the BRAKES and ACCU PRESS indicator (ACCU Pressure indicator on A350) before applying the parking brake. The accumulator(s) pressure must be in the green band **(fig.3)**.

If the pressure is not sufficient, the flight crew must keep the brake pedals pressed and contact the ground operator to put chocks in place before switching off the engines and make a logbook entry once the aircraft is parked to alert Maintenance.

Step 2: Parking brake application (Engines running and brake pedals still pressed)

If accumulator pressure is sufficient, the parking brake selector can be set to ON.

Step 3 & 4: Check of the brake pressure, pedal brake release and engine shutdown

To ensure that the PBSELV opened correctly and that sufficient hydraulic pressure is provided to the brakes, it is essential to check the left and right brake pressure on the BRAKES and ACCU pressure indicator (or that the green **PARK BRK** indicator is displayed on the Slat/Flap display on A350). If the indicators show insufficient parking brake pressure, the flight crew must keep the brake pedals pressed and contact the ground operator to put chocks in place before switching off the engines and then make a logbook entry to alert Maintenance. ■



NOTE

What if the aircraft starts to move after parking brake application?

On A300 and A310 aircraft, the parking brake handle must be set back to OFF to recover normal pedal braking to stop the aircraft.

On A320 Family/A330/A340/A350 and A380 aircraft, normal pedal braking has priority over parking brake, so pedal braking can be directly used to stop the aircraft.



NOTE

Why is it not recommended to leave the parking brake ON with hot brakes?

The SOP recommends to set the parking brake back to OFF once the chocks are in place when the brakes are hot (refer to FCOM for temperature values). This is to prevent transmitting heat to the brake pistons potentially causing seal degradation, hydraulic fluid overheating and generation of a black aggregate, that can reduce the piston running clearance and then lead to brake dragging.

ALSO BEWARE DURING MAINTENANCE!

An illustrative event reported to Airbus recently involved an A319 aircraft, which was being towed to the gate to resume operations after maintenance activities. The operator on the ground requested the person seated in the cockpit to set the parking brake to ON before disconnecting the towbar from the nose landing gear. They turned the parking brake handle to the ON position without checking the accumulator pressure on the BRAKES and ACCU pressure indicator or confirming the brake pressure. The ground operator disconnected the towbar and the aircraft began to roll backwards and away from the tow tractor. The person in the cockpit attempted to stop the aircraft by pressing down on the brake pedals but the aircraft continued to roll because there was no hydraulic pressure present in the normal braking system. The aircraft eventually came to rest after colliding with ground obstacles.

This example shows why it is essential to check the braking pressure indications and/or that chocks are in place before disconnecting the towbar or the towing truck. Inflation of the accumulator(s) using the Accu reinflate pushbutton or the appropriate electrical pump pushbutton (depending on the aircraft type) will provide sufficient accumulator pressure for parking brake application for up to 12 hours. ■

AVAILABLE SAFETY ENHANCEMENT: THE PARKING BRAKE MONITORING FUNCTION

Airbus introduced the parking brake monitoring function on A320 Family/A330/A350 aircraft. This function detects any discrepancy between the parking brake handle position and the PBSELV. The **BRAKES PARK BRK FAULT** ECAM warning (fig.4) triggers if the PBSELV does not open when the parking brake handle is set to ON, and reminds the flight crew to consider requesting ground personnel place chocks at the wheels before shutting down the engines.

“ It is essential to check the braking pressure indications and/or that chocks are in place before disconnecting the towbar or the towing truck. ”

BRAKES PARK BRK FAULT
PARK BRK.....OFF
 . BEFORE ENG SHUTDOWN
CHOCKS.....CONSIDER

(fig.4)

Example of an ECAM alert provided by the Parking Brake monitoring function

This modification is installed on A320 family aircraft built from October 2010 (serial number 4468 onward), on A330 aircraft built from January 2011 (serial number 1187 onward) and on all A350.

This parking brake monitoring function modification can be retrofitted on earlier A320 Family/A330/A340 aircraft by the following Service Bulletins:

- SB A320-32-1381
- SB A320-31-1353
- SB A330-32-3244
- SB A340-32-4285
- SB A340-32-5105

GROUND OPERATION RECOMMENDATIONS

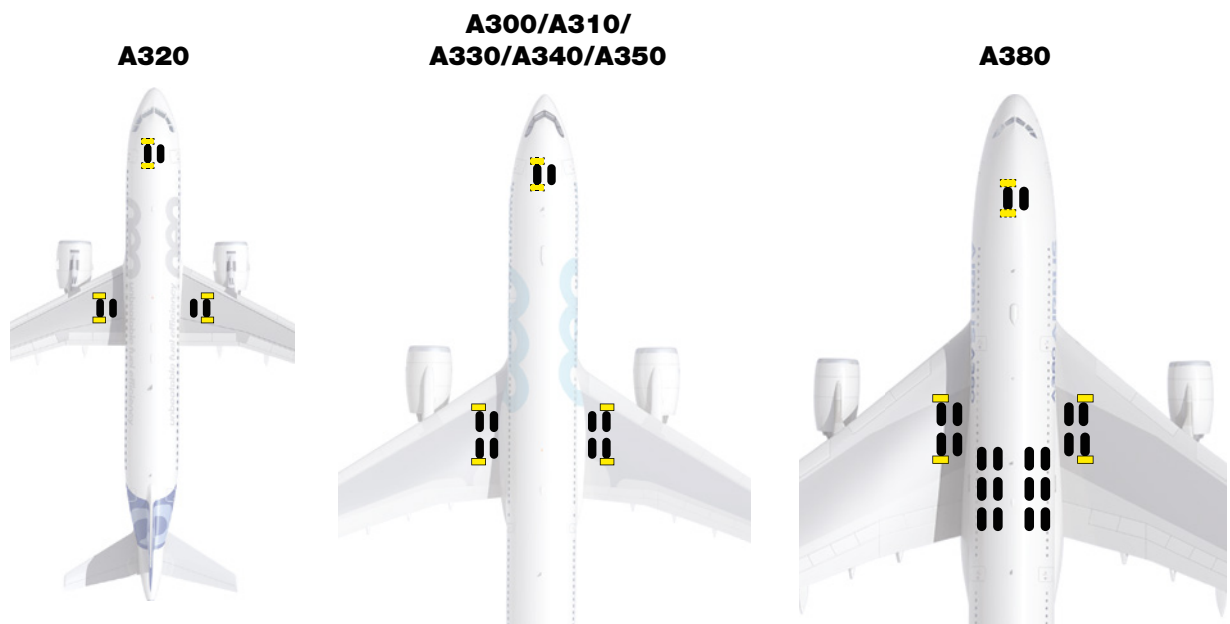
Chocks Placement

At the gate (transit)

Airbus recommends to first place a set of chocks on one wheel of the nose landing gear as soon as the aircraft comes to a stop. Then two sets of chocks should be placed on the outboard wheels of the main landing gear only when the engines are switched off and spooling down. Chocks on the NLG can now be removed if it is required **(fig.5)**. The ground operator must notify the flight crew that the chocks are in place.

(fig.5)

Recommended location
of chocks during transit

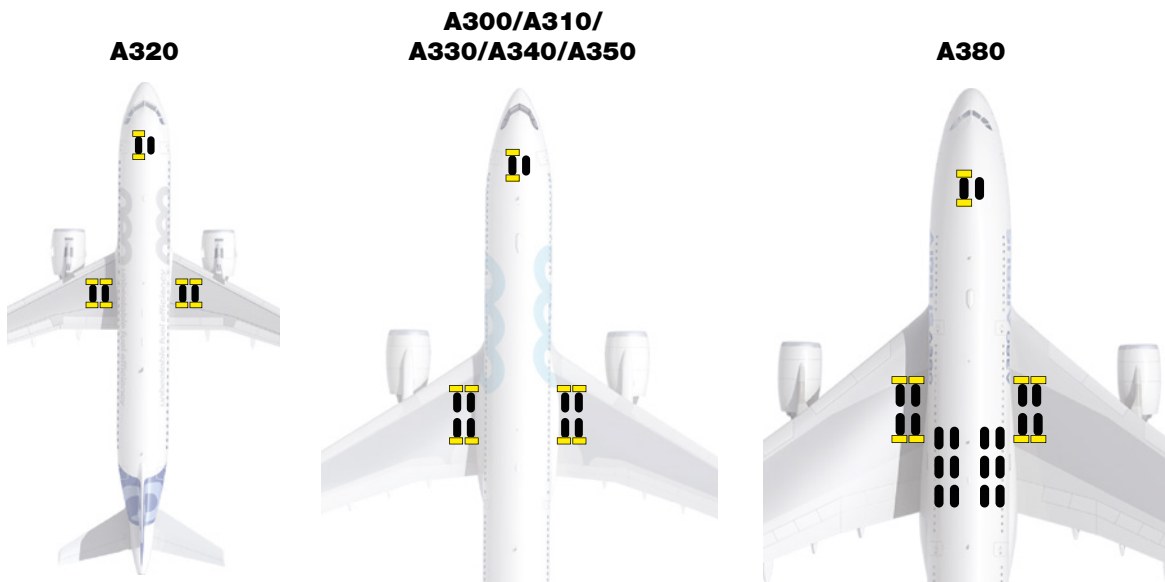


Night stop, long stay or windy conditions

For a night stop, a long stay or in the case of strong wind, Airbus recommends to keep the nose landing gear chocks in place and also secure the inboard wheels of the main landing gear with additional sets of chocks **(fig.6)**.

(fig.6)

Recommended location of chocks during night stop, long stay or in strong wind conditions



During Maintenance

Specific chocks placements may be required for a maintenance task. The chocks placement guidance in the Aircraft Maintenance Manual (AMM) should be followed.

Chocks design

Many different types of chocks are used by ground operators throughout the world. Airbus participated in a study to define an optimum design for chocks that can solve recurrent issues faced in operation such as:

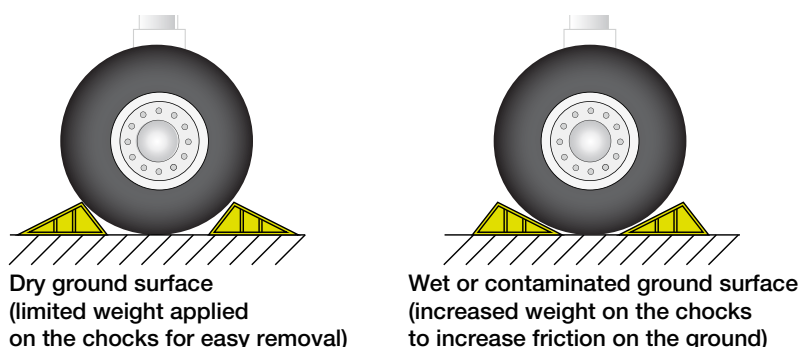
- Chocks durability
- High weight with associated handling difficulties
- Reduced efficiency on wet and contaminated aprons
- Difficulties to remove chocks before pushback with risk of delay

The recommended chocks are made of urethane type material and have an asymmetric design enabling optimum efficiency depending on if the apron is dry or wet/contaminated **(fig.7)**.

For more information, refer to the AIR4905 revA document published by SAE international that provides general considerations for the design and use of aircraft wheel chocks.

(fig.7)

Example of chocks with asymmetric design adapted to apron state



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To ensure that an aircraft remains safe and stationary when using the parking brake, flight crew or maintenance personnel must first ensure that sufficient accumulator pressure is available using the BRAKES and ACCU pressure indicator before setting the brake handle to ON. If the indicator is in the green band, they can set the parking brake to ON and confirm using the pressure indicator that sufficient pressure is applied to the brakes. If not, they must wait until chocks are correctly placed at the wheels before releasing the brake pedals and switching off the engines or disconnecting from the towing vehicle. Maintenance must be alerted about the issue to troubleshoot and rectify.

When chocks are required for ground operations or when the parking brake pressure is insufficient, chocks must be correctly placed at the aircraft's wheels. Airbus recommends chocks made of urethane type material with an asymmetric design that allows them to be orientated for the most efficient holding friction on wet or dry apron surfaces.

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