

	LANDING GEAR BRAKES AND ANTISKID		1.32.30	P 1
			SEQ 100	REV 16

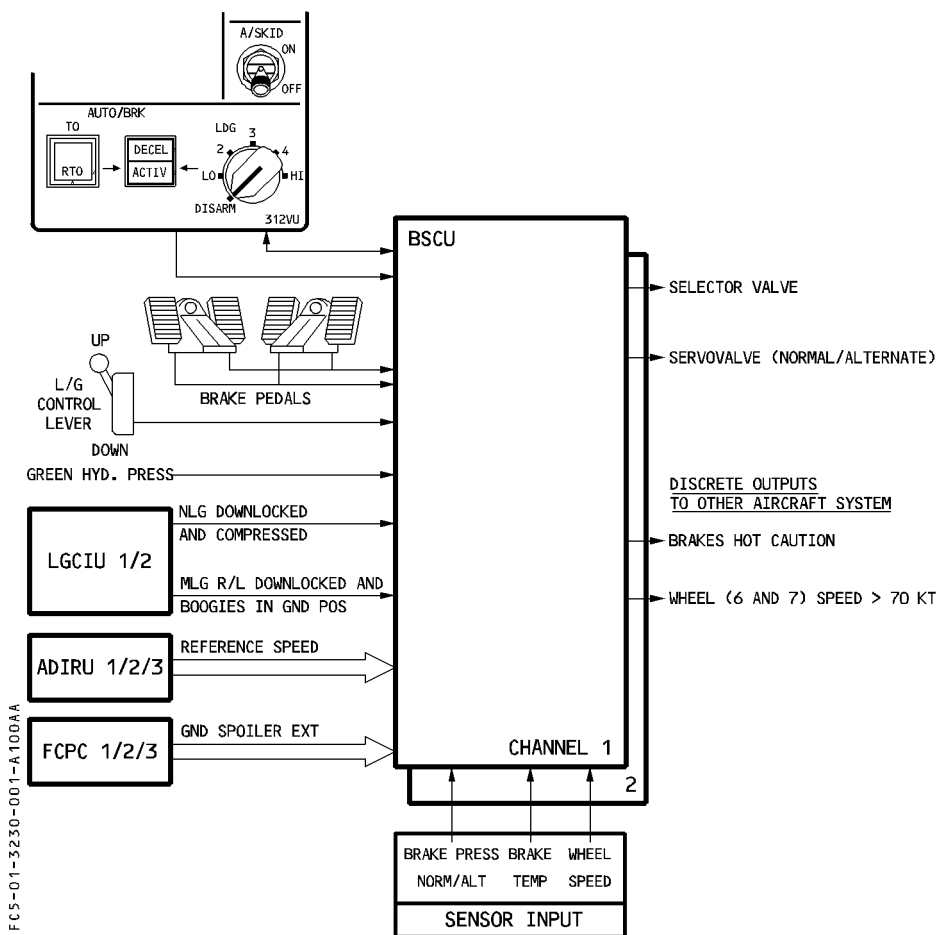
DESCRIPTION

GENERAL

The main and center wheels are equipped with carbon multidisc brakes, which can be actuated by either of two independent brake systems.

The normal system uses green hydraulic pressure, whilst the alternate system uses the blue hydraulic system (backed up by the hydraulic accumulator).

An antiskid and autobrake system is also provided.



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Braking commands come from either the brake pedals (pilot action), or the autobrake system (deceleration rate selected by the crew). The left pedal controls the left main landing gear brakes, and the forward wheel brakes of the center landing gear. The right pedal controls the right main landing gear brakes, and the rear wheel brakes of the center landing gear.

In normal operation, a dual system Brake and Steering Control Unit (BSCU) controls normal braking with antiskid and autobraking.

Depending on the failure, braking may revert to :

- Alternate braking with antiskid. This braking mode is also controlled by the BSCU.
- Alternate braking without antiskid. This braking mode may be controlled by the BSCU, or by the EBCU in case of a dual BSCU system failure, or if the antiskid is switched OFF.
- Alternate braking without antiskid on accumulator. This braking mode may be controlled by the BSCU, or by the EBCU in case of a dual BSCU system failure, or if the antiskid is switched OFF.

All normal and alternate braking components are fully-monitored. Any detected failure is signaled to the crew via ECAM warnings.

The BSCU performs the following secondary functions :

- It checks for residual pressure in the brakes,
- It monitors brake temperature,
- It provides discrete wheel speed information to other aircraft systems.

A changeover between the two BSCU systems takes place at each DOWN landing lever selection, or in case one system fails.

The main and center gear wheels are fitted with fuse plugs which prevent tires from bursting, in the event of an overheat.

Main and center gear wheels are also equipped with brake cooling fans, which permit a higher cooling speed of the brakes. ◀

ANTISKID SYSTEM

The antiskid system provides maximum braking efficiency by maintaining the wheels at the limit of an impending skid.

At skid onset, brake release orders are sent to the normal and alternate servovalves, as well as to the ECAM system which displays the released brakes.

Full braking performance is achieved only with brake pedals at full deflection.

Below 10 knots (ground speed), the antiskid system is only effective during heavy braking.

An ON/OFF switch activates or deactivates the antiskid system.

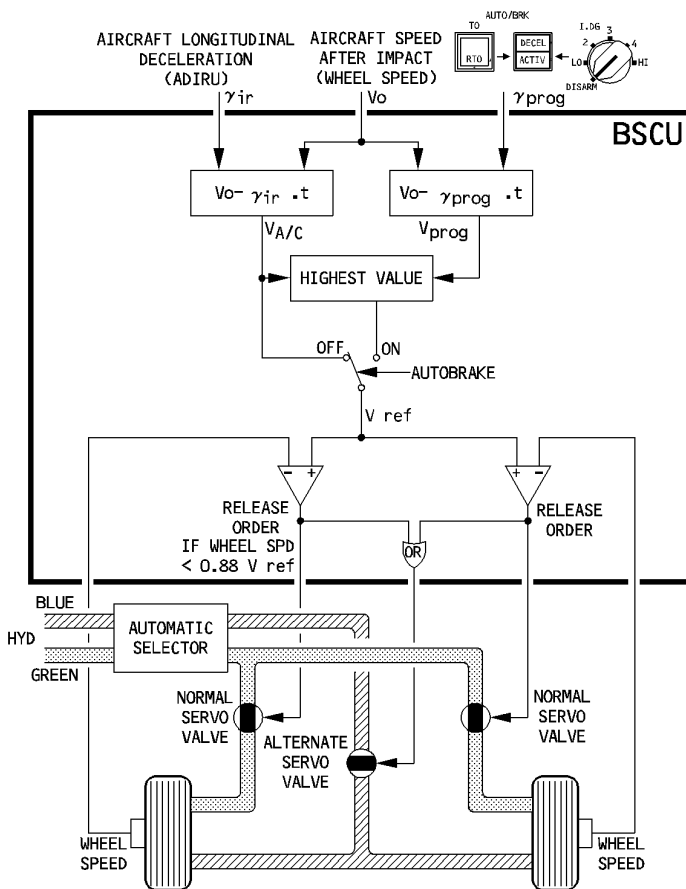
ANTISKID PRINCIPLE

The speed of each main and center gear wheel (given by a tachometer) is compared to the aircraft speed (reference speed). When the speed of a wheel decreases below approximately 0.88 times (depending on conditions) reference speed, brake release orders are given to maintain the wheel slip at that value (best braking efficiency).

In normal operation, the reference speed is determined by the BSCU from the horizontal acceleration of ADIRU 1, 2 or 3.

In case all ADIRUs fail, reference speed equals the maximum of either main and center landing gear wheel speeds. Deceleration is limited to a default value of 2.5 m/s^2 (8.2 ft/s^2).

FOR INFO



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AUTOBRAKE

The objective of this system is to :

- Reduce braking delay, in the event of an accelerate-stop, to improve performance.
- Establish and maintain a selected deceleration rate during landing, to improve comfort and reduce crew workload.

SYSTEM ARMING

The crew may arm the automatic braking by :

- For takeoff, pressing the TO pushbutton
- For landing, selecting, with the selector switch, one of the five automatic braking modes (LO, 2, 3, 4 or HI)

In addition, the following conditions must be met :

- Green pressure available
- Antiskid electrically-powered
- No failure in the braking system
- At least two PRIMs and one ADIRU available

Note : *Autobrake may be armed with the parking brake on.*

SYSTEM ACTIVATION

Automatic braking is initiated by the ground spoiler extension command (Refer to 1.27).

Consequently, in the event of an acceleration stop, if the deceleration is initiated with the speed below 72 knots, automatic braking will not be operative because the ground spoilers will not be extended.

SYSTEM DISARMING

The system is disarmed by :

- For takeoff :
 - Pressing the TO pushbutton, or
 - Loosing one or more arming conditions, or
 - Applying sufficient deflection to one brake pedal when the autobrake is operative, or
 - Ground spoiler retraction (Refer to 1.27), or
 - Flight condition since 10 seconds.
- For landing
 - Setting the selector switch to the DISARM position, or
 - Loosing one or more arming conditions, or
 - Applying sufficient deflection to one brake pedal when the autobrake is operative, or
 - Ground spoiler retraction (Refer to 1.27), or
 - Flight condition since 10 seconds.

Note : *If automatic braking, set for a landing, is disarmed, the selector switch automatically returns to the DISARM position.*

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OPERATION

There are four operation modes :

- Normal braking
- Alternate braking with antiskid
- Alternate braking without antiskid
- Parking brake.

NORMAL BRAKING

Antiskid is operative and autobrake is available.

Normal braking is operative when :

- Green hydraulic pressure is available ;
- Main landing gear is on ground ;
- A/SKID switch is ON.

The control is electrically- achieved through the BSCU, either :

- Via the pedals, or
- Automatically on ground, by the autobrake system.

Note : *In flight, normal braking is automatically activated when the landing gear is set to the up position to brake the wheel.*

The antiskid system is controlled by the BSCU, via the normal servovalves.

No brake pressure indication is provided.

ALTERNATE BRAKING WITH ANTISKID

Autobrake is inoperative.

It is active when green hydraulic pressure is low or normal braking is lost, provided the :

- Blue hydraulic pressure is available ;
- A/SKID switch is ON ;
- PARKING BRAKE is not ON.

Note : *Alternate braking is also active in flight, when the landing gear is up.*

Braking inputs are made by the brake pedals and sent to the BSCU. Then, taking into account the brake pedal inputs and the antiskid function, the BSCU :

- Commands the Emergency Brake Control Unit (EBCU) to energize the alternate brake selector valve to pressurize the blue hydraulic circuit.
- Electrically controls the Alternate Servo Valve to obtain the correct pressure for the related brakes.

Brake pressure, as well as accumulator pressure, are indicated on a triple indicator located on the center instrument panel.

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ALTERNATE BRAKING WITHOUT ANTISKID

Autobrake and antiskid are inoperative.

The antiskid system is either deactivated :

- Electrically (A/SKID switch OFF, or power supply failure, or BSCU failure), or
- Hydraulically (B + G system low pressure, the brakes are supplied by the brake accumulator only).

Depending on the brake pedals' demand :

- The BSCU, or
- The Emergency Brake Control Unit (EBCU), in case of dual BSCU channel failure or A/SKID switched OFF,
controls the alternate brake selector and the alternate servo valves.

Brake pressure, as well as accumulator pressure, is indicated on a triple indicator located on the center instrument panel.

To avoid wheel locking and limit the risk of tire burst, brake pressure is automatically limited to 1000 psi.

Accumulators are designed to supply at least seven full brake applications.

PARKING BRAKE

Brakes are supplied by the blue hydraulic system, or by accumulator pressure via the parking brake control valve, which opens allowing full pressure application on the main gear wheel brakes.

If the parking brake is used as emergency braking (ground spoilers deployed), full pressure also applies on the center gear wheel brakes.

The accumulator maintains the parking pressure for at least 12 hours.

If the parking brake is activated and no blue hydraulic or accumulator brake pressure is available, then the normal braking system can be applied via the brake pedals.

Blue accumulators can be pressurized by pressing the blue electrical pump switch.

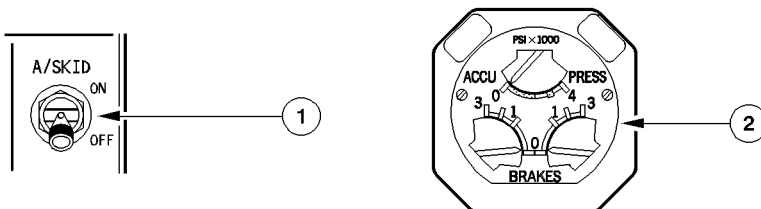
Brake pressure, as well as accumulator pressure, are indicated on a triple indicator located on the center instrument panel.

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CONTROLS AND INDICATORS

CENTER INSTRUMENT PANEL

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① A/SKID switch

- ON :
- If green hydraulic pressure is available, antiskid is available.
 - If green hydraulic pressure is lost :
 - Blue hydraulic pressure automatically takes over to supply the brakes ;
 - Antiskid remains available ;
 - Brake blue pressure is displayed on the triple indicator.
- OFF :
- BSCU braking command is deactivated. EBCU takes over and controls the alternate braking without antiskid.
 - Blue hydraulic pressure supplies the brakes.
 - Brake pressure is automatically limited to 1000 psi.
 - Differential braking remains available by pedals.
 - Brake blue pressure is displayed on the triple indicator.

Note : A BSCU reset is performed when the A/SKID switch is set from OFF to ON.

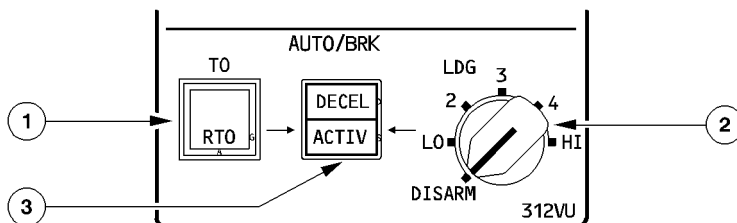
② BRAKE and ACCU PRESS indicator

Brake pressure is only indicated when the blue hydraulic system controls the brake pressure, which means when the alternate braking system is activated, or when the parking brake is applied.

- ACCU PRESS indication:
- Green Band : Allowed pressure area in the brake accumulators. Provides full pressure to the brakes.
 - Amber Band : Forbidden pressure area. Requires repressurization of the accumulators.

BRAKE pressure indication: Indicates blue pressure delivered to the left and right brakes, measured downstream of the alternate servo valves.

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① TO pushbutton (momentary action)

Allows the selection of the RTO autobrake mode on ground only. This mode is normally selected for takeoff.

In the event of an aborted takeoff, maximum pressure is sent to the brakes, as soon as ground spoiler deployment order is present.

RTO : Comes on blue, when the TO autobrake mode is armed.
Off : The TO autobrake mode is deactivated.

② DISARM LO, 2, 3, 4 HI rotary selector switch

Allows the selection of the landing autobrake modes.

DISARM : Landing autobrake disarmed or cancelled. When the landing autobrake is disarmed, the rotary selector switch automatically returns to the DISARM position.

LO, 2, 3, 4, HI : Corresponding landing autobrake mode selected.

③ DECEL/ACTIV indicator

ACTIV : Comes on blue, when the autobrake becomes active.

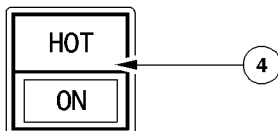
DECEL : Comes on green, when the autobrake function is active and when 80 % of the selected deceleration rate is achieved. Predetermined rates could also be achieved by reversers only, or a combination of both reversers and brakes.

Note : On a slippery runway, the predetermined deceleration may not be reached due to the slippery runway condition. In this case, the DECEL light will not come on, even if autobrake is active (ACTIV light ON).

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BRK FAN

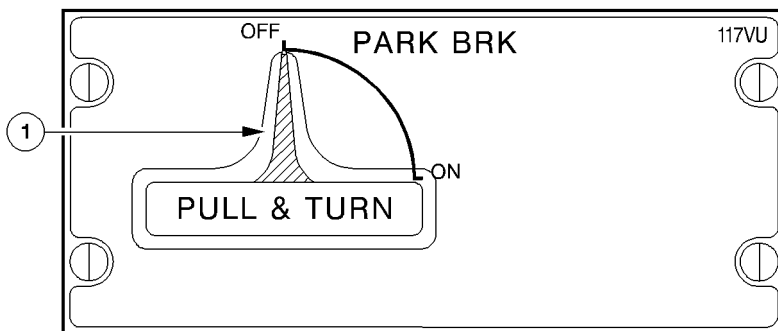


④ BRK FAN pb

- ON : The brake fans run, provided the main and center landing gear are downlocked.
The ON legend comes on blue.
- Off : Brake fans stop.
- HOT It : This amber light and associated ECAM caution come on, when one brake temperature exceeds 300°C.

PEDESTAL

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① PARK BRK handle

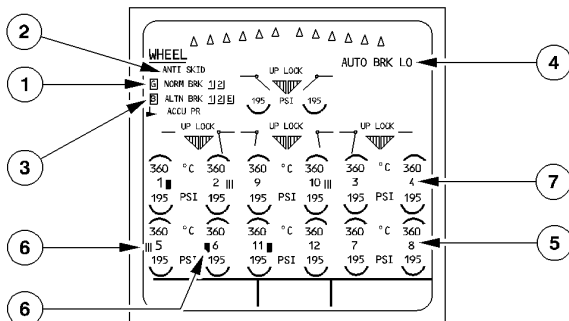
Pull the handle, then turn it clockwise to apply the parking brake.
The «PARK BRAKE ON» indication is displayed on the ECAM memo page.

CAUTION

As long as the handle is not at the «ON» position, the parking brake is not applied.

ECAM WHEEL PAGE

In case of a braking or steering system failure, the failed system is shown in amber, and the remaining operative systems are shown in green. Systems are also shown in amber, when they are not hydraulically-powered (before engine start, for example).



① NORM BRK indication

Nothing appears in normal operation.



Ⓐ NORM BRK label

This indication appears in green, when the normal brake system 1(2) is failed and system 2(1) is active, or when one BSCU system is failed.

This indication appears in amber, when the normal braking is failed due to the loss of normal braking system 1 and 2, or to the loss of both BSCU systems 1 and 2, or to green hydraulic low pressure.

Ⓑ NORM BRK hydraulic supply indication

G when the NORM BRK label is displayed. It is in green when hydraulic pressure is available. It is in amber, in case of a green hydraulic low pressure.

Ⓒ BSCU systems indication

When the NORM BRK label is displayed, the status of BSCU systems 1 and 2 is displayed.

Number appears in green, when the corresponding BSCU system is available. It becomes amber, when the corresponding BSCU system fails.

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②ANTISKID indications :

Nothing appears in normal operation.

This indication appears when NORM BRK, or ALTN BRK, or ACCU PR labels are displayed.

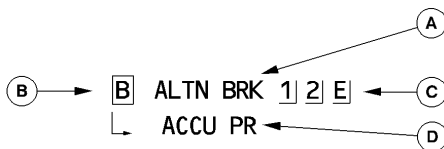
It is in green when the antiskid system is still available.

It is in amber when antiskid is lost due to the failure of the BSCU antiskid function, or to both BSCU channels 1 and 2, or if the antiskid is switched OFF, or in the case of blue and green hydraulic low pressure.

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③ ALTN BRK indication

Nothing appears in normal operation.



Ⓐ ALTN BRK label

This indication appears in green, when the alternate braking is available and :

- The blue hydraulic system is in low pressure, or
- ANTI SKID, or NORM BRK, or ACCU PR labels are displayed, or
- Alternate braking system 1 or 2 is failed.

This indication appears in amber, when the alternate braking system is lost due to:

- Blue hydraulic system and blue accumulator low pressure, or
- Both BSCU systems 1 and 2 and EBCU failure
- Both ALTN BRK system 1 and 2, and E (coming from EBCU) failure.

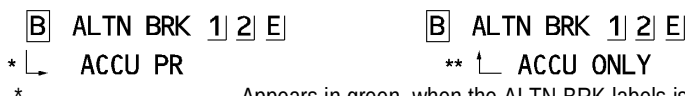
Ⓑ ALTN BRK hydraulic supply indication

B appears when the ALTN BRK label is displayed. It is green when blue hydraulic pressure is available. B appears in amber, in case of blue hydraulic low pressure.

Ⓒ BSCU and EBCU channels indication

When ALTN BRK label is displayed, the BSCU systems 1 and 2, and EBCU system status are displayed. Number or letters appear in green, when the corresponding BSCU or EBCU system is available. They become amber, when the corresponding BSCU or EBCU system fails.

Ⓓ ACCU indications



**

Appears in green, when the ALTN BRK labels is displayed, and the blue hydraulic system is available. Appears in amber, when the blue hydraulic system and the accumulator are in low pressure.

Appears in green, when alternate braking is pressurized by the blue accumulator.

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④ AUTO BRK indication

Displayed : – In green when the autobrake is armed ;
– In amber and an associated ECAM caution comes on in case of autobrake system failure, or normal braking failure, or failure of both BSCU channels.

LO, 2, 3, 4, HI or RTO indicates the selected rate (green). It is not displayed when the autobrake is faulty.

⑤ Wheel number identification

It is in white.

⑥ Release indications

Nothing appears in normal operation.

■ : It is amber, on the inboard side of the landing gear, in case of residual braking.
III : It is amber, on the outboard side of the landing gear, in case of :
– NORM brake released fault when normal braking is active, or
– ALTN brake released fault when alternate braking is active.

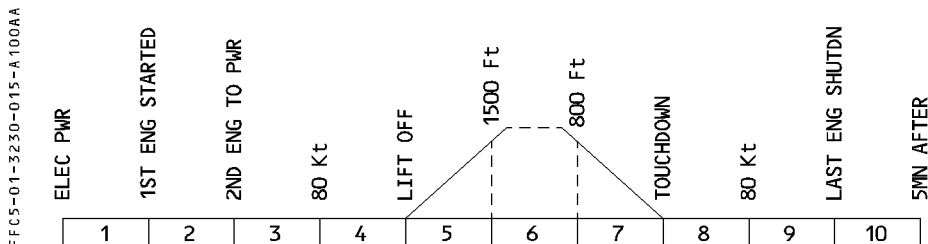
⑦ Brake temperature indication

- It is normally green (minimum indication 0°C).
 - The green arc appears on the hottest wheel, when one brake temperature exceeds 100°C.
 - It becomes amber and an associated ECAM caution appears when the corresponding brake temperature exceeds 300°C.
- In addition, the arc becomes amber, on the hottest wheel.

Note : Below 100°C, the indicated brake temperature may be below the actual brake temperature. This difference can reach 25°C with an actual brake temperature of 30°C, and decreases when the temperature increases.

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WARNINGS AND CAUTIONS



E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
CONFIG PARK BRK ON Parking brake is ON, when thrust levers are set at T.O or FLX T.O power position.	CRC	MASTER WARN	NIL	NIL	1, 2, 5 to 10
PARK BRK LO PR	SINGLE CHIME	MASTER CAUT	WHEEL	BRK FAN HOT 	3 to 8
BRAKES HOT One brake temperature higher than 300°C.					4, 8
AUTO BRK FAULT A tachometer is failed, or a servovalve is jammed closed on one or two wheels.					3, 4, 5
A/SKID FAULT Antiskid is inoperative					4, 5
A/SKID OFF Switch in the OFF position.					1, 4, 5 10
RELEASED Brake of one wheel is released. It is detected when the landing gear is downlocked and at least one engine is running.					1, 4 to 8, 10
RESIDUAL BRAKING (on ground) Brake pressure of at least one wheel is above 15 bar with pedals released.					3, 4, 5, 8
HYD SEL VALVE Failure or brake normal selector valve in open position.					3, 4, 5, 7, 8
SYS 1(2) FAULT One BSCU channel is failed.	NIL	NIL	NIL		3, 4, 5, 7, 8, 9
NORM BRK FAULT Normal braking function is lost.	SINGLE CHIME	MASTER CAUT	WHEEL		3, 4, 5, 7, 8, 9
ALTN BRK FAULT Alternate braking function is lost.	NIL	NIL			3, 4, 5, 7, 8

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E/WD : FAILURE TITLE conditions	AURAL WARNING	MASTER LIGHT	SD PAGE CALLED	LOCAL WARNING	FLT PHASE INHIB
NORM + ALTN BRK FAULT Normal and alternate functions are lost. Parking brake available.	SINGLE CHIME	MASTER	WHEEL	NIL	4, 5
BRK B ACCU LO PR The blue brake accumulator is in low pressure.		CAUT	NIL		3 to 8
EBCU FAULT ECBU failure. Alternate braking available through the BSCUs.	NIL	NIL			3, 4, 5, 7, 8
BRAKES/NWS MINOR FAULT Single system failure (loss of redundancy) or autobrake rotary selector failure.					2 to 8

MEMO DISPLAY

- If the parking brake is on, the PARK BRK message is displayed :
 - In green, in flight phases 1, 2, 9 and 10.
 - In amber, in other flight phases.
- The BRK FAN memo is displayed in green, if the BRK FAN pushbutton is ON. ◀