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Attachment 10 – American Airlines Operations Manual

Volume 1 and 2 [Excerpts]

OPERATIONAL FACTORS/HUMAN PERFORMANCE

DCA19LA134



A319/320/321

Operating Manual

Volume I

Revision Number: 21

Revision Date: 05 MAR 19

Temporary Revision Record		
No.	Subject	Date Issued
10.1	Spurious Compressor Vane ECAM Message	14 AUG 15
21.1	A321NX Emergency Equipment Diagram	12 MAR 19

Fast Reference Links
Revision 21 Highlights

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1.2 Weight Limits

1.2.1 Takeoff Weight. Maximum takeoff weight (the weight at brake release or at start of takeoff roll) is limited by the *most* restrictive of the following:

- maximum certificated takeoff weight
- maximum runway limited takeoff weight
- tire speed and brake energy limit weights
- maximum takeoff weight (climb limited)
- obstacle clearance, enroute, and landing weight limitations

1.2.2 Landing Weight. The maximum landing weight is limited by the *most* restrictive of the following, including limitations for inoperative equipment:

- maximum certificated landing weight
- maximum landing weight (runway length plus obstacle)
- maximum landing weight (climb limited)

1.2.3 Certificated Weight Limits.

Maximum	Weights (lbs.)				
	A319	A320	A321 (Non-Sharklet)	A321-IAE (Sharklet)	A321-CFM (Sharklet)
Taxi	167,330	170,637	205,911	207,014	207,014
Takeoff	166,448	169,755	205,029	206,132	206,132
Landing	137,788	142,198	171,519	171,519	174,606
Zero Fuel	128,970	134,481	162,701	162,701	166,669

• Note •

Perform an “overweight landing” when a condition causes it to be safer to land overweight than to continue flight until at or below maximum certificated landing weight. See QRH, “Overweight Landing” procedure.

1.3 Operations

1.3.1 Operational Limits.

Minimum flight crew	Captain and First Officer
Maximum wind for takeoff and landing	50 knots (including gusts)(A)
Maximum crosswind for takeoff and landing	35 knots¹ (including gusts)(A)
Maximum crosswind for landing Vis < 4000 or 3/4	15 knots (A)
Maximum crosswind (including gusts) for Autoland (Vis ≥ 4000 3/4)	20 knots²
Maximum tailwind component for takeoff (A320 and A321 with IAE engines)	10 knots
Maximum tailwind component for takeoff (All A319 and A320/321 with CFM engines)	15 knots
Maximum tailwind component for landing (Non-Sharklet)	10 knots
Maximum tailwind component for landing (Sharklet)	15 knots
Maximum runway slope (uphill, downhill)	+2.0%, -2.0%
Maximum operating altitude	39,000 feet (A)
Maximum takeoff and landing pressure altitude (except A319 with Sharklets)	9,200 feet
Maximum takeoff and landing pressure altitude (A319 with Sharklets)	14,100 feet
Minimum takeoff and landing pressure altitude	-1,000 feet
Maximum operating altitude with flaps and/or slats extended	20,000 feet
Maximum gear extension altitude	25,000 feet

¹ Maximum crosswind values have been demonstrated with flight controls in normal law as well as direct law with and without yaw damper.

² See paragraph [1.10.2 Autoland](#).

Takeoff

2d-4

Takeoff Types

05 MAR 19

The traditional use of upwind aileron is not recommended. In strong crosswind conditions, small lateral control sidestick input may be used to maintain wings level. Excessive lateral input causes spoiler deployment, which increases the aircraft's tendency to weathervane and increases drag.

If some lateral control has been applied on the ground, center the sidestick during rotation so that the aircraft becomes airborne with a zero roll rate demand.



A319/320/321

Operating Manual

Volume II



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Chapter 9: Flight Controls

9.1 System Description

9.1.1 General. The fly-by-wire system was designed and certified to render the new generation of aircraft even more safe, cost effective, and pleasant to fly.

Basic Principle.

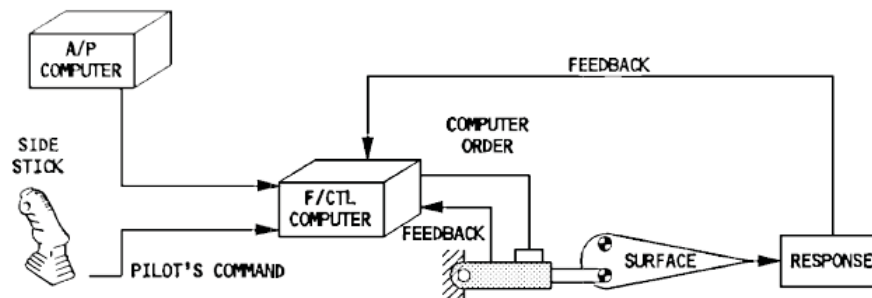
Flight control surfaces are all:

- Electrically-controlled, and
- Hydraulically-activated.

The stabilizer and rudder can also be mechanically-controlled.

Pilots use sidesticks to fly the aircraft in pitch and roll (and in yaw, indirectly, through turn coordination). Computers interpret pilot input and move the flight control surfaces, as necessary, to follow their orders.

However, when in normal law, regardless of the pilot's input, the computers will prevent excessive maneuvers and exceedence of the safe envelope in pitch and roll axis. However, as on conventional aircraft, the rudder has no such protection.



A321 Load Alleviation Function (LAF) (As Installed). The load alleviation function permits to alleviate the wing structure loads. The function is achieved through the upward deflection of:

- The two ailerons only, or
- The two ailerons associated to the spoilers 4 and 5.

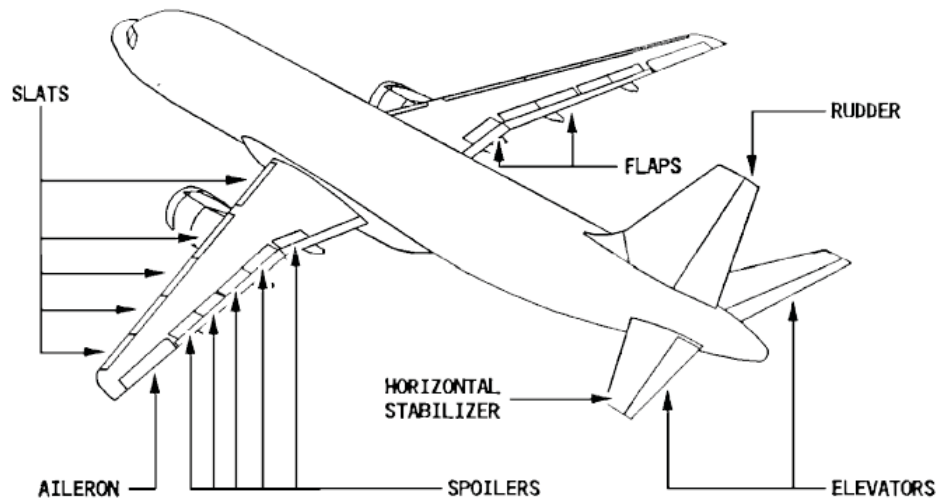
The LAF has 2 sub-functions:

- A sub-function activated in case of stable maneuver (ailerons deflections only)
- A sub-function activated in case of gust detection (ailerons and spoilers deflections)

In case of continuous turbulences, the two LAF sub-functions can be activated independently (the highest alleviation is taken into account).

The LAF is available when the aircraft is in clean configuration and in Normal law. The LAF orders are added to those generated by the normal law.

Control Surfaces.



Flight Controls

9-3

System Description

01 OCT 18

The flight controls are electrically or mechanically controlled as follows:

Pitch axis

- Elevator = Electrical
- Stabilizer = Electrical for normal or alternate control. Mechanical for manual trim control.

Roll axis

- Ailerons = Electrical
- Spoilers = Electrical

Yaw axis

- Rudder = Mechanical, however control for yaw damping, turn coordination and trim is electrical.

Speed brakes

- Speed brakes = Electrical

• Note •

All surfaces are hydraulically actuated.

Cockpit Controls.

- Each pilot has a sidestick controller with which to exercise manual control of pitch and roll. These are on their respective lateral consoles.
The two sidestick controllers are not coupled mechanically, and they send separate sets of signals to the flight control computers.
- Two pairs of pedals, which are rigidly interconnected, give the pilot mechanical control of the rudder.
- The pilots control speed brakes with a lever on the center pedestal.
- The pilots use mechanically interconnected handwheels on each side of the center pedestal to control the trimmable horizontal stabilizer.
- The pilots use a single switch on the center pedestal to set the rudder trim.
- There is no manual switch for trimming the ailerons.

Computers. Seven flight control computers process pilot and autopilot inputs according to normal, alternate, or direct flight control laws. The computers are:

2 ELACs. (Elevator Aileron Computer)

For: Normal elevator and stabilizer control.

Aileron control.

3 SECs. (Spoilers Elevator Computer)

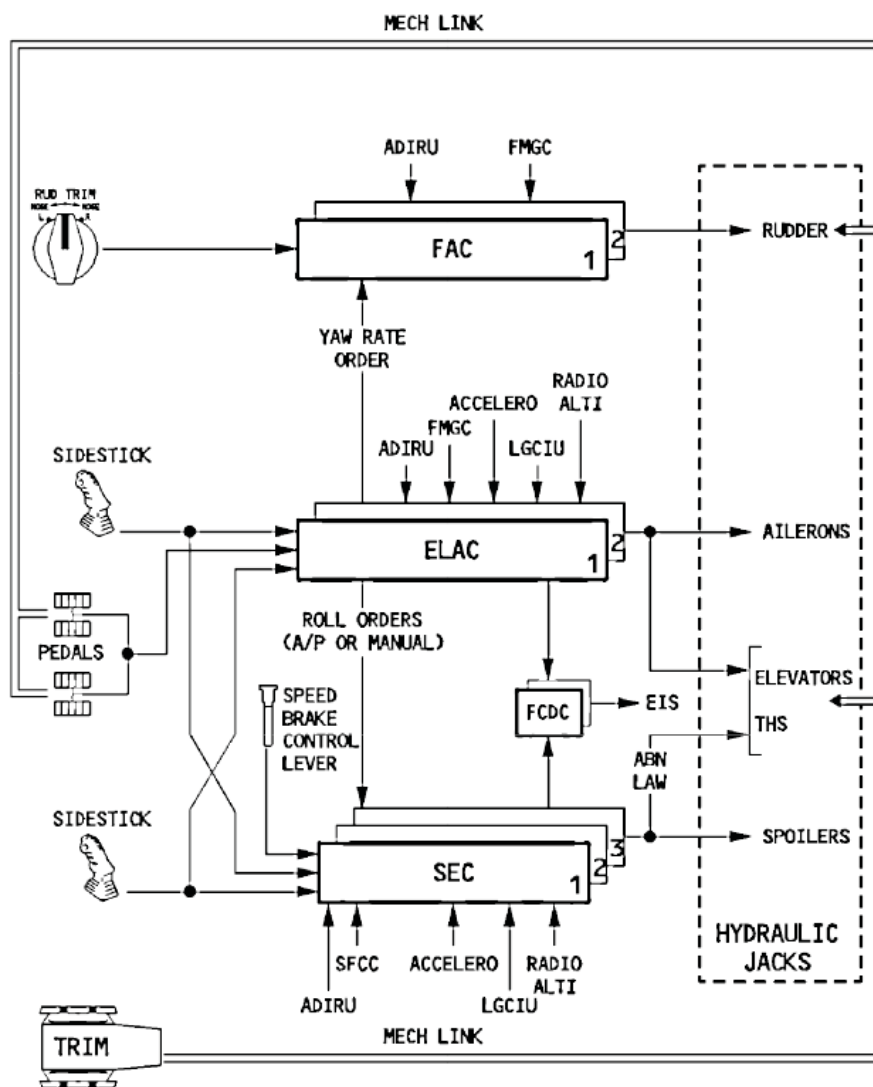
For: Spoilers control.

Standby elevator and stabilizer control.

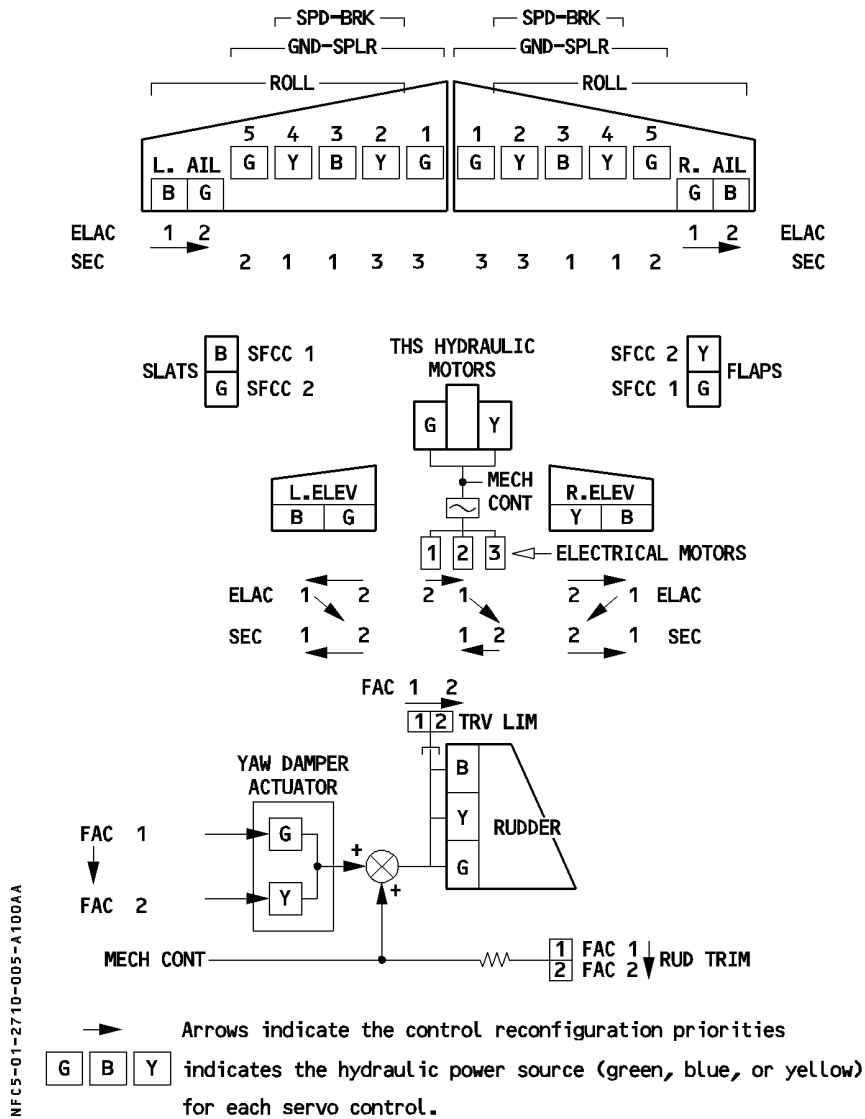
2 FACs. (Flight Augmentation Computer)

For: Electrical rudder control.

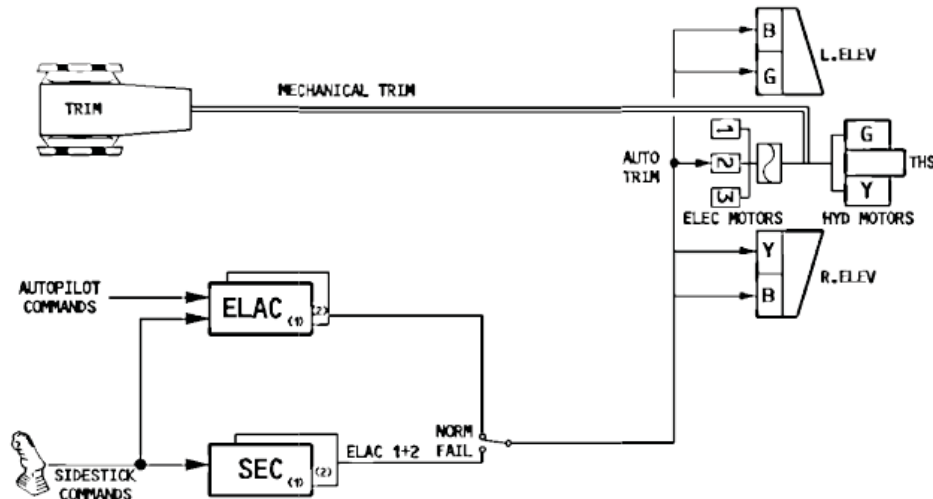
In addition 2 FCDC. Flight Control Data Concentrators (FCDC) acquire data from the ELACs and SECs and send it to the electronic instrument system (EIS) and the centralized fault display system (CFDS).



Architecture.



Pitch Control.



Two elevators and the Trimmable Horizontal Stabilizer (THS) control the aircraft in pitch. The maximum elevator deflection is 30 ° nose up, and 17 ° nose down. The maximum THS deflection is 13.5 ° nose up, and 4 ° nose down.

Electrical Control.

- In normal operations, ELAC2 controls the elevators and the horizontal stabilizer, and the green and yellow hydraulic jacks drive the left and right elevator surfaces respectively. The THS is driven by N° 1 of three electric motors.
- If a failure occurs in ELAC2, or in the associated hydraulic systems, or with the hydraulic jacks, the system shifts pitch control to ELAC1. ELAC1 then controls the elevators via the blue hydraulic jacks and controls the THS via the N° 2 electric motor.
- If neither ELAC1 nor ELAC2 is available, the system shifts pitch control either to SEC1 or to SEC2, (depending on the status of the associated circuits), and to THS motor N° 2 or N° 3.

In case of failure, the actuators are reconfigured,

Mechanical Control. Mechanical control of the THS is available from the pitch trim wheel at any time, if either the green or yellow hydraulic system is functioning.

Mechanical control from the pitch trim wheel has priority over electrical control.

Actuation.

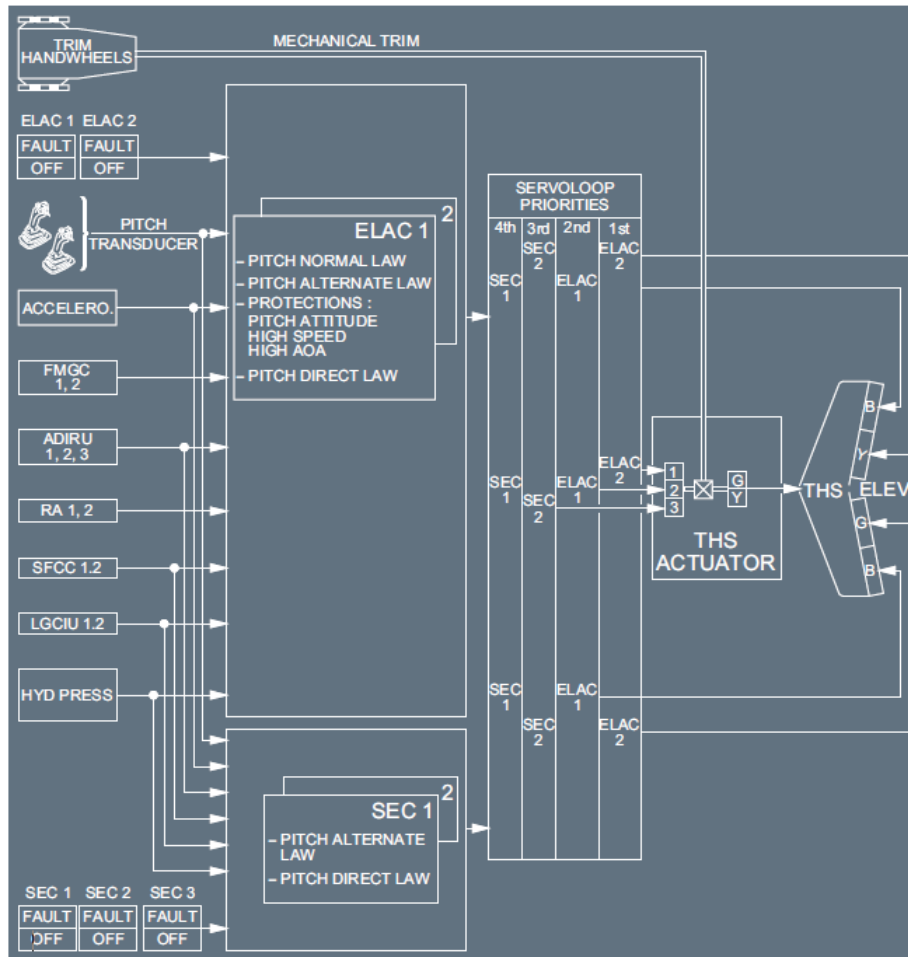
Elevators

- Two electrically-controlled hydraulic servojacks drive each elevator.
Each servojack has three control modes:
 - Active: The jack position is electrically-controlled.
 - Damping: The jack follows surface movement.
 - Centering: The jack is hydraulically retained in the neutral position.
- In normal operation:
 - One jack is in active mode.
 - The other jack is in damping mode.
 - Some maneuvers cause the second jack to become active.
- If the active servojack fails, the damped one becomes active, and the failed jack is automatically switched to damping mode.
- If neither jack is being controlled electrically, both are automatically switched to the centering mode.
- If neither jack is being controlled hydraulically, both are automatically switched to damping mode.
- If one elevator fails, the deflection of the remaining elevator is limited in order to avoid putting excessive asymmetric loads on the horizontal tailplane or rear fuselage.

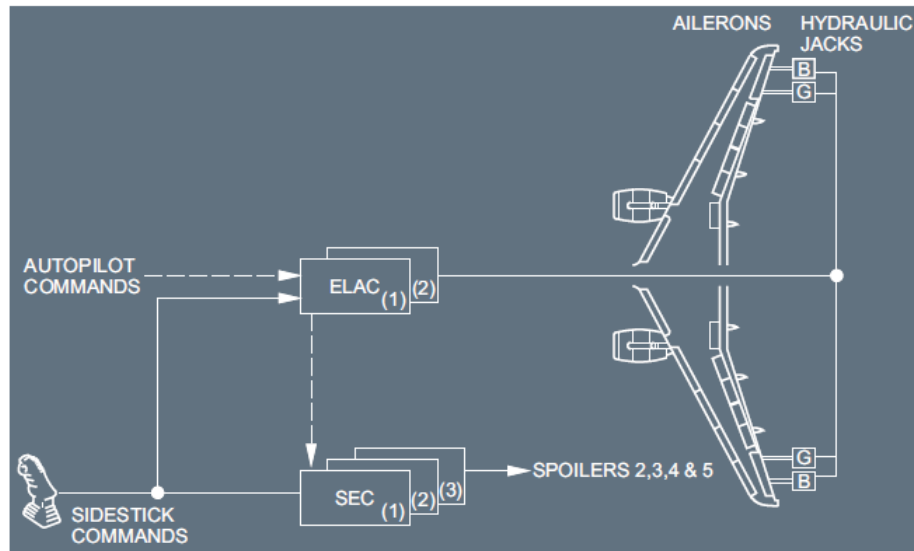
Stabilizer

- A screwjack driven by two hydraulic motors drives the stabilizer.
- The two hydraulic motors are controlled by:
 - One of three electric motors, or
 - The mechanical trim wheel.

Pitch Control Schematic.



Roll Control.



One aileron and four spoilers on each wing control the aircraft about the roll axis.

The maximum deflection of the ailerons is 25 °.

The ailerons extend 5 ° down when the flaps are extended (aileron droop).

The maximum deflection of the spoilers is:

A319/A320 – 35 °

A321 – 35 ° for spoilers 2, 4, and 5 and 7 ° for spoilers 3.

Electric Control.

- The ELAC 1 normally controls the ailerons.
If ELAC1 fails, the system automatically transfers aileron control to ELAC2.
If both ELACs fail, the ailerons revert to the damping mode.
- SEC3 controls the N° 2 spoilers, SEC1 the N° 3 and 4 spoilers, and SEC2 the N° 5 spoilers.
If a SEC fails, the spoilers it controls are automatically retracted.

Actuation.Ailerons

Each aileron has two electrically controlled hydraulic servojacks.

One of these servojacks per aileron operates at a time.

Each servojack has two control modes:

- Active: Jack position is controlled electrically
- Damping: Jack follows surface movement.

The system automatically selects damping mode, if both ELACs fail or in the event of blue and green hydraulic low pressure.

Spoilers

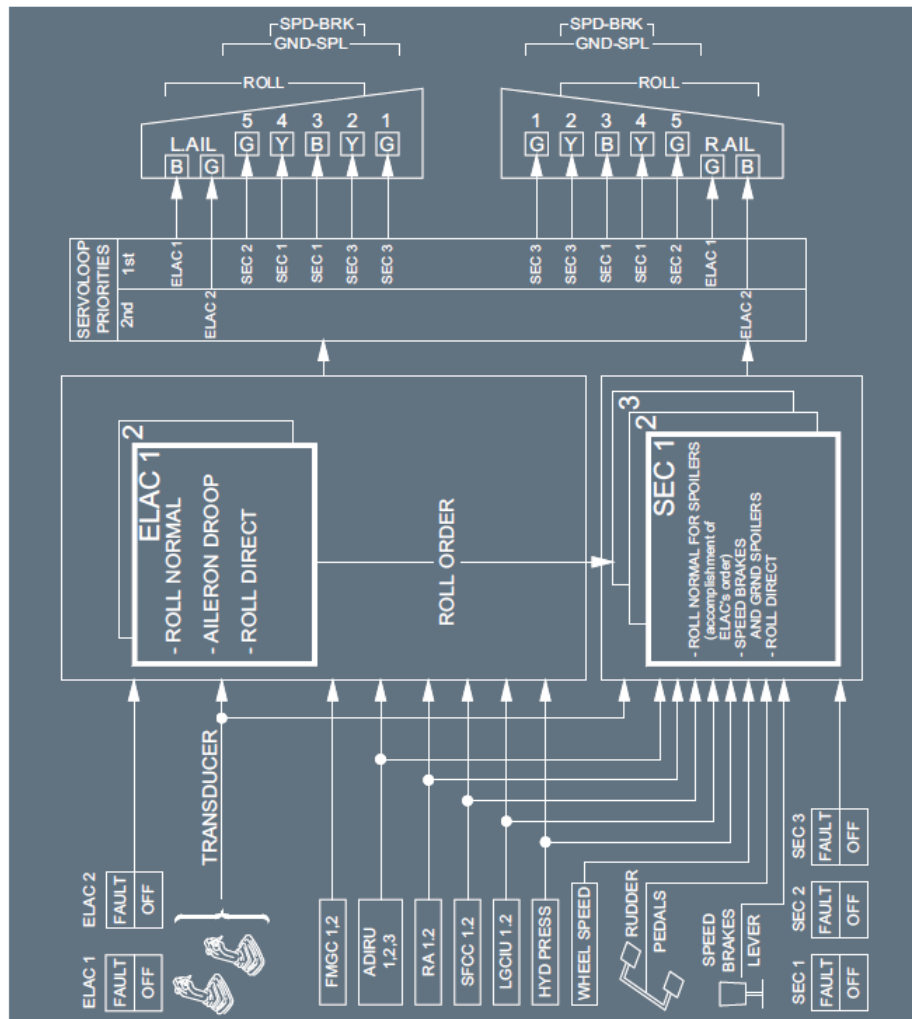
A servojack positions each spoiler. Each servojack receives hydraulic power from either the green, yellow, or blue hydraulic system, controlled by the SEC1, 2 or 3.

The system automatically retracts the spoilers to their zero position, if it detects a fault or loses electrical control.

If the system loses hydraulic pressure, the spoiler retains the deflection it had at the time of the loss, or a lesser deflection if aerodynamic forces push it down.

When a spoiler surface on one wing fails, the symmetric one on the other wing is inhibited.

Roll Control Schematic.



Speed Brakes and Ground Spoilers. The pilot controls the speedbrakes with the speedbrake lever.

The speedbrakes are actually spoilers 2, 3 and 4.

Speedbrake extension is inhibited, if:

- SEC1 and SEC3 both have faults.
- An elevator (L or R) has a fault (in this case only spoilers 3 and 4 are inhibited).
- Angle-of-attack protection is active.
- Flaps are in configuration FULL (A319 / A320) and 3 or FULL (A321).
- Thrust levers above MCT position.
- Alpha Floor activation.

If an inhibition occurs when the speedbrakes are extended, they automatically retract and remain retracted until the inhibition condition disappears and the pilots reset the lever.

(The speedbrakes can be extended again, 10 seconds or more after the lever is reset).

When a speedbrake surface on one wing fails, the symmetric one on the other wing is inhibited.

• **Note** •

1. For maintenance purposes, the speedbrake lever will extend the N° 1 surfaces when the aircraft is stopped on ground, regardless of the slat/flap configuration.
2. When the aircraft is flying faster than 315 kt or M 0.75 with the autopilot engaged, the speedbrake retraction rate is reduced (Retraction from FULL to in takes about 25 seconds).

The maximum deflection for the spoilers is:

A319:

- 25 ° for spoilers 3 and 4;
- 12.5 ° for spoiler 2 in configuration 3, and 17.5 ° in other configurations.

A320:

The maximum speedbrake deflection in manual flight is:

- 40 ° for spoilers 3 and 4
- 20 ° for spoiler 2.

The maximum speedbrake deflection with the autopilot engaged is:

- 25 ° for spoilers 3 and 4
- 12.5 ° for spoiler 2.

The maximum speedbrake deflection achievable with the autopilot engaged is obtained by setting the speedbrake lever to the half way position. On setting the position of the speedbrake lever from half to full, no increase in speedbrake deflection will be achieved.

A321:

- The maximum deflection for the spoilers 2, 3 and 4 is 25 °.

For these surfaces (which perform both roll and speedbrake functions) the roll function has priority. When the sum of a roll order and a simultaneous speedbrake order on one surface is greater than the maximum deflection available in flight, the same surface on the other wing is retracted until the difference between the two surfaces is equal to the roll order.

Ground Spoiler Control. Spoilers 1 to 5 act as ground spoilers. When a ground spoiler surface on one wing fails, the symmetric ground spoiler surface on the other wing is inhibited.

Arming

The pilot arms the ground spoilers by pulling the speedbrake control lever up into the armed position.

Full Extension – Rejected Takeoff Phase

- If the ground spoilers are armed and the speed exceeds 72 kt, the ground spoilers will automatically extend as soon as both thrust levers are reset to idle.
- If the ground spoilers are not armed and the speed exceeds 72 kt, the ground spoilers will automatically extend as soon as reverse is selected on one engine (the other thrust lever remains at idle).

Full Extension - Landing Phase

Basic Aircraft

- If the ground spoilers are armed and all thrust levers are at idle, the ground spoilers will automatically extend as soon as both main landing gears have touched down.
- If the ground spoilers are not armed and both main landing gears have touched down, the ground spoilers will automatically extend as soon as reverse is selected

Configuration Warnings. The following warnings and cautions appear in the lower part of the E/WD if the aircraft is not in takeoff configuration when the flight crew presses the TO CONFIG pushbutton on the ECAM control panel or applies takeoff power.

Warnings/Cautions	TO Config Test	TO Power
BRAKES HOT (A)	Triggered	Triggered
CONFIG RUD TRIM NOT IN TO RANGE (R)		
CONFIG PITCH TRIM NOT IN TO RANGE (R)		
CONFIG FLAPS NOT IN TO CONFIG (R)		
CONFIG SPD BRK NOT RETRACTED (R)		
CONFIG SLATS NOT IN TO CONFIG (R)		
CONFIG L SIDESTICK FAULT (R)		
CONFIG R SIDESTICK FAULT (R)		
DOOR (A)		
F/CTL FLAP/MCDU DISAGREE (A) ^{1, 2}		
F/CTL PITCH TRIM/MCDU/CG DISAGREE (A) ¹		
FUEL R(L) TK PUMP 1+2 LO PR (A) ¹		Not Triggered
HYD G(Y) ENG 1(2) PUMP LO PR (A) ¹		
HYD G(Y)(B) SYS LO PR (A) ¹		
ELEC IDG 1(2) DISCONNECTED (A) ¹		
ELEC GEN 1(2) FAULT (A) ¹		
ELEC GEN 1(2) OFF (A) ¹	Triggered if the two GENs are inop.	
ENG 1 OIL LO TEMP (A) ¹	Triggered	
ENG 2 OIL LO TEMP (A) ¹		
CONFIG PARK BRK ON (R)	Not Triggered	Triggered
ENG THR LEVERS NOT SET (A)		

¹ As installed.

(A) Amber

(R) Red

² Caution is inhibited in case of CONFIG FLAPS NOT IN T.O CONFIG warning.