AIRBUS A320

Flight Tutorial

Fault management

For X-PLANE

The first flight tutorial allowed us to familiarize ourselves with the onboard instruments, create and modify a flight plan with the MCDU as well as learn about the different systems linked to the FCU.

It is therefore necessary to have a good understanding of the normal operation of the Airbus A320 from the creation of a flight plan to landing because, these normal operations during an incident-free flight will not be detailed here.

In this tutorial we will describe the actions to take in the event of a breakdown, and particularly initially, in the event of breakdowns that could affect the engines.

The Toliss Airbus A320 comes with a module, the ISCS, which we know well for situation backups, performance calculations, ground operations and many other things.

A tab is dedicated to failures: FAULT SCENARIOS.
This tab allows you to program different failures as we will see later, but in this tutorial, we will only cover failures affecting an engine.
Once you have mastered the management of these failures, it will be easy to manage the other available ones.

This tutorial includes :

1. Preparing a flight from NICE (LFMN) to TOULOUSE (LFBO).

   Flight plan programming and takeoff performance input into the MCDU.
   Secondary flight plan programming.
   Routine preparation of the aircraft for takeoff.
   Taxiing to runway 04R in NICE.

2. The detailed description of the ECAM.

3. The role of pilots.

4. Take-off and failure management:

   - Engine failure before V1.
   - Engine failure after V1.

Flight preparation from Nice to Toulouse.

The situation: Parked at Gate 48A of LFMN after our first flight of the day.

- **Preparation of the main flight plan**.

The flight plan to our next destination is :
`LFMN SID TURIL UL127 FJR DCT AFRIC STAR LFBO.`

ALTN / CO RTE: LFML (MARSEILLE).
COST INDEX 75 .
Flight level : FL340.
Transition altitude : 5000 ft.
Departure : SID: TURI7A.
Initial climb : FL120.

Arrival : STAR AFRI7S.

(A different flight plan is possible depending on the current FMGC database).

Block fuel: 5.5 (for information purposes, this value can be reduced or increased).

PERF: V1 140; VR 140; V2 142 (enter the values indicated in your ISCS).
FLEX TO TEMP: 70.

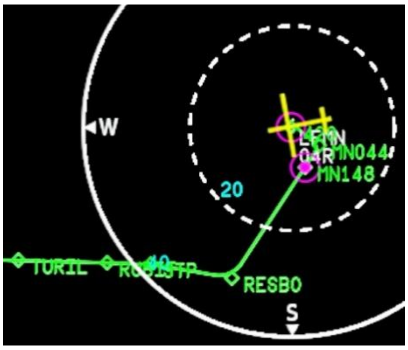
- **Preparation of the secondary flight plan**.

We saw in the previous tutorial that the secondary flight plan allows you to program a different departure runway or to prepare an immediate return to the departure airport following a failure that prevents the flight from continuing under safe conditions, or due to another unforeseen event.

In the vast majority of cases, it is the preparation for an immediate return that is considered.

To access the secondary flight plan, press the SEC F-PLN button on the MCDU.
Then copy the active flight plan into the secondary plan.

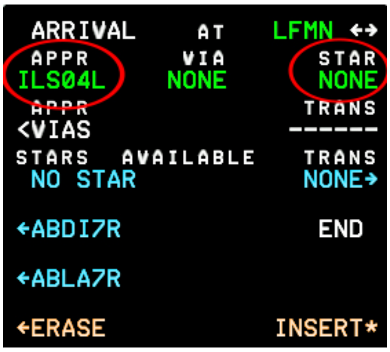
The secondary flight plan appears in white in the MCDU, and on the ND (here in PLAN mode), it merges with the main plan.



Now we need to change the destination airport.

We will choose a waypoint near our destination, which will become the last one in our secondary flight plan : RESBO.

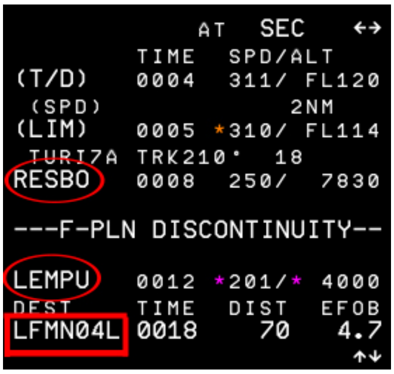
Open the RESBO side review page and enter LFMN in the NEW DEST field.



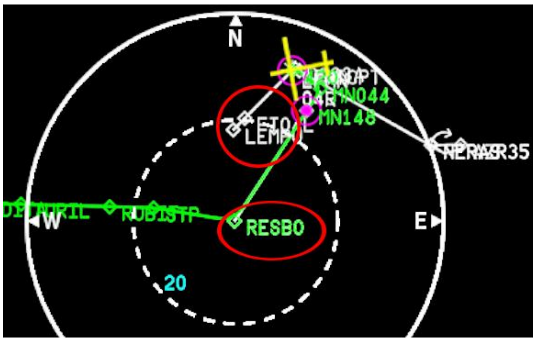
The new flight plan appears on the MCDU. All that remains is to fill in the ARRIVAL page at LFMN :

Select runway 04 L.

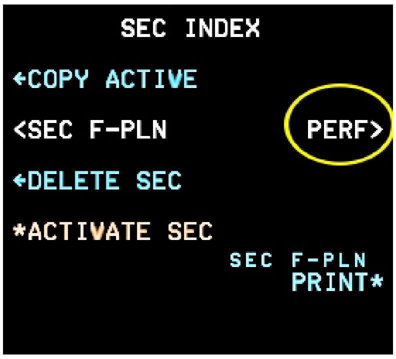
NO STAR



The last waypoint is indeed RESBO, and a new waypoint was automatically created in line with the runway : LEMPU.



These flight plans are just examples, and over time, AIRACS will have changed. You will adapt your flight plans to the situation at hand, and you can even create different flight plans. The main focus of this tutorial is on fault management.



To complete the preparation of an immediate return, you must open the **PERF pages** from the SEC INDEX page :

- Phase SEC APP.
  left column, then right column (Baro 390 in NICE).
- Phase SEC GO AROUND.
  (Don't forget to change the default value of the field ENG OUT ACC which must be at 1010 in NICE).

After the usual checks: Pre-taxi checklist, engine start, preparation of the aircraft configuration for flight (FLAP 1+F, SPOILER ARM, AUTO BRK MAX),

Alignment on runway 04R.

Final checks before takeoff: TO CONFIG on ECAM,

<u>Make a backup of the situation, which will serve as the starting point for the rest of the tutorial.</u>

ECAM.
Electronic Centralized Aircraft Monitor.

It is associated with a sound and light alarm system.

The ECAM consists of two main screens :

UPPER ECAM : E/WD (Engine/Warning Display).
Displays :
- Engine information (N1, EGT etc.).
- Alarms and memos.

LOWER ECAM: SD System Display.
Displays :
- A schematic view of each system (FUEL, APU, ELEC etc.)
- Alarms and memos.

ECAM control panel (on the pedestal).
Allows you to manually select system pages and clear faults using the two CLR keys (see details page 6).

E/WD - Upper ECAM.
ENGINE/WARNING DISPLAY.

The upper screen of the ECAM is divided into three parts:

①Central part: engine-related information.

-Top right: thrust mode linked to the lever position, % power and FLEX temperature.
-Below: fuel and flap position.

②Warning and alert zone.
Their color indicates the level of importance: green for information messages, amber for warning messages and red for serious alerts.

Example: an important message reminding indicating that the flaps have not been extended to the position specified in the MCDU.

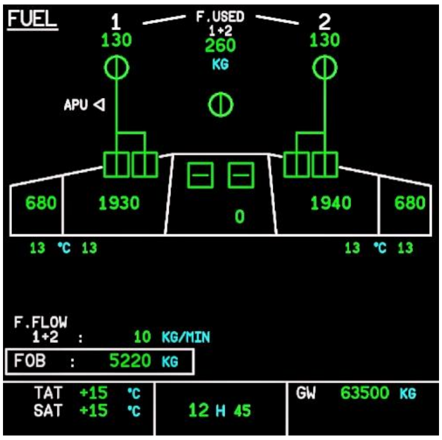
This area also displays takeoff and landing checklists: blue elements indicate actions to be performed. Here, spoilers must be armed, and the takeoff config test before must be completed.

This area is also used to display failures and the corresponding procedures to resolve them.

③Status message area.

The importance of these messages is again indicated by their color: green, amber or red.

An exception applies to the T.O. INHIBIT and LAND INHIBIT messages which are displayed in magenta. These inform the crew that all secondary alerts are deactivated so as not to cause distraction during takeoff and landing.



SD - Lower ECAM

SYSTEM DISPLAY

The upper part displays the status of the different systems:

- ✓ ENG : Engines (N1, EGT, oil, etc.).
- ✓ BLEED : Air intakes, pressurization.
- ✓ ELEC : Electrical system.
- ✓ HYD : Hydraulic systems.
- ✓ F/CTL : Flight controls.
- ✓ FUEL : Fuel (displayed here).
- ✓ APU : Auxiliary Power Unit.
- ✓ COND : Air conditioning, cabin pressurization.
- ✓ DOOR : Doors.
- ✓ WHEEL : Wheels, brakes, temperature.
- ✓ STS : Failure status.

These pages are automatically selected depending on the current action. For example, the APU page is displayed when the APU is started, provided that no page is manually selected.

The bottom part always displays the same information, regardless of the selected page:

- ✓ TAT : Total Air Temperature.
- ✓ SAT : Static Air Temperature.
- ✓ Clock: (UTC Time).
- ✓ GW : Gross Weight (total mass) calculated by the FMGC based on the data entered in the INIT pages of the MCDU. If these are not entered, GW will display XX in amber instead of the weight.

ECAM control panel.

Located on the pedestal between the two pilots, it allows interaction with both ECAM screens (E/WD and SD).

The two rotary knobs on the left adjust the brightness of the two ECAM screens.

- ✓ The T.O CONFIG button is used to check before takeoff that the aircraft is correctly configured.
- ✓ 11 buttons allow you to manually display the 11 system pages :
  ENG, BLEED, PRESS, ELEC, HYD, APU, COND, DOOR, WHEEL, F/CTL and STS.
  Here the light associated with the FUEL button is on and the FUEL page is permanently displayed on the SD.
  In this case, automatic selection of system pages is disabled because the FUEL page has been manually displayed. To return control to the system, press the FUEL button, the light goes out, and the system automatically displays the appropriate page.
- ✓ The ALL button allows you to view all the system pages successively with each press.
- ✓ The two CLR buttons allow you to clear the fault checklist messages in the E/WD message area and display the next page (indicated by a green arrow ↓).
- ✓ The RCL button recalls old messages that have not been displayed or processed.
- ✓ *It also allows cancellation of an alarm display for the remainder of the flight.*

CREW PILOTING.

The technical crew in the cockpit consists of two pilots:

- Captain:
  Ultimately responsible for the flight (safety, decisions, regulatory compliance).
  Sits on the left.
- First officer:
  As co-pilot, assists the captain and take over if the captain becomes unavailable.

Both captain and first officer hold the same qualification. They and alternate between the roles of Pilot Flying (PF) and Pilot Monitoring (PM) to maintain versatility and ensure skill retention. On each flight, one is PF, the other PM.

Monitoring means supervising and understanding all elements related to trajectory and system operation.

Role of the Pilot Flying (PF):

1. **Primary task:** pilot, control and monitor the aircraft's trajectory and navigation following procedures and regulations.
2. **Secondary task:** monitor actions carried out by the PM that do not directly involve trajectory.

Role of the Pilot Monitoring (PM):

1. **Primary task:** supervise trajectory and navigation.
   In case of deviation, alert the PF and if needed, intervene.
2. **Secondary task:**
   - ✓ ATC Communications
   - ✓ Checklists (reading and performing actions as needed)
   - ✓ Monitoring aircraft systems
   - ✓ Other operational tasks

Why two pilots are essential:

1. Safety.
   a) Human redundancy: If one pilot becomes unfit (fatigue, medical issue, etc.), the other can take over.
   b) Mutual verification: pilots monitor each other to avoid human errors (missed checklists, navigation mistakes).
2. Task distribution.

   The workload is split between PF and FM, reducing error risks, especially during critical phases (takeoff, approach, landing or in emergency emergencies and complex situations (difficult weather) etc.
   Regulations.

   Required by civil aviation rules.

   A single pilot cannot safely manage all operations, especially under stress or fatigue. Two brains and four hands are essential to ensure safety.

FRONT ENGINE FAILURE V1.

This situation is covered in the tutorial even though it does not require any complex handling by the pilots, as the correct response is simply to abort takeoff.

The aircraft is ready for takeoff from runway 04R.

Open the FAULT SCENARIOS tab in the ISCS.

- Upper part: leave ENABLE RANDOM FAULTS set to OFF.
- Lower part:
  - ✓ Click on ADD NEW FAULT.
  - ✓ In the SELECT field that appears, choose ENG1 (or ENG2).
  - ✓ Then select the IAS speed: 110 (any speed between 10 knots and V1 to account for fault detection time and the appearance of the E/W message and the audible alarm).

Now the failure is scheduled.

The PF proceeds with takeoff:

- ✓ At 100 knots the PM announces 100.
- ✓ At 120 knots engine 1 fails.
- ✓ The alarm sounds, and the upper ECAM displays: ENG1 FAIL.
- ✓ The PM announces ENG 1 FAIL.
- ✓ The PF pulls the throttles back to idle and announces STOP: takeoff is aborted.

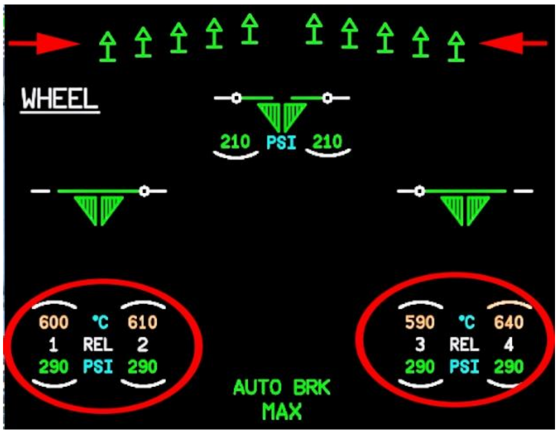
The autobrake activates to MAX and the spoilers deploy automatically.

The aircraft stops. The ECAM message area indicates:

ECAM checklist advises waiting for brakes to cool down before attempting another takeoff.

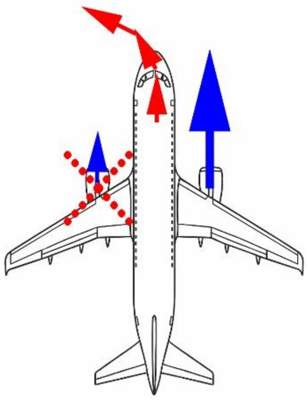
The WHEEL page of the lower ECAM indicates brake temperature around 600°C or higher.

Taxi back to the gate.



ENGINE FAILURE AFTER V1.

The main effects of engine failure-:



1. The Airbus A320 being a twin-engine aircraft, a failure of one of them causes a strong thrust asymmetry.

   For example, if the left engine stops working, the right engine (the live engine) continues to push, creating a lateral imbalance.

   The aircraft will rotate on its yaw axis on the side of the failed engine.

   The PF (Flying Pilot) must correct mainly with the right rudder pedal to maintain the trajectory axis.

2. Loss of performance.

   In the event of a total loss of thrust, performance is reduced by 50%, or even more given the additional drag.

Engine failure on takeoff is a must-do exercise for any multi-engine aircraft pilot.

Airbus distinguishes two cases:

1. Engine failure without damage (it is assumed that the engine may restart).
2. Engine failure with damage (engine is considered lost).

To make the distinction in the simulator, we will mainly look at the N1 (blower engine speed).
If the N1 is zero, or very low, this shows that the blower is damaged, so a restart is excluded.

Severe vibrations also indicate that the engine has suffered damage (broken blade, internal damage).

For Airbus, the manufacturer prioritizes what it calls engine safety.

- If the engine has no damage, the engine is considered safe when the master engine of the failed engine is turned OFF.
- If the engine has suffered damage, the engine is considered lost and the fire valve must be closed and a fire extinguisher discharged.

In this tutorial, we will detail the actions to be taken in the event of an engine failure at the most unfavorable moment, that is to say just at the so-called decision speed, called V1 or shortly after.

Managing an engine failure.

Airbus has defined 3 rules, called golden rules : FLY, NAV, COM.

1. FLY : the priority is to get the plane flying.
   Maintain an attitude, bank and engine thrust appropriate to the situation.
   - ✓ When the engine fails, the aircraft will experience a strong yaw moment, due to the thrust asymmetry.
     The pilot must first cancel this yaw by pushing on the rudder pedal on the side where the engine is still working (this is called the live engine).
     The rudder trim rotary switch and RESET pushbutton are not active when the autopilot is engaged.
   - ✓ After the rotation, carried out at the speed called VR, the pilot will have to compensate for this effort, thanks to the yaw compensator (rudder trim).
   - ✓ Then maintain the SRS vertical guidance mode, which will give the attitude adapted to the reduced thrust due to the engine failure (approximately 12°).
2. NAV : then, the pilot must ensure that the trajectory followed does not present any danger and respects the flight plan.
3. COM : notify air traffic control to inform them of the engine failure, our intentions, “PAN PAN” or “MAYDAY” message, then inform passengers of an immediate return.

After detecting an engine failure, the actions to be carried out by the two pilots follow one another quickly, and stress must also be managed.

At each phase of our flight, and to read all the flight instruments correctly, it is advisable to press the PAUSE button on our simulator, then resume the flight.
Some will think that this PAUSE button does not exist on the real aircraft, and therefore that it is not realistic. But our flight is not carried out in a realistic situation since in reality there are always two pilots which is not the case for us who will assume the two functions of PF and PM, unless we carry out our simulation in a shared cockpit, which is possible in X-PLANE.
On the other hand, we will program a breakdown in the ISCS, which removes any element of surprise, whereas in reality a breakdown can occur at any time without warning.

For these reasons, do not hesitate to press the PAUSE button.

Programming an engine failure on takeoff.

Open the FAULT SCENARIOS tab in ISCS.

- Upper part : ENABLE RANDOM FAULTS leave on OFF.
- Lower part:
  - ✓ Click on ADD NEW FAULT.
  - ✓ In the SELECT field that appears, select ENG1.
  - ✓ Then select FAIL (W DAMAGE) : with damage, the engine is lost.
  - ✓ Then select IAS.
  - ✓ Set the CAS [KTS] slider to 140 or higher if you prefer to trigger the failure on initial climb.

The following two options are:

- RECVRBL = recoverable. The engine can be restarted.
- NO DAMAGE = no damage to the engine, we can try to restart.

Other options are available on the ISCS, you can test them later.

We will choose FAIL (W DAMAGE) so we don't have to restart the engine.

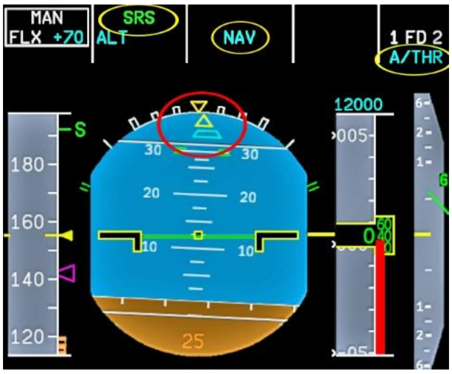
TAKEOFF WITH ENGINE FAILURE.

We are lined up on runway 04R, ready for takeoff.

Two roles have been defined: Pilot Flying (PF) and Pilot Monitoring (PM), and you are the PF. We will describe the role of the two pilots. Since you are alone in the cockpit, you will have to carry out the actions of each of them.

1. **The PF advances the throttle to display 50% of N1, parking brakes applied**.
   He pushes slightly on the handle (half a deflection) to keep the front wheel on the ground).
2. When both engines are stabilized at 50%, he releases the brake.
3. **The PF advances the levers into the FLEX / MCP notch.**
   Regardless of the FLEX or TO/GA departure, the PM takes a cue when releasing the brakes because we must not exceed 10 minutes in TO/GA to avoid damaging the engines. This is why the PM starts his stopwatch to avoid exceeding this duration.
4. The PM announces “THRUST SET” after checking on the FMA that the thrust is indeed FLEX.
5. The PM announces “100 Kts” (one hundred knots); the PF replies “CHECKED”.
   This allows cross-checking of the two anemometers and detection of any possible speed anomaly.
6. The PM announces V1 then rotation.
7. The PF performs the rotation.

ENGINE FAILURE 1 (left)



The FMA tells us that:

- We are in SRS vertical management mode.
- NAV mode is armed.
- The A/THR is armed but not active.

The turn angle indicator has changed appearance.

The Beta target has changed from yellow to blue and is shifted revealing a thrust asymmetry.

The explanation is given by ECAM:

The message ENG 1 FAIL (amber) is displayed in the warnings and alerts area.

Higher up, the engine parameters confirm the message.

PM announces "ENGINE 1 FAIL".

In this situation, golden rule number 1 must be applied:
Fly, Navigate, Communicate, in that order, with the appropriate division of labor.

Maintain control of the aircraft on the ground until VR if the failure occurred between V1 and VR.

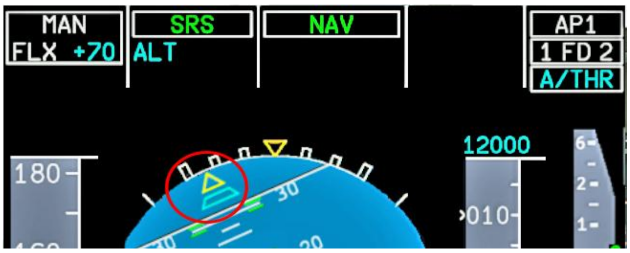
Perform the rotation at VR.

The FLY (to fly): the priority is to compensate for the aircraft's yaw.

1. The PF must compensate for the aircraft yaw by pushing on the rudder pedal on the side where the engine is still running (live engine).
   In our case, the left engine is out, the PF will press the right foot on the rudder pedal to counter the effect of the asymmetry which makes the plane turn to the left.
   The goal is to center the beta target (blue) on the tilt indicator (yellow triangle).
2. Then the PF will compensate for the rudder pedal effort using the yaw trim to the right.
3. PM announces “POSITIVE CLIMB”.
4. The PF asks for “GEAR UP”.
5. The PM retracts the landing gear and announces “GEAR UP”.
   then he disarms the spoilers

Then you must maintain the pitch angle to maintain the attitude adapted to the SRS (Speed Reference System) speed by following the green horizontal bar of the FD.

The aircraft being correctly trimmed, the AP can be engaged.



1. It is necessary to ensure that the trajectory does not present any danger.
   (In our case in NICE, there is relief in the axis of the runway).
2. NAV is now active (green),
   (it was armed: blue).

If necessary, take a heading in HDG mode on the FCU, then integrate the trajectory of our flight plan in NAV mode.

The FLY is finished: fault treatment.

While the PF concentrated on piloting, the PM analyzed the engine failure and monitored the aircraft's trajectory.

Now the breakdown must be addressed, at the initiative of the PF.

The PF announces “ECAM ACTION”:

The ECAM and its drop-down checklist will give us the instructions necessary to resolve the fault.

ECAM now displays :

- The name of the breakdowns is underlined (amber color): ENG 1 FAIL.
- Actions to be taken (blue color).
  -ENG START SEL......IGN
  -THR LEVER 1.......IDLE
- The conditions for performing the following actions (white color).

As soon as the actions are performed, the corresponding lines are automatically deleted.

1. **Turn the ENG START rotary knob to IGN position**.
   (PM action monitored by the PF).

   The screen opposite is displayed:
   The ENG START SEL…IGN line is cleared.

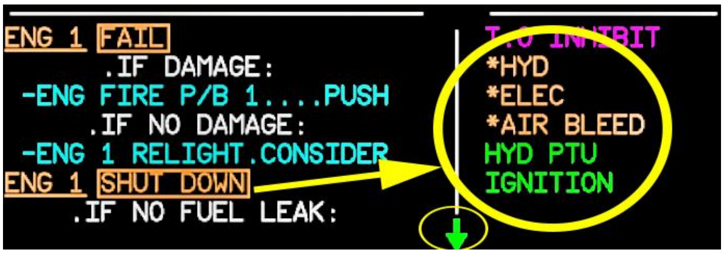
2. **Bring back the throttle of engine 1 to IDLE position**.
   (PF action monitored by the PM).

   On the screen opposite, the line THR LEVER 1…IDLE is also deleted.

Now let's perform the following action: -ENG MASTER 1.......OFF
subject to the condition IF NO RELIGHT AFTER 30S (white color).

The engine did not restart after 30 seconds:
We move the main switch of engine 1 to OFF.

The following screen appears:



On the left, a new amber line is displayed:
ENG 1 SHUT DOWN .
It causes 5 notifications to be displayed in the status message area, including 3 important ones in amber, which we will analyze later.

But first and foremost, the following action must be taken: -ENG FIRE P/B 1....PUSH
since our breakdown is with DAMAGE therefore irrecoverable.

This involves activating the engine 1 firewall which shuts off the fuel pumps and the engine 1 electric generator (located on the overhead panel).

Note: these actions are carried out by the PF or by the PM, always under the monitoring control of the PM and the PF depending on the case, in order to avoid any risk of error which would significantly worsen the situation: it is not a question of cutting off the power supply to the live engine by mistake (this has happened!).

3. **Open the protective cover of the engine fire button 1**.
(PM action monitored by the PF).

4. **Press the fire button** (this action is irreversible).
(PM action monitored by the PF).

Immediately, the display of engine parameters 1 disappears and is replaced by amber-colored XX.

The following instructions in case of damage are:
-AGENT1 AFTER 8 S.DISCH (Wait for the 10 second countdown).

After counting down the 10s, the instruction AGENT 1 …DISCH appears (blue color).

5. **Press the AGENT 1 button.**
(PM action monitored by the PF).

The extinguisher will empty into the engine, and once finished, the yellow DISCH word will light up on the button.

The ECAM displays the messages opposite.

6. **PM announces "ENGINE 1 SECURED".**

7. **PF announces "STOP ECAM"**
It is now necessary to temporarily stop the instructions given by the ECAM because the priority now that the aircraft's trajectory and the engine are secure is to continue the flight.

At or above acceleration speed:
in NICE, it's 1010 (see the MCDU PERF page).

8. **The PF presses the PUSH TO LEVEL OFF button on the FCU**
and announces "PUSH TO LEVEL OFF", the PM replies "CHECKED",
The PF ANNOUNCES "VS 0"
The plane stops climbing, levels off, and the speed increases.

The FMA displays:
Column 1: We are still in manual mode: MAN FLEX +70
Column 2: VS +0
Column 5: A/THR in blue, autothrust is armed but not active.

When the aircraft reaches speed S or above, the flaps must be retracted.

The PF announces “FLAPS 0”

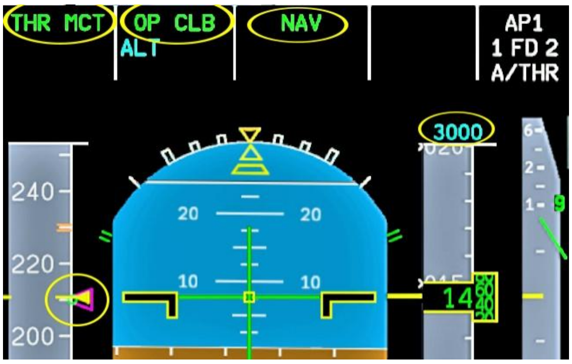
9. **The PM retracts the flaps and announces “FLAPS 0”**
10. **The PF sets the altitude on the FCU to 3,000 and announces “3,000 ft SET”.** The PM replies "CHECKED".

When the speed trend arrow reaches the green dot.

11. **The PF pulls the FCU ALT button and announces “open climb”.** PM replies "CHECKED".

When the LVR MCT message is flashing on the FMA.

12. **The PF brings the ENG 2 lever back into the CLIMB notch, then immediately pushes it back into the FLEX / MCT notch** and announces “THRUST MCT”. The PM replies “CHECKED”.



The FMA displays:

- ✓ Thrust management mode: THR MCT.
- ✓ Vertical guidance mode: OP CLB.
- ✓ -Horizontal guidance mode: NAV.

The upper ECAM displays the position of the lever in blue : MCT.

Column 5: A/THR has changed from blue to white. Controlled by the FMGS, it will be able to vary the thrust when other modes are engaged (SPEED, OP DES etc.) as long as the ENG 2 lever remains in the FLEX / MCT notch.

Caution: *the LVR MCT message flashes as soon as the green dot speed is reached.*
If the throttle is moved to the FLEX/MCT detent before pulling the FCU ALT button, the FMA will display SPEED in the first column instead of THR MCT.
After pulling the ALT button on the FCU, the FMA will display THR MCT.

The target speed is the green dot. The target altitude is 3,000.

Note: The trapezoidal-shaped sideslip indicator displayed under the yellow triangle (roll indicator), which was blue (beta target) has returned to yellow: Sideslip indicator (skid indicator).

The color of the skid target changes from yellow to blue~~,~~ in case of engine failure during takeoff and go-around if the aircraft is not in clean configuration (flaps) and the live engine power exceeds 80% of N1.
The beta target (blue), when centered, allows for optimal performance during climb in asymmetric thrust conditions.
In yellow, the sideslip (skid indicator) has returned to yellow, the aircraft is yaw trimmed, the sideslip is still present but it is adjusted for optimal performance.

The NAV is finished, let's move on to the COM (communication).

Inform the NICE control tower of our situation: engine failure, and of our intentions.
Inform passengers that we are returning to NICE.

13. Upon reaching the target altitude of 3000, the PF calls out "ALT STAR", then "ALT".
PM replies "CHECKED".
At level, we can continue the ECAM actions.

14. The PF announces "CONTINUE ECAM".

Both pages of our ECAM still have actions to be carried out in the left column.

Note: in the right column, LAND ASAP (As Soon As Possible): landing as soon as possible.

(This page is displayed after pressing the CLR key on the ECAM keyboard).

The right column shows urgent and non-urgent alerts that will need to be addressed after the failures.

We deal with the faults one after the other in the order in which they appear on the ECAM.

I. ENG 1 FAIL

The requested actions: ENG 1 START on IGN and THR LEVER 1 on IDLE having been executed, we can clear the first fault.

✓ The PM asks: "CLEAR ENGINE 1?".

✓ The PF responds "CLEAR ENGINE 1".

✓ The PM presses the CLR key on the ECAM keyboard.

-The line ENG 1 FAIL and the next two disappeared.

II. ENG 1 SHUT DOWN

The PM reads aloud the following breakdown: "ENG 1 SHUT DOWN",
then all subsequent lines as they are processed.

1) -IMBALANCE......MONITOR

Check on the FUEL page that there is no fuel imbalance between left and right.

2) -TCAS MODE SEL.......TA

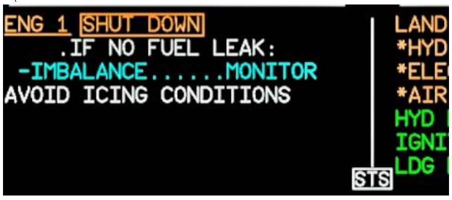
The PM turns the TCAS knob to the TA ONLY position and announces "TCAS TA".
(The TCAS MODE SEL….TA line is cleared.)

3) -X BLEED............SHUT

In the AIR COND panel in the upper panel, turn the X BLEED rotary knob to the SHUT position. (action announced by the PM).

Notice the PACK 1 button is lit FAULT, which is normal since engine 1 is stopped.

(The line X BLEED…SHUT is also deleted).



With the actions taken, we can verify that we are not in icing conditions. AVOID ICING CONDITIONS

Note: the blue line -IMBALANCE...MONITOR is always displayed because it does not imply an action to be performed but a simple check.

The line ENG 1 SHUT DOWN *can now be erased.*

PM asks "CLEAR ENGINE 1?".

The PF responds “CLEAR ENGINE 1”.

The PM presses the CLR key on the ECAM.

The left column failures are cleared.

The breakdowns have been dealt with, now it remains to analyze the alerts present in the right column of the ECAM.

A color code of the alert characters makes it possible to quickly identify critical or informative information:

LAND ASAP

Red: Level 3 alert (warning).
Urgent situation-: requires immediate action.
Here, the landing must be immediate.

LAND ASAP

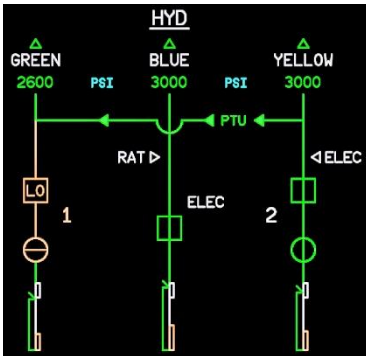
Amber: Level 2 alert (caution).
Abnormal situation: requires action, but not immediate.
Here, landing is necessary, after performing the actions required in the checklist.

IGNITION

Green: Normal status.

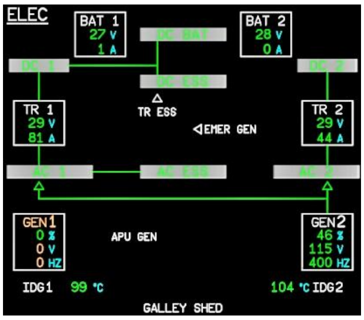
The PM reads aloud the lines of the right column of the ECAM, specifying the color.

1) PM announces “LAND ASAP amber”.



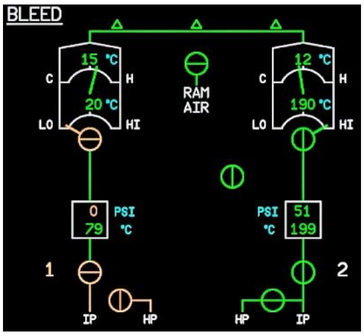
2) PM announces "HYD amber".
The HYD page is automatically displayed on the ECAM.
Check: the green circuit is supplied by engine 1, but the PTU provides pressure: Normal situation.

- ✓ PM asks “CLEAR HYD?”.
- ✓ PF responds “CLEAR HYD”.
- ✓ PM presses the CLEAR key on the ECAM: the amber HYD line is erased.



3) PM announces “ELEC amber”.
The ELEC page is displayed automatically.
Verification: GEN 1 is faulty since it is associated with ENG 1 down: Normal situation.

- ✓ PM asks “CLEAR ELEC?”.
- ✓ PF responds “CLEAR ELEC”.
- ✓ PM presses the CLEAR button on the ECAM: the amber ELEC line is erased.



4) PM announces “AIR BLEED amber”.
The BLEED page is displayed automatically.
Verification: BLEED 1 is faulty since it is associated with ENG 1 down: Normal situation.

- ✓ PM demande « CLEAR BLEED ? »
- ✓ PF répond « CLEAR BLEED »
- ✓ PM presses the CLEAR button on the ECAM: the amber BLEED line is erased.

The SUPERIOR ECAM now only displays green lines except for the LAND ASAP line.

All amber lines preceded by an * have been checked and deleted.

When the STATUS page is displayed (automatically) on the lower ECAM.

15. PM announces “STATUS”.

16. PF Responds “STOP ECAM”.

The PF wonders aloud if one of the following three questions should be considered :

a. Is it necessary to read a normal checklist?
b. Is a reset possible?
c. Can the engine be restarted?

These are the three generic questions that the crew asks themselves in all situations of failure of any kind occurring during any phase of the flight.

a. For example, a checklist may not have been read at the time of the breakdown because the crew was focused on dealing with an urgent problem.
We don't have any unread checklists.

b. After a flight instrument failure (MCDU, PFD, FD etc.), turning the instrument in question off and on again can resolve the problem and may modify the failures listed in the STATUS page. Engine failure is not affected by a reset.

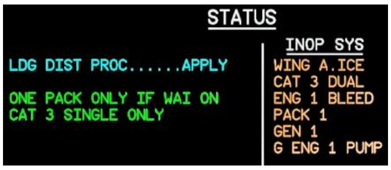
c. Can the engine be restarted?
The answer is no because we discharged one or two fire extinguishers which made the engine permanently inoperable.

This is when we think that starting the APU might be a good idea to get a larger quantity of compressed air and electricity when needed.

17. PF asks PM to turn on the APU.
The PM presses the MASTER SW button on the APU then START on the overhead panel.

18. PF announces "STOP ECAM".

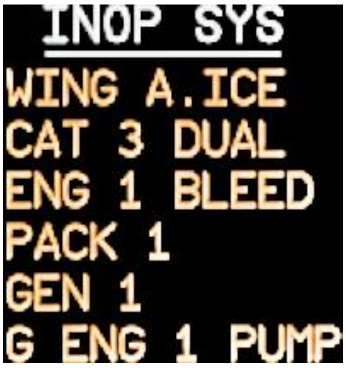
19. PF requests "READ STATUS".



The STATUS page of the LOWER ECAM is displayed automatically after the last page is erased (BLEED).

20. PM reads aloud the lines of the left column, then those of the right.

- **Left column**-: Information (green) or actions to be performed (blue).
  - : LDG DIST PROC......APPLY Landing procedure requiring the application of an increased distance.
  - : ONE PACK ONLY IF WAI ON If the wing anti-icing (WAI = Wing Anti Ice) is activated, only one air conditioning PACK must remain in operation.
  - : CAT 3 SINGLE ONLY Automatic approach capability in CAT 3 (very low visibility conditions) is limited to SINGLE mode (mono PA), instead of DUAL mode (2PA).



- -**Right column** : the list of systems down for information only. (red or amber color depending on the importance).
  Systems inoperative.
- De-icing the wings.
- CAT 3 DUAL.
- Bleed air engine 1.
- Pack 1.
- Engine generator 1.
- The pressure is low on the green hydraulic pump of engine 1.

The Airbus A320 has 3 hydraulic circuits:

- Green.
- Blue.
- Yellow.

Engine 1 is the main source of the green circuit which supplies:

- The main brakes.
- The landing gear.
- The Spoilers.
- Rudder and more …

The failure of engine 1 is compensated by the PTU (Power Transfer Unit) which takes hydraulic pressure from the operational circuits (blue and yellow) to send it to the green circuit.

All lines having been commented,

21. PM asks: “CLEAR STATUS? ».

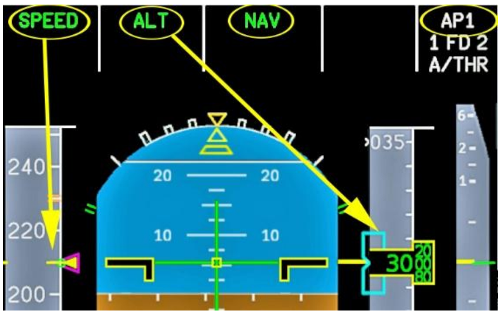
22. PF responds: “CLEAR STATUS”.

23. PM presses the CLR key and announces: “CLEAR STATUS”.
The STATUS page is deleted.

24. PM announces “ECAM ACTIONS COMPLETED”.

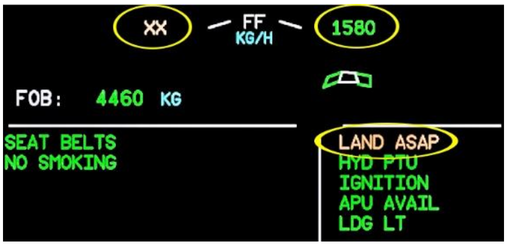
CONTINUATION OF THE FLIGHT
Return to NICE

We are at 3,000 feet and following our flight plan path LFMN-LFBO.
The lower ECAM displays the CRUISE page.



The FMA displays :

- 1st column, speed management mode: SPEED
  The speed is stabilized on the target speed which is also the green dot (210).
- 2nd column, vertical guidance mode: ALT
  The plane is stabilized at an altitude of 3,000 feet.
- 3rd column, horizontal guidance mode: NAV
  We follow our flight plan aided by the active AP1.



The upper ECAM tells us that everything is OK except:

- Engine 1 is stopped (orange cross).
- LAND ASAP: warning message for rapid landing.

We need to prepare our return to NICE LFMN airport.

Before our departure, we created a secondary flight plan in anticipation of a hypothetical return to NICE.

1. Press the SEC F-PLAN key on the MCDU to display the SEC INDEX page.

2. Then press LSK 4L to activate the second flight plan.

The last two waypoints before LFMN are LEMPU and FI04L (after a discontinuity).

3. Press the DIR key on the MCDU to display the DIR TO page.
4. Select LEMPU by pressing the corresponding LSK L key. The temporary DIR TO page is displayed (in yellow).

5. Press LSK 6R  to validate.

Our new main flight plan is active: destination LFMN RUNWAY 04L.

Now you need to activate the APPROACH phase in the MCDU.

6. Press the PERF button on the MCDU.
   The CLB page is displayed.

7. Press  ACTIVATE APP PHASE.

8. Press  CONFIRM APP PHASE.

The EO CLR (Engine Out) message indicates that an optimized procedure to continue flight safely with a single engine is in progress.
The LSK 1R (EO CLR) key allows this procedure to be manually deleted if the engine is restarted or if the procedure is no longer necessary (false alarm).

We leave the minimum altitude before go-around in case of poor visibility at 390 BARO.

For all approaches, it is necessary to plan for a possible go-around.

Press the NEXT PHASE button.

In the THR RED/ACC and ENG OUT ACC fields, change the default values to 3,000.

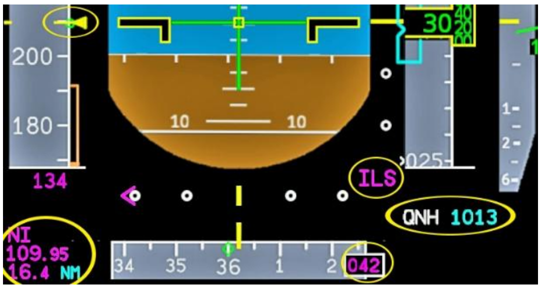
In the FCU, set the target altitude of 3,000 which is that of the NERAS holding pattern.

We arrive at LEMPU and, after a final right turn, we will capture the LOC and align ourselves with the runway axis:

The white broken arrow after FI04L on our route represents the start of the glide-guided descent.

Press the APP button on the FCU.
On the FMA G/S and LOC are armed (blue).

9. -Adjust the two baro (1013, PERF page).



The PFD gives us the essential elements:

- Green dot speed: 250.
- VAPP 134.
- ILS-: NI 109.95 à 16,4NM HDG 042

10. -Display the ND in TERRAIN mode.

TERRAIN mode allows us to see a color representation of the relief in relation to the altitude of the aircraft.

Red: Immediate danger. The terrain is higher than our current altitude, collision is certain.

Amber: Potential danger. The safety margin is not assured.

Green: No danger.

Blue: Represents the sea.

← Press the TERR ON ND button to display TERRAIN mode.

11. Extend flap 1 when capturing the LOC (or at the latest within three NM of the descent).
12. Flaps 2 when capturing the Glide (or at the latest before 2,000 feet AGL).
13. Extend the landing gear.
14. Autobrake on MED.
15. Arm the Spoilers.
16. Flaps on 3 then Full.

We will perform a go-around to 500 ft AGL (can be done at your convenience between 0 and 500 ft).

***Important**: We are in situation N-1 with the left engine inoperative.*
- *Autopilot is engaged, it has applied automatic rudder trim.*
- *The aircraft is coordinated and the rudder pedals are neutral.*

Two situations must be considered:

a) **Go-around with AP engaged.**
Simply move the engine 2 lever to the TO/GA position. The aircraft will accelerate and climb, the autopilot will manage the rudder trim and automatically compensate for the asymmetry. There is no need to manually compensate with the rudder pedal; any pedal movement could disconnect the PA.

b) **Go-around with AP disconnected.**
The asymmetry must be compensated for with the rudder pedal and the trim must be applied manually at the same time. Once correctly trimmed, the AP can be re-engaged.

Go-around

We are at about 500 ft, the AP is engaged.

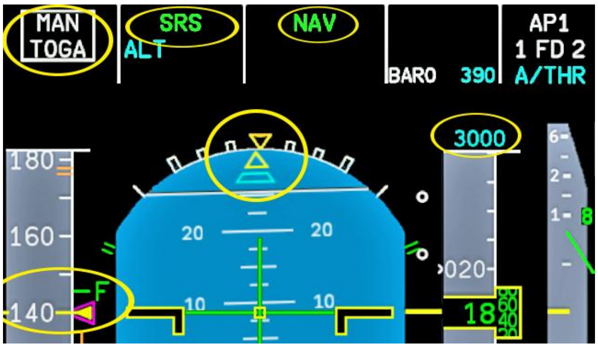
1. **Push the lever to the TO/GA position.**
2. **Flaps on 3.**

The plane accelerates and begins to climb.

The autopilot automatically applies rudder trim to compensate for the strong thrust asymmetry, allowing the rudder pedals to remain neutral.

The AP controls the go-around attitude (SRS on the FMA) as well as the trajectory (green NAV on the FMA).

3. **When the vario is positive, retract the landing gear.**



The FMA displays:

- Speed management mode: MAN TOGA.
- Vertical guidance mode: SRS.
- Lateral guidance mode: NAV active.

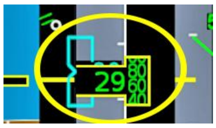
On the PFD the beta target is in blue (the AP is compensating the aircraft).
The target altitude is 3,000 ft.

The target speed (140) will be constant until reaching the target altitude.

We are monitoring the trajectory towards the NERAS waypoint.

Approaching acceleration altitude:
(here the target altitude of 3,000 selected in the FCU is the same as the acceleration altitude defined in the GO AROUND page of PERF).

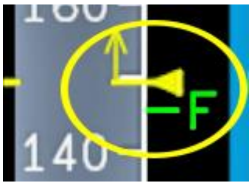
- The FMA displays ALT * (Alt star) 

- On the PFD the altitude is framed by a blue rectangle: 

- The aircraft begins to accelerate:

3. **At speed F or above:**

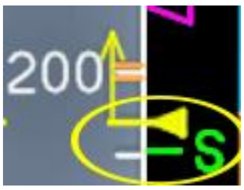
   Flaps 1 (1+F).



4. **At speed S or above:**

   Flaps 0

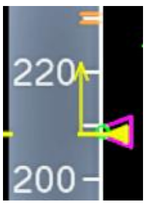
   and disarm the spoilers.



5. **When LVR MCT is flashing**

   bring the throttle back from

   engine 2 to the FLEX / MCT notch.



Note: The FLEX / CT message flashes when speed reaches green dot.

Preparing for landing.

The aircraft is stabilized at 3,000 ft. We have clearance to land on runway 04 L.
We can keep the flight plan that remained in the FMGS: landing on runway 04 L.

1. Activate the approach phase in the MCDU.
2. Display the flight plan, to verify that it is valid.
3. Press the DIR key on the MCDU to go directly to the LEMPU waypoint.
4. Prepare for landing as before.
5. Disconnect the AP at approximately 500 ft AGL
   (at the latest at the minimums in case of poor visibility: here at 360 ft AGL).

The aircraft is coordinated and trimmed because the pilot has applied automatic rudder trim.
The pedals remain neutral; the trim is not reset to zero.

6. During the flare and landing.
   Simply keep the aircraft aligned with the runway and make corrections with the rudder pedals as needed.
7. After landing and braking, maintain the trim. It will be reset before the next flight during the AFTER START checklist.

FLIGHT CONTROLS

The Airbus A320 is equipped with fly-by-wire flight controls managed by computers.

On a conventional aircraft, the yokes are connected directly to the control surfaces (elevator and roll) by cables; they are mechanically linked and move simultaneously.

The Airbus pilot controls the plane with a side joystick connected to computers:

- Flight Augmentation Computeur (FAC)~~,~~
- Spoilers and Elevators Computer (SEC)
- Elevator And Aileron Computer (ELAC)

The computers analyze the pilot's inputs on the joystick and then send the commands to the control surfaces.

These computers are controlled by switches located on the overhead panel.

This system guarantees flight envelope protection, simplifies and automates many functions.

Roll axis.

When the pilot wants to turn, he only uses the joystick, no rudder pedals because the computer automatically coordinates the yaw axis.
When the desired bank angle is reached, the joystick is returned to neutral, and the aircraft automatically maintains this bank angle.
To return to horizontal, simply move and hold the joystick in the opposite direction, then release it to neutral when the aircraft is back to horizontal.

Similarly, to climb, the pilot pulls on the stick.

Pitch axis.

If the aircraft is level and the pilot wishes to climb to a pitch attitude of 20 degrees, the pilot pulls back on the stick: the pitch will gradually increase to 5, 10, 15 then 20 degrees.
When the desired pitch attitude is reached, the pilot returns the stick to neutral, and the aircraft will maintain the 20-degree climb.

Note that the trim is automatic.

To return to level flight, push and hold the stick until pitch reaches 0 degree, then release to neutral.

On a conventional aircraft, during a turn, the plane tends to pitch down, and the pilot must compensate by pulling back on the stick.
On the Airbus, compensation is automatic.

FLIGHT PROTECTIONS.

1. NORMAL LAW

When all systems are active: security is maximum.

Roll axis.

Under normal conditions, the bank angle should never exceed 33°.
The autopilot does not exceed 25°.

In an emergency, it is possible to go beyond 33° by maintaining pressure on the stick, but by released, the aircraft automatically returns to 33°.

The maximum bank angle is 67° in clean configuration, and 45° with flaps extended.

Pitch axis.

Maximum pitch-up angle is 30° while maximum pitch-down angle is 15°.

“Alpha prot” protection. This protection prevents the aircraft from stalling at high angles of attack: if triggered, it engages the **“Alpha Floor”** mode: the aircraft pitches down and autothrust automatically applies TOGA thrust.
To exit this mode once the situation is stabilized, the pilot must manually disconnect and reconnect the autothrust.

2. ALTERNATIVE LAW.

When certain systems fail (engine, on-board instruments, etc.), the Airbus A320 leaves Normal Law and switches to a degraded mode (with loss of certain protections):
ECAM displays corresponding alerts.

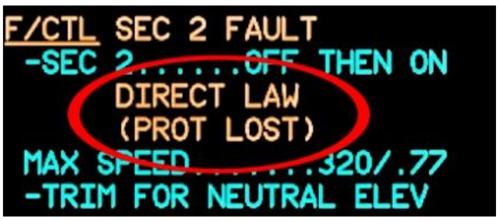
Examples:

- Pitch controls managed differently with less trim stability.
- Maximum bank angle limited manually, with no automatic return to 33°.

3. ~~IN~~ DIRECT LAW.

~~As a consequence~~ In the event of ~~a~~ severe failures, ~~this is~~ the aircraft reverts to Direct Law, the most degraded ~~form of the~~ Fly-By-Wire ~~system~~ mode: the aircraft then behaves like a ~~normal~~ conventional aircraft, ~~there is no longer any~~ without protections (overspeed, stall, etc.).

Roll and pitch controls are direct: to turn, ~~you have to~~ yaw must be compensated ~~in the yaw axis~~ with ~~the~~ rudder pedals. ~~You also have~~ The pilot must ~~to~~ manage ~~the~~ trim manually.



This is the ~~worst~~ most demanding situation, ~~which~~ requir~~es~~ing ~~special~~ particular attention from the ~~pilot~~ crew. A warning message appears on~~,~~ ~~who is notified by a message on~~ the ECAM to notify the pilot.