AIRBUS

# A318/A319/A320/A321

# Flight Crew Training Manual

## FOREWORD

ALL

The Flight Crew Training Manual (FCTM) is published as a supplement to the Flight Crew Operating Manual (FCOM) and is designed to provide pilots with practical information on how to operate the Airbus aircraft. It should be read in conjunction with the FCOM. In the case of any conflict, the FCOM is the over-riding authority.

Airline training policy may differ in certain areas. Should this be the case, the airline training policy is the over-riding authority.

## HIGHLIGHTS

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Every time a change is made to the technical content of a documentary unit (DU), a highlight is created to explain the reason for this change.

Revision marks, at the beginning of the revised paragraph of the DU, identify the changes. The format of the revision mark is an uppercase letter "R", followed by a number in brackets.

These numbers in brackets correspond to highlights that are located on the highlight page. Highlight pages, located at the end of each section of a chapter, provide all of the highlights of a section.

## COMMENT - QUESTIONS - SUGGESTIONS

ALL

FCTM holders and users are encouraged to submit questions and suggestions regarding this manual to:

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or

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## INTRODUCTION

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The Airbus cockpit is designed to achieve pilot operational needs throughout the aircraft operating environment, while ensuring maximum commonality within the Fly by Wire family. The cockpit design objectives are driven by three criteria:

. Reinforce the safety of flight

. Improve efficiency of flight

. Answer pilot requirements in a continuously changing environment

Airbus operational rules result from the design concept, more particularly from the following systems:

. The **Fly by wire** system with its control laws and protections, commanded through the side stick,

. An integrated **Auto Flight System** (AFS) comprising:
- The FMS interfaced through the MCDU,
- The AP/FD interfaced through the FCU,
- The A/THR interfaced through the non back driven thrust levers,
- The FMA, providing Guidance targets and Information, to monitor the AFS

. A set of **Display units** (DU) providing information and parameters required by the crew
- To operate and to navigate the aircraft (the EFIS)
- To communicate (the DCDU)
- To manage the aircraft systems (the ECAM)
- FMA interface to provide Guidance targets and information to monitor the AFS/FD

. A **Forward Facing Cockpit Layout** with "Lights out" or "Dark Cockpit" concept assisting the crew to properly control the various aircraft systems.

The operational rules applicable to these specific features are given in the other sections of this chapter.

## OPERATIONAL GOLDEN RULES

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1. The aircraft can be flown like any other aircraft

2. Fly, navigate, communicate - in that order
3. One head up at all times
4. Cross check the accuracy of the FMS
5. Know your FMA at all times
6. When things dont go as expected - take over
7. Use the proper level of automation for the task
8. Practice task sharing and back-up each other

## INTRODUCTION

ALL

The relationship between the Pilot Flyings (PFs) input on the sidestick, and the aircrafts response, is referred to as control law. This relationship determines the handling characteristics of the aircraft.

There are three sets of control laws, and they are provided according to the status of the: Computers, peripherals, and hydraulic generation.

The three sets of control laws are:

. Normal law

. Alternate law

. Direct law.

## NORMAL LAW

ALL

### OBJECTIVES

The aim of normal law is to provide the following handling characteristics within the normal flight envelope (regardless of aircraft speed, altitude, gross weight and CG):

. Aircraft must be stable and maneuverable

. The same response must be consistently obtained from the aircraft

. The Actions on the sidestick must be balanced in pitch and in roll.

The normal law handling characteristics, at the flight envelope limit are:

. The PF has full authority to achieve Maximum aircraft Performance

. The PF can have instinctive/immediate reaction, in the event of an emergency

. There is a reduced possibility of overcontrolling or overstressing the aircraft.

Normal Law is the law that is most commonly available, and it handles single failures.

## CHARACTERISTICS IN PITCH

### IN FLIGHT

When the PF performs sidestick inputs, a constant G-load maneuver is ordered, and the aircraft responds with a G-Load/Pitch rate. Therefore, the PFs order is consistent with the response that is "naturally" expected from the aircraft: Pitch rate at low speed; Flight Path Rate or G, at high speed.

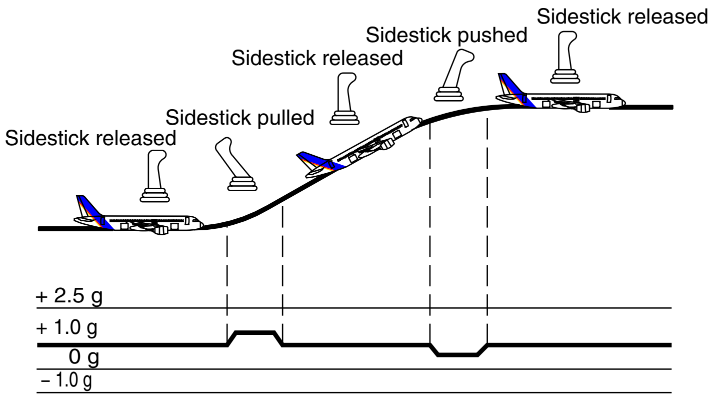
So, if there is no input on the stick:

. The aircraft maintains the flight path, even in case of speed changes

. In case of configuration changes or thrust variations, the aircraft compensates for the pitching moment effects

. In turbulence, small deviations occur on the flight path. However, the aircraft tends to regain a steady condition.

AIRBUS PITCH CHARACTERISTIC

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**Operational Recommendation:**

Since the aircraft is stable and auto-trimmed, the PF needs to perform minor corrections on the sidestick, if the aircraft deviates from its intended flight path.

The PF should not fight the sidestick, or overcontrol it. If the PF senses an overcontrol, the sidestick should be released.

### AT TAKEOFF AND LANDING

The above-mentioned pitch law is not the most appropriate for takeoff and flare, because the stable flight path is not what the PF naturally expects. Therefore, the computers automatically adapt the control laws to the flight phases:

. GROUND LAW: The control law is direct law

. FLARE LAW: The control law is a pitch demand law.

**Operational Recommendation:**

Takeoff and landing maneuvers are naturally achieved. For example, a flare requires the PF to apply permanent aft pressure on the sidestick, in order to achieve a progressive flare. Whereas, derotation consists of smoothly flying the nosegear down, by applying slight aft pressure on the sidestick.

## LATERAL CHARACTERISTICS

### NORMAL CONDITIONS

When the PF performs a lateral input on the sidestick, a roll rate is ordered and naturally obtained.

Therefore, at a bank angle of less than 33 degrees, with no input on the sidestick, a zero roll rate is ordered, and the current bank angle is maintained. Consequently, the aircraft is laterally stable, and no aileron trim is required.

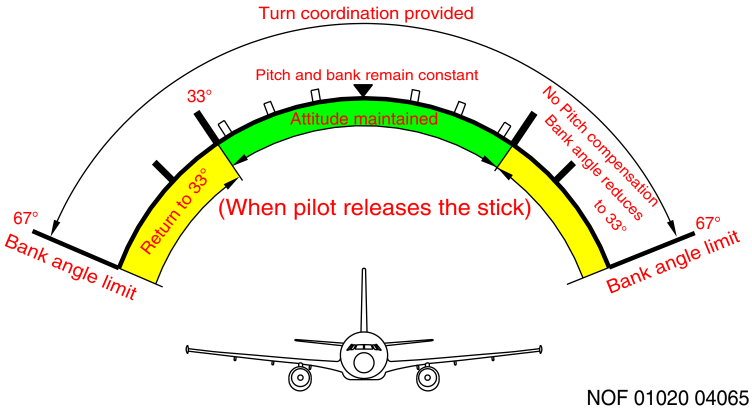
However, lateral law is also a mixture of roll and yaw demand with:

- Automatic turn coordination
- Automatic yaw damping
- Initial yaw damper response to a major aircraft assymetry.

In addition, if the bank angle is less than 33 degrees, pitch compensation is provided.

If the bank angle is greater than 33 degrees, spiral stability is reintroduced and pitch compensation is no longer available. This is because, in normal situations, there is no operational reason to fly with such high bank angles for a long period of time.

AIRBUS LATERAL CHARACTERISTIC

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**Operational Recommendation:**

During a normal turn (bank angle less than 33 degrees), in level flight:

. The PF moves the sidestick laterally (the more the sidestick is moved laterally, the greater the resulting roll rate - e.g. 15 degrees/second at max deflection)

. Not necessary to make a pitch correction

. Not necessary to use the rudder.

In the case of steep turns (bank angle greater than 33 degrees), the PF must apply:

. Lateral pressure on the sidestick to maintain bank

. Aft pressure on the sidestick to maintain level flight.

## ENGINE FAILURE

In flight, if an engine failure occurs, and no input is applied on the sidestick, lateral normal law controls the natural tendency of the aircraft to roll and yaw.

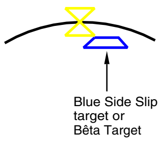
If no input is applied on the sidestick, the aircraft will reach an approximate 5-degree constant bank angle, a constant sideslip, and a slowly-diverging heading rate.

The lateral behavior of aircraft is safe.

However, the PF is best suited to adapt the lateral trimming technique, when necessary. From a performance standpoint, the most effective flying technique, in the event of an engine failure at takeoff, is to fly a constant heading with roll surfaces retracted. This technique dictates the amount of rudder that is required, and the resulting residual sideslip.

As a result, to indicate the amount of rudder that is required to correctly fly with an engine-out at takeoff, the measured sideslip index is shifted on the PFD by the computed, residual-sideslip value. This index appears in blue, instead of in yellow, and is referred to as the beta target. If the rudder pedal is pressed to center the beta target index, the PF will fly with the residual slip, as required by the engine-out condition. Therefore, the aircraft will fly at a constant heading with ailerons and spoilers close to neutral position.

BETA TARGET ON PFD

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**Operational Recommendation:**

In the case of an engine failure at takeoff, the PF must:

. Smoothly adjust pitch to maintain a safe speed (as per SRS guidance)

. Center the Beta target (there is no hurry, because the aircraft is laterally safe)

. When appropriate, trim the aircraft laterally using the rudder trim

. Apply small lateral sidestick inputs, so that the aircraft flies the appropriate heading.

## AVAILABLE PROTECTIONS

Normal Law provides five different protections (Refer to the "Protections" paragraph):

. High angle-of-attack protection

. Load factor protection

. High pitch attitude protection

. Bank angle protection

. High speed protection.

## ALTERNATE LAW

ALL

In some double failure cases, the integrity and redundancy of the computers and of the peripherals are not sufficient to achieve normal law and associated protections. System degradation is progressive, and will evolve according to the availability of remaining peripherals or computers.

Alternate law characteristics (usually triggered in case of a dual failure):

. In pitch: Same as in normal law with FLARE in DIRECT

. In roll: Roll DIRECT

. Most protections are lost, except Load factor protection

At the flight envelope limit, the aircraft is not protected, i.e.:

. In high speed, natural aircraft static stability is restored with an overspeed warning

. In low speed, the auto pitch trim stops at Vc prot (below VLS), and natural longitudinal static stability is restored, with a stall warning at 1.03 VS1g.

In certain failure cases, such as the loss of VS1g computation or the loss of two ADRs, the longitudinal static stability cannot be restored at low speed. In the case of a loss of three ADRs, it cannot be restored at high speed.

In alternate law, VMO setting is reduced to 320 kt, and A FLOOR is inhibited. (On A318, MMO setting is also reduced to .77.)

**Operational Recommendation:**

The handling characteristics within the normal flight envelope, are identical in pitch with normal law.

Outside the normal flight envelope, the PF must take appropriate preventive actions to avoid losing control, and/or avoid high speed excursions. These actions are the same as those that would be applied in any case where non protected aircraft (e.g. in case of stall warning: add thrust, reduce pitch, check speedbrakes retracted).

## DIRECT LAW

ALL

In most triple failure cases, direct law triggers. When this occurs:

. Elevator deflection is proportional to stick deflection. Maximum deflection depends on the configuration and on the CG

. Aileron and spoiler deflections are proportional to stick deflection, but vary with the aircraft configuration

. Pitch trim is commanded manually

Handling characteristics are natural, of high-quality aircraft, almost independent of the configuration and of the CG. Therefore, the aircraft obviously has no protections, no automatic pitch trim, but overspeed or stall warnings.

**Operational Recommendation:**

The PF must avoid performing large thrust changes, or sudden speedbrake movements, particularly if the center of gravity is aft. If the speedbrakes are out, and the aircraft has been re-trimmed, the PF must gently retract the speedbrakes, to give time to retrim, and thereby avoid a large, nose-down trim change.

ALL

## INDICATIONS

The ECAM and PFD indicate any control law degradation.

. **On the ECAM**
- In ALTN Law:
  FLT CTL ALTN LAW (PROT LOST)
  MAX SPEED......320(320/.77 on A318)
- In Direct Law:
  FLT CTL DIRECT LAW (PROT LOST)
  MAX SPEED......320/.77
  MAN PITCH TRIM USE

. **On the PFD**

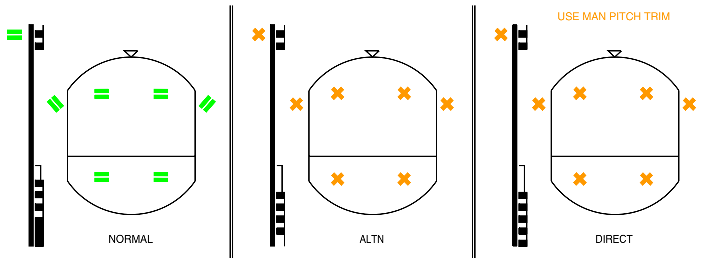
The PFD enhances the PFs awarness of the status of flight controls.

Specific symbols (= in green), and specific formatting of low speed information on the speed scale in normal law, indicate which protections are available.

When protections are lost, amber crosses (X) appear, instead of the green protection symbols (=).

When automatic pitch trim is no longer available, the PFD indicates this with an amber USE MAN PITCH TRIM" message below the FMA.

FLY-BY-WIRE STATUS AWARENESS VIA THE PFD

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Therefore, by simply looking at this main instrument (PFD), the flight crew is immediately aware of the status of flight controls, and the operational consequences.

## PROTECTIONS

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### OBJECTIVES

One of the PF’s primary tasks is to maintain the aircraft within the limits of the normal flight envelope. However, some circumstances, due to extreme situations or aircraft mishandling, may provoke the violation of these limits.

Despite system protections, the PF must not deliberately exceed the normal flight envelope. In addition, these protections are not designed to be structural limit protections (e.g. opposite rudder pedal inputs). Rather, they are designed to assist the PF in emergency and stressful situations, where only instinctive and rapid reactions will be effective.

Protections are intended to:

. Provide full authority to the PF to consistently achieve the best possible aircraft performance in extreme conditions

. Reduce the risks of overcontrolling, or overstressing the aircraft

. Provide PF with an instinctive and immediate procedure to ensure that the PF achieves the best possible result.

## BANK ANGLE PROTECTION

Bank angle protection prevents that any major upset, or PF mishandling, causes the aircraft to be in a high-bank situation (wherein aircraft recovery is complex, due to the difficulty to properly assess such a situation and readily react). Bank angle protection provides the PF with full authority to efficiently achieve any required roll maneuver.

The maximum achievable bank angle is plus or minus:

. 67 degrees, within the Normal Flight envelope (2.5 g level flight)

. 45 degrees, in high Speed protection (to prevent spiral dive)

## HIGH SPEED PROTECTION

When flying beyond maximum design speeds VD/MD (which are greater that VMO/MMO), there is an increased potential for aircraft control difficulties and structural concerns, due to high air loads. Therefore, the margin between VMO/MMO and VD/MD must be such that any possible overshoot of the normal flight envelope should not cause any major difficulty.

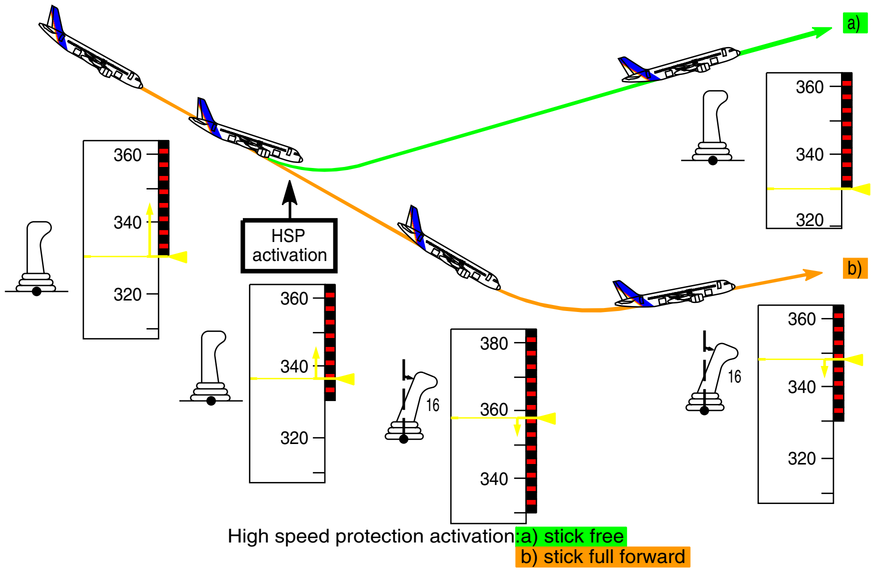
High speed protection adds a positive nose-up G demand to a sidestick order, in order to protect the aircraft, in the event of a dive or vertical upset. As a result, this enables a reduction in the margin betwen VMO/MMO and VD/MD.

Therefore, in a dive situation:

. If there is no sidestick input on the sidestick, the aircraft will slightly overshoot VMO/MMO and fly back towards the envelope.

. If the sidestick is maintained full forward, the aircraft will significantly overshoot VMO/MMO without reaching VD/MD. At approximately VMO + 16 / MMO + 0.04, the pitch nose-down authority smoothly reduces to zero (which does not mean that the aircraft stabilizes at that speed).

AIRBUS HIGH SPEED PROTECTION

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The PF, therefore, has full authority to perform a high speed/steep dive escape maneuver, when required, via a reflex action on the sidestick.

*Note*:

1. *An OVERSPEED warning is provided.*
2. *At high altitude, this may result in activation of the angle of attack protection.*
   *Depending on the ELAC standard, the crew may have to push on the stick to get out of this protection law.*

## LOAD FACTOR PROTECTION

On commercial aircraft, high load factors can be encountered during evasive maneuvers due to potential collisions, or CFIT

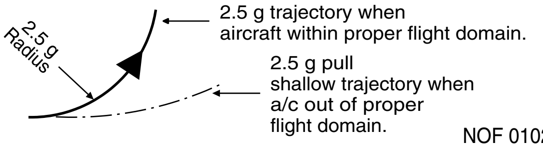
Pulling "g" is efficient, if the resulting maneuver is really flown with this "g" number. If the aircraft is not able to fly this trajectory, or to perform this maneuver, pulling "g" will be detrimental.

On commercial aircraft, the maximum load that is structurally allowed is:

. 2.5 g in clean configuration,

. 2.0 g with the flaps extended.

AIRBUS LOAD FACTOR PROTECTION AND SAFETY

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On most commercial aircraft, the potential for an efficient 2.5 g maneuver is very remote. Furthermore, as G Load information is not continuously provided in the cockpit, airline PFs are not used to controlling this parameter. This is further evidenced by inflight experience, which reveals that: In emergency situations, initial PF reaction on a yoke or sidestick is hesitant, then aggressive.

With load factor protection, the PF may immediately and instinctively pull the sidestick full aft: The aircraft will initially fly a 2.5 g maneuver without losing time. Then, if the PF still needs to maintain the sidestick full aft stick, because the danger still exists, then the high AOA protection will take over. Load factor protection enhances this high AOA protection.

Load factor protection enables immediate PF reaction, without any risk of overstressing the aircraft.

Flight experience has also revealed that an immediate 2.5 g reaction provides larger obstacle clearance, than a hesitant and delayed high G Load maneuver (two-second delay).

## HIGH PITCH ATTITUDE PROTECTION

Excessive pitch attitudes, caused by upsets or inappropriate maneuvers, lead to hazardous situations:

. Too high a nose-up ► Very rapid energy loss

. Too low a nose-down ► Very rapid energy gain

Furthermore, there is no emergency situation that requires flying at excessive attitudes. For these reasons, pitch attitude protection limits pitch attitude to plus 30 degrees/minus 15 degrees.

Pitch attitude protection enhances high speed protection, high load factor protection, and high AOA protection.

## HIGH ANGLE-OF-ATTACK (AOA) PROTECTION

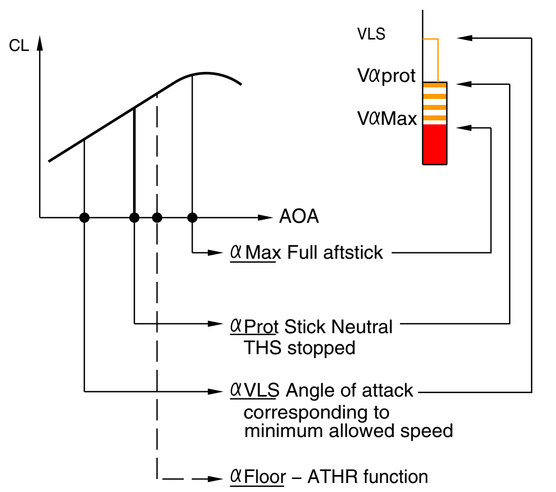
High AOA protection enables the PF to pull the sidestick full aft in dangerous situations, and thus consistently achieve the best possible aircraft lift. This action on the sidestick is instinctive, and the high AOA protection minimizes the risk of stalls or control loss.

High AOA protection is an aerodynamic protection:

. The PF will notice if the normal flight envelope is exceeded for any reason, because the autopitch trim will stop, the aircraft will sink to maintain its current AOA (alpha PROT, strong static stability), and a significant change in aircraft behavior will occur.

. If the PF then pulls the sidestick full aft, a maximum AOA (approximately corresponding to CL Max) is commanded. In addition, the speedbrakes will automatically retract, if extended.

AIRBUS AOA PROTECTION

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In addition to this aerodynamic protection, there are three more energy features:

. If ATHR is in SPEED mode, the speed cannot drop below VLS, even if the target speed is below VLS

. If the angle-of-attack still increases and reaches ALPHA Floor threshold, the A/THR triggers TOGA thrust and engages (unless in some cases of one engine-out).

In case of an emergency situation, such as Windshear or CFIT, the PF is assisted in order to optimize aircraft performance via the:

. A/THR: Adds thrust to maintain the speed above VLS

. ALPHA FLOOR: Provides TOGA thrust

. HIGH AOA protection: Provides maximum aerodynamic lift

. Automatic speedbrake retraction: Minimizes drag.

**Operational Recommendations:**

When flying at alpha max, the PF can make gentle turns, if necessary.

The PF must not deliberately fly the aircraft in alpha protection, except for brief periods, when maximum maneuvering speed is required.

If alpha protection is inadvertently entered, the PF must exit it as quickly as possible, by easing the sidestick forward to reduce the angle-of-attack, while simultaneously adding power (if alpha floor has not yet been activated, or has been cancelled). If alpha floors has been triggered, it must be cancelled with the disconnect pushbutton (on either thrust lever), as soon as a safe speed is resumed.

In case of GPWS/SHEAR:

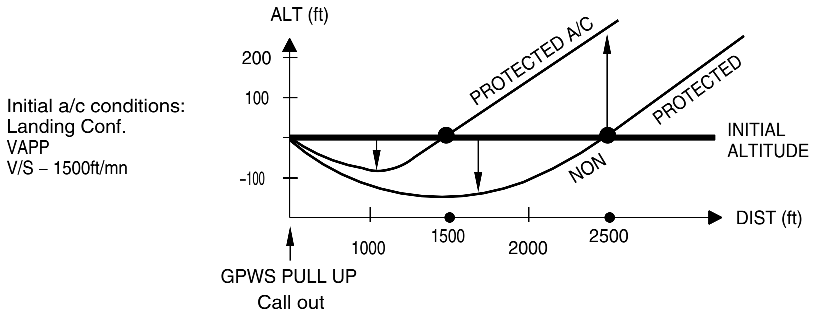
. Set the thrust levers to TOGA

. Pull the sidestick to full aft (For shear, fly the SRS, until full aft sidestick).

. Initially maintain the wings level

This immediately provides maximum lift/maximum thrust/minimum drag. Therefore, CFIT escape maneuvers will be much more efficient.

PROTECTED A/C VERSUS NON PROTECTED A/C GO-AROUND TRAJECTORY

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The above-illustrated are typical trajectories flown by all protected or not protected aircraft, when the PF applies the escape procedure after an aural GPWS PULL UP" alert.

The graph demonstrates the efficiency of the protection, to ensure a duck-under that is 50 percent lower, a bucket-distance that is 50 percent shorter, a safety margin that more than doubles (due to a quicker reaction time), and a significant altitude gain (+/- 250 ft). These characteristics are common to all protected aircraft, because the escape procedure is easy to achieve, and enables the PF to fly the aircraft at a constant AOA, close to the max AOA. It is much more difficult to fly the stick shaker AOA on an aircraft that is not protected.

MSN 0002-0030 0033 0035-0039 0042 0044 0052-0055 0059-0073 0076-0078 0081-0088 0091-0094 0098-0112 0115-0117 0120 0122 0126-0151 0154-0159 0161-0170 0172-0184 0186-0190 0193-0196 0198-0204 0207 0209-0212 0214-0220 0223-0229 0231-0233 0235-0246 0248-0251 0253-0258 0264-0270 0274 0277-0280 0283-0293 0295 0300 0302-0305 0308-0317 0322-0324 0326-0328 0330-0331 0333-0337 0341-0344 0346 0348 0350-0352 0354 0356-0357 0359 0362-0366 0376-0379 0382-0386 0389 0391-0394 0401 0403-0405 0411-0415 0420 0422 0424-0426 0428-0430 0434-0440 0442-0450 0452-0466 0468 0470-0477 0479-3260

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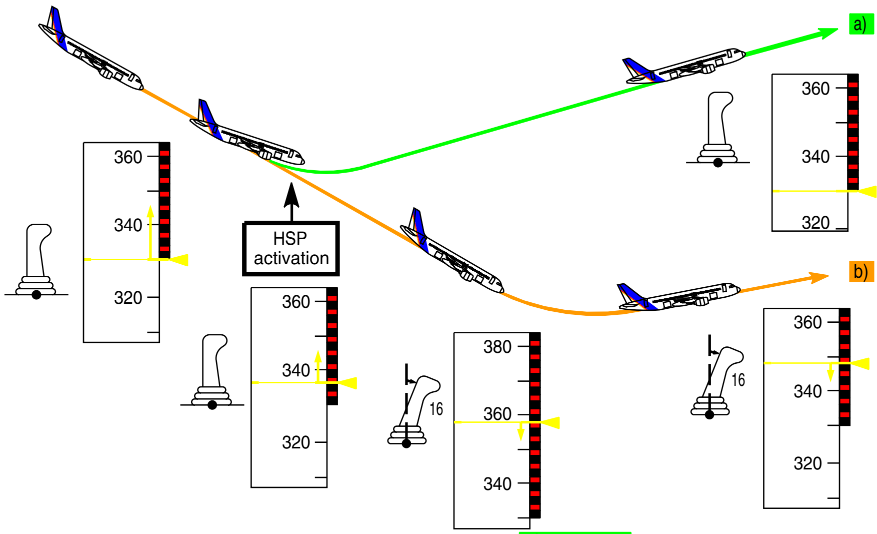


High speed protection activation: a) stick free
b) stick full forward

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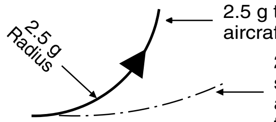


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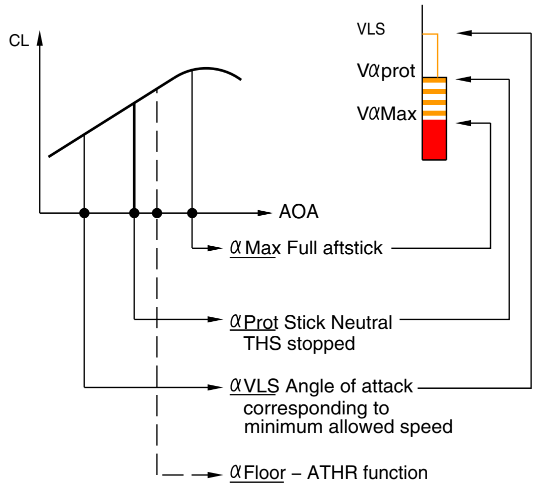
. The PF will notice if the normal flight envelope is exceeded for any reason, because the autopitch trim will stop, the aircraft will sink to maintain its current AOA (alpha PROT, strong static stability), and a significant change in aircraft behavior will occur.

. If the PF then pulls the sidestick full aft, a maximum AOA (approximately corresponding to CL Max) is commanded. In addition, the speedbrakes will automatically retract, if extended.

AIRBUS AOA PROTECTION

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In addition to this aerodynamic protection, there are three more energy features:

. If ATHR is in SPEED mode, the speed cannot drop below VLS, even if the target speed is below VLS

. A "LOW ENERGY" aural alert triggers, when the aircraft energy level drops below a specific threshold function of, for example, IAS, ACCEL/DECEL, or FPA.
For example, if the aircraft decelerates at 1 kt/sec, and:
– The FPA is -3 degrees, the alert will trigger at approximately VLS -8,

– The FPA is -4 degrees, the alert will trigger at approximately VLS -2.
This "SPEED, SPEED, SPEED" alert draws the PF's attention to the SPEED scale, and indicates the need to adjust thrust.
It comes immediately before the ALPHA Floor, and is available when the aircraft is below 2000 feet RA and is in CONF $\geq$ 2.

. If the angle-of-attack still increases and reaches ALPHA Floor threshold, the A/THR triggers TOGA thrust and engages (unless in some cases of one engine-out).

In case of an emergency situation, such as Windshear or CFIT, the PF is assisted in order to optimize aircraft performance via the:

. A/THR: Adds thrust to maintain the speed above VLS

. Low Energy Speed - Speed warning: Enhances PF awareness

. ALPHA FLOOR: Provides TOGA thrust

. HIGH AOA protection: Provides maximum aerodynamic lift

. Automatic speedbrake retraction: Minimizes drag.

**Operational Recommendations:**

When flying at alpha max, the PF can make gentle turns, if necessary.

The PF must not deliberately fly the aircraft in alpha protection, except for brief periods, when maximum maneuvering speed is required.

If alpha protection is inadvertently entered, the PF must exit it as quickly as possible, by easing the sidestick forward to reduce the angle-of-attack, while simultaneously adding power (if alpha floor has not yet been activated, or has been cancelled). If alpha floors has been triggered, it must be cancelled with the disconnect pushbutton (on either thrust lever), as soon as a safe speed is resumed.

In case of GPWS/SHEAR:

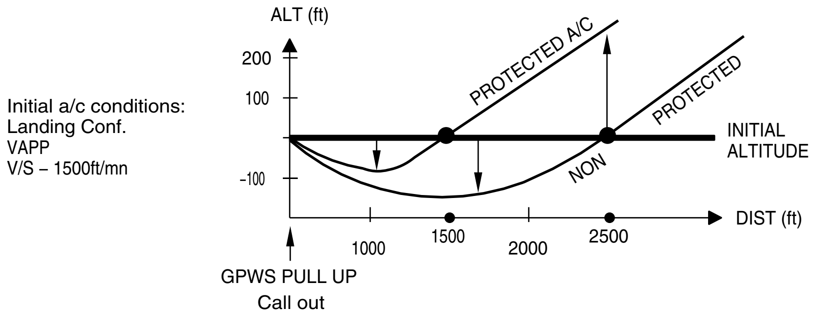
. Set the thrust levers to TOGA

. Pull the sidestick to full aft (For shear, fly the SRS, until full aft sidestick).

. Initially maintain the wings level

This immediately provides maximum lift/maximum thrust/minimum drag. Therefore, CFIT escape maneuvers will be much more efficient.

PROTECTED A/C VERSUS NON PROTECTED A/C GO-AROUND TRAJECTORY

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The above-illustrated are typical trajectories flown by all protected or not protected aircraft, when the PF applies the escape procedure after an aural " GPWS PULL UP" alert.

The graph demonstrates the efficiency of the protection, to ensure a duck-under that is 50 percent lower, a bucket-distance that is 50 percent shorter, a safety margin that more than doubles (due to a quicker reaction time), and a significant altitude gain (+/- 250 ft). These characteristics are common to all protected aircraft, because the escape procedure is easy to achieve, and enables the PF to fly the aircraft at a constant AOA, close to the max AOA. It is much more difficult to fly the stick shaker AOA on an aircraft that is not protected.

## MECHANICAL BACKUP

ALL

The purpose of the **mechanical** backup is to achieve all safety objectives in MMEL dispatch condition: To manage a temporary and total electrical loss, the temporary loss of five fly-by-wire computers, the loss of both elevators, or the total loss of ailerons and spoilers.

It must be noted that it is very unlikely the **mechanical** backup will be used, due to the fly-by-wire architecture. For example, in case of electrical emergency configuration, or an all-engine flameout, alternate law remains available.

In the unlikely event of such a failure, **mechanical** backup enables the PF to safely stabilize the aircraft, using the rudder and manual pitch trim, while reconfiguring the systems.

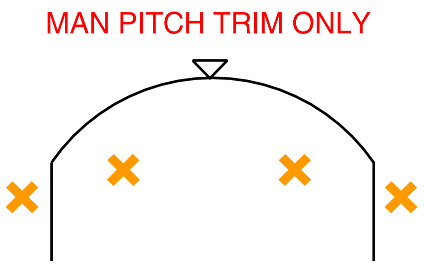
In such cases, the objective is not to fly the aircraft accurately, but to maintain the aircraft attitude safe and stabilized, in order to allow the restoration of lost systems.

The pitch trim wheel is used to control pitch. Any action on the pitch trim wheel should be applied smoothly, because the THS effect is significant due to its large size.

The rudder provides lateral control, and induces a significant roll with a slight delay. The PF should apply some rudder to turn, and wait for the aircraft reaction. To stabilize and level the wings, anticipate by releasing the rudder pedals.

A red MAN PITCH TRIM ONLY" message appears on the PFD to immediately inform the PF that the mechanical backup is being used.

BACK-UP INDICATION ON PFD

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## ABNORMAL ATTITUDES

ALL

If the aircraft is, for any reason, far outside the normal flight envelope and reaches an abnormal attitude, the normal controls are modified and provide the PF with maximum efficiency in regaining normal attitudes. (An example of a typical reason for being far outside the normal flight envelope would be a mid-air collision).

The so-called "abnormal attitude" law is :

- Pitch alternate with load factor protection (without autotrim)
- Lateral direct law with yaw alternate

These laws trigger, when extreme values are reached:

- Pitch (50 degrees up, 30 degrees down)
- Bank (125 degrees)
- AOA (30 degrees, -10 degrees)
- Speed (440 kt, 60 kt)
- Mach (0.96, 0.1).

It is very unlikely that the aircraft will reach these attitudes, because fly-by-wire provides protection to ensure rapid reaction far in advance. This will minimize the effect and potential for such aerodynamic upsets.

The effectiveness of fly-by-wire architecture, and the existence of control laws, eliminate the need for upset recovery maneuvers to be trained on protected Airbus aircraft.

## SIDESTICK AND PRIORITY P/B

ALL

When the Pilot Flying (PF) makes an input on the sidestick, an order (an electrical signal) is sent to the fly-by-wire computer. If the Pilot Not Flying (PNF) also acts on the stick, then both signals/orders are added.

Therefore, as on any other aircraft type, PF and PNF must not act on their sidesticks at the same time. If the PNF (or Training Captain) needs to take over, the PNF must press the sidestick priority pushbutton, and announce: "I have control".

If a flight crewmember falls on a sidestick, or a mechanical failure leads to a jammed stick (there is no associate ECAM caution), the "failed" sidestick order is added to the "non failed" sidestick order.

In this case, the other not affected flight crewmember must press the sidestick priority pushbutton for at least 40 seconds, in order to deactivate the "failed" sidestick.

A pilot can at any time reactivate a deactivated stick by momentarily pressing the takeover push button on either stick.

In case of a "SIDE STICK FAULT" ECAM warning, due to an electrical failure, the affected sidestick order (sent to the computer) is forced to zero. This automatically deactivates the affected sidestick. This explains why there is no procedure associated with that warning.

*Note: When a sidestick is deactivated by the opposite sidestick priority pushbutton, it can be reactivated with its own sidestick priority pushbutton.*

## AUTOPILOT/FLIGHT DIRECTOR

ALL

### OBJECTIVE

The Auto Pilot (AP) and Flight Director (FD) assist the flight crew to fly the aircraft within the normal flight envelope, in order to:

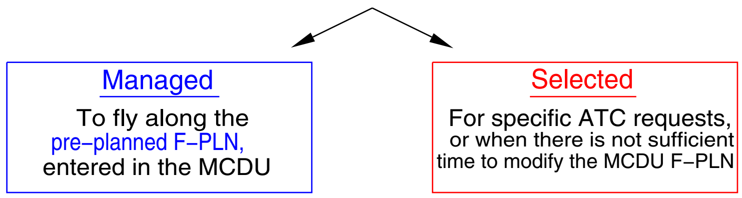
- Optimize performance in the takeoff, go-around, climb, or descent phases
- Follow ATC clearances (lateral or vertical)
- Repeatedly fly and land the aircraft with very high accuracy in CAT II and CAT III conditions.

To achieve these objectives:

- The AP takes over routine tasks. This gives the Pilot Flying (PF) the necessary time and resources to assess the overall operational situation.
- The FD provides adequate attitude or flight path orders, and enables the PF to accurately fly the aircraft manually.

### MANAGED AND SELECTED MODES

The choice of mode is a strategic decision that is taken by the PF.

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Managed modes require:

- Good FMS navigation accuracy (or GPS PRIMARY)
- An appropriate ACTIVE F-PLN (i.e. the intended lateral and vertical trajectory is entered, and the sequencing of the F-PLN is monitored).

If these two conditions are not fulfilled → Revert to selected modes

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## MAIN INTERFACES WITH THE AP/FD

| MCDU | FCU |
|---|---|
| Long–term* interface | Short–term interface |
| To prepare lateral or vertical revisions, or to preset the speed for the next phase. | To select the ATC HDG, expedite, speed, etc. (quickly performed "head–up") |

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*The DIR TO function is an exception to this rule.

### OPERATIONAL RECOMMENDATION:

With the FMS, anticipate flight plan updates by preparing:

. EN ROUTE DIVERSIONS

. DIVERSION TO ALTN

. CIRCLING

. LATE CHANGE OF RWY

in the SEC F-PLN. This enables the MCDU to be used for short-term actions.

## TASKSHARING AND COMMUNICATIONS

The FCU and MCDU must be used, in accordance with the rules outlined below, in order to ensure:

. Safe operation (correct entries made)

. Effective inter-pilot communication (knowing each other's intentions)

. Comfortable operations (use "available hands", as appropriate)

| | |
|---|---|
| MCDU entries are performed by the PF, during a temporary transfer of command to the PNF.<br><br>A crosscheck must be performed.<br><br>Time−consuming entries should be avoided below 10000 feet.<br>Entries should be restricted to those that have an operational benefit.<br><br>(PERF APPR, DIR TO, DIR TO INTERCEPT, RAD NAV, LATE CHANGE OF RUNWAY, ACTIVATE SEC F−PLN, ENABLE ALTN) | FCU entries are performed by:<br>− The PF, with the AP on.<br>− The PNF (upon PF request), with the AP off.<br><br>FCU entries must be announced.<br><br>Upon FCU entries:<br><br>The PF must check and announce the corresponding PFD/FMA target and mode.<br><br>The PNF must crosscheck and announce "CHECKED". |

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## AP/FD MONITORING

The FMA indicates the status of the AP, FD, and A/THR, and their corresponding operating modes. The PF must monitor the FMA, and announce any FMA changes. The flight crew uses the FCU or MCDU to give orders to the AP/FD. The aircraft is expected to fly in accordance with these orders.

The main concern for the flight crew should be:

**WHAT IS THE AIRCRAFT EXPECTED TO FLY NOW ?**

**WHAT IS THE AIRCRAFT EXPECTED TO FLY NEXT ?**

If the aircraft does not fly as expected:

And, if in managed mode ⇒ Select the desired target

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- Or, disengage the AP, and fly the aircraft manually.

## AUTOPILOT (AP) OPERATION

The AP can be engaged within the normal flight envelope, 5 seconds after liftoff and at least 100ft. It automatically disengages, when the aircraft flies significantly outside the normal flight envelope limits.

The AP cannot be engaged, when the aircraft is outside the flight envelope. Flight control laws are designed to assist the flight crew to return within the flight envelope, in accordance with the selected strategy.

The AP may be used:

. For autoland: Down to the aircraft landing rollout, in accordance with the limitations indicated in the FCOM

. For other approaches, down to:
  - The MDA for straight in Non Precision Approach
  - MDA-100 ft for circling approach
  - 160 ft for ILS approach with CAT1 displayed on FMA
  - 500 ft for all others phases.

It may also be used, in case of:

. Engine failure: Without any restriction, within the demonstrated limits, including for autoland

. Abnormal configuration (e.g. slats/flaps failure): Down to 500 feet AGL. Extra vigilance is required in these configurations. The flight crew must be ready to take over, if the aircraft deviates from its intended, safe flight path.

The sidestick's instinctive disconnect pushbutton should be used to disengage the AP. Instinctive override action on the sidestick consists of pushing or pulling the sidestick, when the AP is engaged. This action disengages the AP, and should be done as per design, i.e. in case of an instinctive reaction (to an AP hard over for example).

## USE OF THE FD WITHOUT THE AP

When manually flying the aircraft with the FDs on, the FD bars or the FPD symbol provide lateral and vertical orders, in accordance with the active modes that the flight crew selects.

Therefore:

⇒ Fly with a centered FD or FPD

⇒ If not using FD orders, turn off the FD.

It is strongly recommended to turn off both FDs, to ensure that the A/THR is in SPEED mode, if the A/THR is active.

## AUTOTHRUST (A/THR)

MSN 0035 0037-0038 0043 0045-0058 0064-0067 0074-0077 0080-0082 0089-0091 0095-0099 0112-0114 0119 0123-0124 0138-0139 0148 0151 0163-0170 0178-0182 0189-0190 0193-0196 0198 0205 0212 0219 0221-0222 0225 0230 0243 0245 0247 0249-0251 0256-0258 0289 0293-0295 0299-0301 0304 0308 0314-0317 0322 0326-0328 0334-0336 0338 0343-0344 0348-0349 0351 0354 0357 0362-0363 0365-0366 0370-0371 0376 0379 0383 0386 0389-0394 0396-0398 0402 0406 0411 0413-0414 0416 0422-0425 0429-0432 0437 0440-0441 0443-0444 0446-0448 0451 0453 0455 0460-0461 0469 0471 0476 0478 0480-0482

### OBJECTIVE

The A/THR computer (within the FG) interfaces directly with the engine computer, referred to as the FADEC.

The A/THR sends to the FADEC the thrust targets that are needed to:

. Obtain and maintain a target speed, when in SPEED mode

. Obtain a specific thrust setting (e.g. CLB, IDLE), when in THRUST mode.

### INTERFACE

When the A/THR is active, the thrust lever position determines the maximum thrust that the A/THR can command in SPEED or THRUST mode. Therefore, with A/THR active, thrust levers act as a thrust limiter or a thrust-rating panel.

The A/THR computer does not drive back the thrust levers. The PF sets them to a specific detent on the thrust lever range. The A/THR system provides cues that indicate the energy of the aircraft:

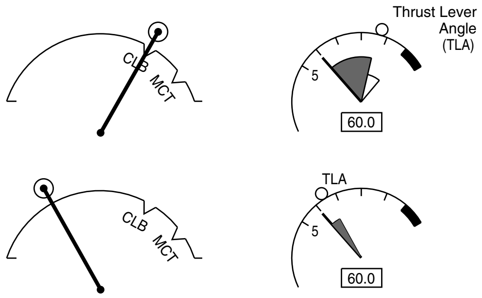
. Speed, acceleration, or deceleration, obtained by the speed trend vector

. N1, and N1 command on the N1 gauge.

All these cues are in the flight crews direct line of vision.

In other words, the Thrust Lever Angle (TLA) should not be used to monitor correct A/THR operation. Neither should the thrust lever position of a conventional autothrottle, be considered a cue because, in many hazardous situations, the thrust lever position can be misleading (e.g. engine failure, thrust lever jammed).

THE TLA DETERMINES MAX THRUST FOR THE A/THR

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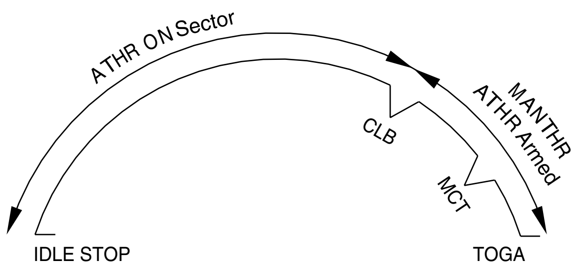
## NORMAL OPERATIONS

The A/THR can only be active, when the thrust levers are between IDLE and the CLB detent.

When the thrust levers are beyond the CLB detent, thrust is controlled manually to the thrust lever position, and the A/THR is armed (A/THR appears in blue on the FMA). This means that the A/THR is ready to be re-activated, when the flight crew sets the thrust levers back to the CLB detent (or below).

A/THR OPERATING SECTORS _ ALL ENGINES OPERATING

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### At Takeoff

The thrust levers are set either full forward to TOGA, or to the FLX detent. Thrust is manually controlled to the TLA, and A/THR is armed. The FMA indicates this in blue.

### After Takeoff

When the aircraft reaches THR RED ALT, the flight crew sets the thrust levers back to the CLB detent. This activates A/THR. MAX CLB will, therefore, be the maximum normal thrust setting that will be commanded by the A/THR in CLB, CRZ, DES, or APPR, as required.

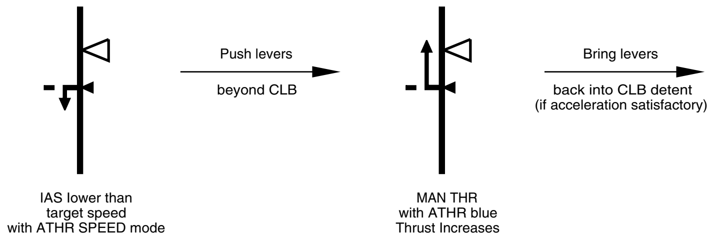
**Thrust Lever(s) below the CLB Detent**

If one thrust lever is set to below the CLB detent, the FMA triggers a LVR ASYM message, as a reminder to the flight crew (e.g. this configuration might be required due to an engines high vibration level). However, if all thrust levers are set to below the CLB detent, with the A/THR active, then CLB or LVR CLB flashes in the first FMA column. This is because there is no operational reason to be in such a situation, and to permanently limit A/THR authority on all engines. In this case, all thrust levers should either be brought back to the CLB detent, or the A/THR should be set to OFF.

**Thrust Levers Beyond the CLB Detent**

If all thrust levers are set to beyond the CLB detent, when A/THR is active, the flight crew manually controls thrust to the Thrust Lever Position. The FMA displays THR or MAN THR in the first FMA column, and the A/THR is armed. As a reminder, CLB or LVR CLB flashes on the FMA. This technique is most efficient, when the aircraft speed goes significantly below the target. When the aircraft speed or acceleration is satisfactory, the thrust levers should be brought back to the CLB detent. This re-activates the A/THR.

<u>SPEED DROP IN APPROACH: RECOMMENDED RECOVERY TECHNIQUE</u>

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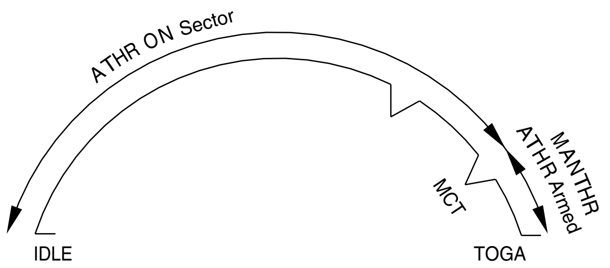
<u>Note</u>: *When using this technique during approach (e.g. to regain VAPP), the thrust levers should be moved past the CLB detent, but not beyond the MCT. In most cases, it is not necessary to go beyond MCT, and the PF may inadvertently advance thrust levers all the way to the TOGA stop, and thereby engage go-around mode.*

**<u>OPERATIONS WITH ONE ENGINE INOPERATIVE</u>**

The above-noted principles also apply to an one-engine inoperative situation, except that A/THR can only be active, when the thrust levers are set between IDLE and MCT.

A/THR OPERATING TECHNIQUE: ONE ENGINE INOPERATIVE

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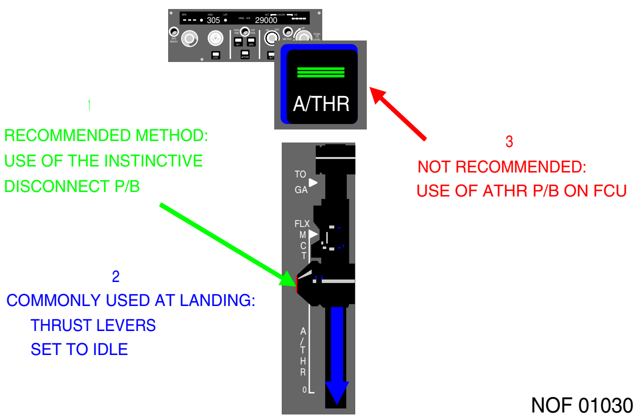
In case of engine failure, the thrust levers will be in MCT detent for remainder of the flight. This is because MCT is the maximum thrust that can usually be commanded by the A/THR for climb or acceleration, in all flight phases (e.g. CLB, CRZ, DES or APPR ).

## TO SET AUTOTHRUST TO OFF

HOW TO SET A/THR OFF

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### 1) USE OF INSTINCTIVE DISCONNECT (I/D) PUSHBUTTON

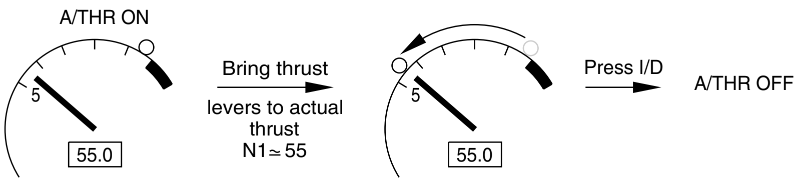
If the I/D pushbutton is pressed when the thrust levers are in CLB detent, thrust will increase to MAX CLB. This may cause a not desired thrust change. For example, during approach, A/THR in SPEED mode, commands approximately N1 55 %. If the PF presses the I/D pushbutton, the A/THR is set to off, and thrust goes to MAX CLB. This will perturbate the approach.

Therefore, the recommended technique for setting A/THR to off is:

- Return the thrust levers to approximately the current thrust setting, by observing the TLA symbol on the thrust gauge
- Press the I/D pushbutton

This technique minimizes thrust discontinuity, when setting A/THR to off.

RECOMMENDED TECHNIQUE TO SET A/THR TO OFF

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### 2) THRUST LEVERS SET TO IDLE

If thrust levers are set to IDLE, A/THR is set to off. This technique is usually used in descent, when the A/THR is in THR IDLE, or at landing. During flare, with the A/THR active, the thrust levers are set to the CLB detent. Then, when thrust reduction is required for landing, the thrust levers should be moved smoothly and set to the IDLE stop. This will retard thrust, and set A/THR to off. As a reminder, the "RETARD" aural alert will sound. In flare, this aural alert will occur at 20 feet, except in the case of autoland, where it occurs at 10 feet.

It should be noted that, when the thrust levers are set back to IDLE and A/THR set to off: The A/THR can be reactivated by pressing the pushbutton on the FCU, and returning the thrust levers to the applicable detent. The thrust levers should be immediately returned to the applicable detent, in order to avoid flashing CLB or LVR CLB message on the first FMA column.

### 3) USE OF THE FCU PUSHBUTTON

Use of the FCU pushbutton is considered to be an involuntary A/THR off command (e.g. in the case of a failure). When pressed, thrust is frozen and remains locked at the value it had when the flight crew pressed the A/THR pushbutton, as long as the thrust levers remain in the CLB or MCT detent.

If thrust levers are out of detent, thrust is manually controlled and, therefore, unlocked.

A THR LK message appears in amber on the FMA

In this case, when the flight crew moves the thrust levers out of detent, full manual control is recovered, and the THR LK message disappears from the FMA.

This feature should not be used, unless the instinctive disconnect pushbuttons are inoperative.

## ALPHA FLOOR

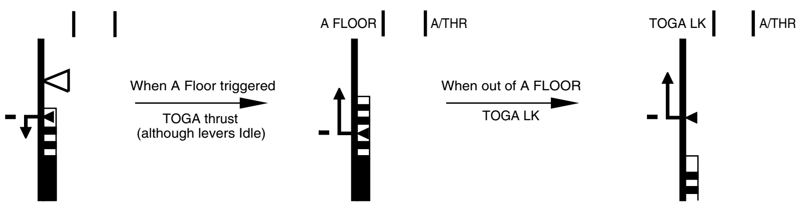
When the aircraft's angle-of-attack goes beyond the ALPHA FLOOR threshold, this means that the aircraft has decelerated significantly (below ALPHA PROT speed): A/THR activates automatically and orders TOGA thrust, regardless of the thrust lever position.

The example below illustrates that:

. The aircraft is in descent with the thrust levers manually set to IDLE.

. The aircraft decelerates, during manual flight with the FD off, as indicated on the FMA.

SPEED SCALE AND FMA INDICATION IN A TYPICAL A FLOOR CASE

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When the speed decreases, so that the angle-of-attack reaches the ALPHA FLOOR threshold, A/THR activates and orders TOGA thrust, despite the fact that the thrust levers are at IDLE.

When the aircraft accelerates again, the angle-of-attack drops below the ALPHA FLOOR threshold. TOGA thrust is maintained or locked. This enables the flight crew to reduce thrust, as necessary. TOGA LK appears on the FMA to indicate that TOGA thrust is locked. The desired thrust can only be recovered by setting A/THR to off, with the instinctive disconnect pushbutton.

ALPHA floor is available, when the flight controls are in NORMAL LAW, from liftoff to 100 ft R/A at landing. It is inhibited in some cases of engine failure.

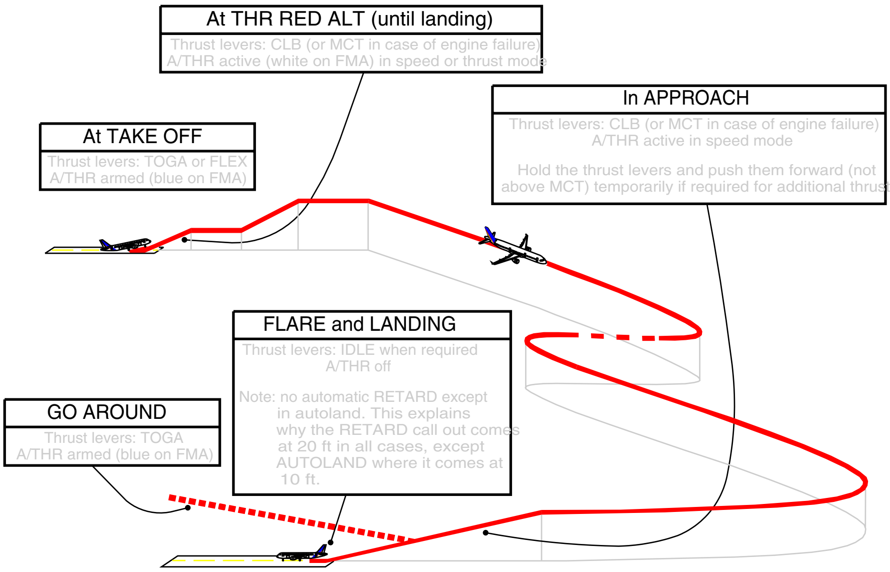
## A/THR USE - SUMMARY

Use of A/THR is recommended during the entire flight. It may be used in most failures cases, including:

. Engine failure, even during autoland

. Abnormal configurations

A/THR USE IN FLIGHT



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A/THR should be monitored via the:

. FMA SPEED / SPEED TREND on the PFD

. N1/N1 command (EPR) on the ECAM E/WD.

MSN 0002-0034 0036 0039-0042 0044 0059-0063 0068-0073 0078 0083-0088 0093-0094 0100-0111 0115-0118 0120-0122 0125-0137 0140-0147 0149-0150 0152-0162 0171-0177 0183-0188 0191-0192 0197 0199-0204 0206-0211 0213-0218 0220 0223-0224 0226-0229 0231-0242 0244 0246 0248 0252-0255 0259-0288 0290-0292 0296-0298 0302-0303 0305-0307 0309-0313 0318-0321 0323-0325 0329-0333 0337 0339-0342 0345-0347 0350 0352-0353 0355-0356 0358-0361 0364 0367-0369 0372-0375 0377-0378 0380-0382 0384-0385 0387-0388 0395 0399-0401 0403-0405 0407-0410 0412 0415 0417-0421 0426-0428 0434-0436 0438-0439 0442 0445 0449-0450 0452 0454 0456-0459 0462-0468 0470 0472-0475 0477 0479 0483-3260

## OBJECTIVE

The A/THR computer (within the FG) interfaces directly with the engine computer, referred to as the FADEC.

The A/THR sends to the FADEC the thrust targets that are needed to:

. Obtain and maintain a target speed, when in SPEED mode

. Obtain a specific thrust setting (e.g. CLB, IDLE), when in THRUST mode.

## INTERFACE

When the A/THR is active, the thrust lever position determines the maximum thrust that the A/THR can command in SPEED or THRUST mode. Therefore, with A/THR active, thrust levers act as a thrust limiter or a thrust-rating panel.

The A/THR computer does not drive back the thrust levers. The PF sets them to a specific detent on the thrust lever range. The A/THR system provides cues that indicate the energy of the aircraft:

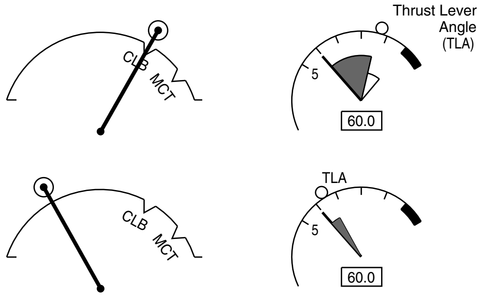
. Speed, acceleration, or deceleration, obtained by the speed trend vector

. N1, and N1 command on the N1 gauge.

All these cues are in the flight crews direct line of vision.

In other words, the Thrust Lever Angle (TLA) should not be used to monitor correct A/THR operation. Neither should the thrust lever position of a conventional autothrottle, be considered a cue because, in many hazardous situations, the thrust lever position can be misleading (e.g. engine failure, thrust lever jammed).

<u>THE TLP DETERMINES MAX THRUST FOR THE A/THR</u>

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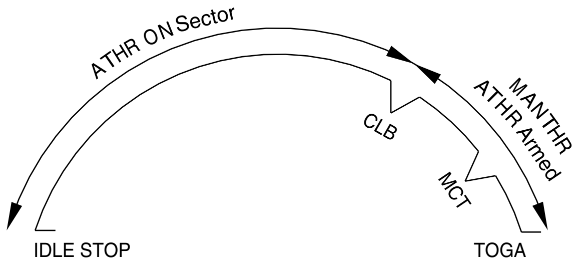
## NORMAL OPERATIONS

The A/THR can only be active, when the thrust levers are between IDLE and the CLB detent.

When the thrust levers are beyond the CLB detent, thrust is controlled manually to the thrust lever position, and the A/THR is armed . This means that the A/THR is ready to be re-activated, when the flight crew sets the thrust levers back to the CLB detent (or below).A/THR appears in blue on the FMA.

A/THR OPERATING SECTORS _ ALL ENGINES OPERATING

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### At Takeoff

The thrust levers are set either full forward to TOGA, or to the FLX detent. Thrust is manually controlled to the TLA, and A/THR is armed. The FMA indicates this in blue.

### After Takeoff

When the aircraft reaches THR RED ALT, the flight crew sets the thrust levers back to the CLB detent. This activates A/THR. MAX CLB will, therefore, be the maximum normal thrust setting that will be commanded by the A/THR in CLB, CRZ, DES, or APPR, as required.

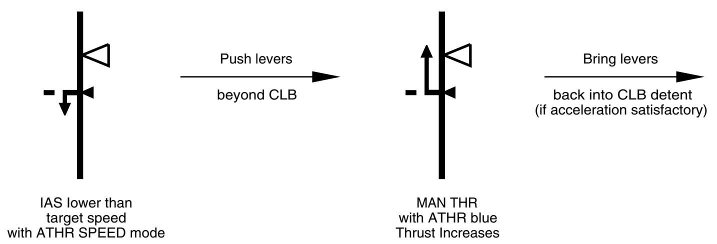
**Thrust Lever(s) below the CLB Detent**

If one thrust lever is set to below the CLB detent, the FMA triggers a LVR ASYM message, as a reminder to the flight crew (e.g. this configuration might be required due to an engines high vibration level). However, if all thrust levers are set to below the CLB detent, with the A/THR active, then the ECAM repeatedly triggers the AUTO FLT AUTOTHRUST LIMITED caution. This is because there is no operational reason to be in such a situation, and to permanently limit A/THR authority on all engines. In this case, all thrust levers should either be brought back to the CLB detent, or the A/THR should be set to OFF.

**Thrust Levers Beyond the CLB Detent**

If all thrust levers are set to beyond the CLB detent, when A/THR is active, the flight crew manually controls thrust to the Thrust Lever Position. The FMA displays THR or MAN THR, and the A/THR is armed. As a reminder, CLB or LVR CLB flashes on the FMA. This technique is most efficient, when the aircraft speed goes significantly below the target. When the aircraft speed or acceleration is satisfactory, the thrust levers should be brought back to the CLB detent. This re-activates the A/THR.

SPEED DROP IN APPROACH: RECOMMENDED RECOVERY TECHNIQUE

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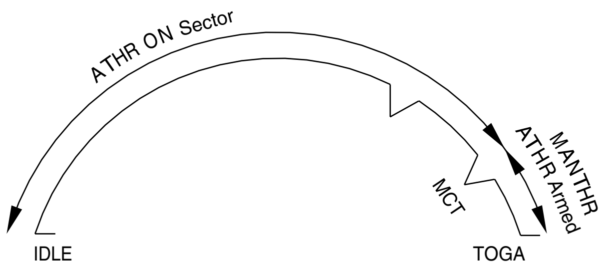
*Note*: *When using this technique during approach (e.g. to regain VAPP), the thrust levers should be moved past the CLB detent, but not beyond the MCT. In most cases, it is not necessary to go beyond MCT, and the PF may inadvertently advance thrust levers all the way to the TOGA stop, and thereby engage go-around mode.*

**OPERATIONS WITH ONE ENGINE INOPERATIVE**

The above-noted principles also apply to an one-engine inoperative situation, except that A/THR can only be active, when the thrust levers are set between IDLE and MCT.

A/THR OPERATING SECTORS - ONE ENGINE INOPERATIVE

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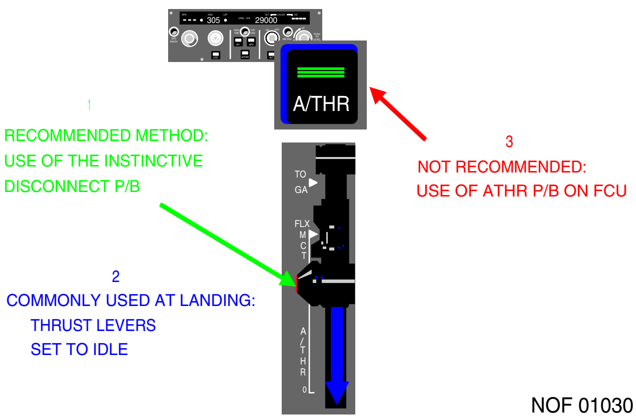
In case of engine failure, the thrust levers will be in MCT detent for remainder of the flight. This is because MCT is the maximum thrust that can usually be commanded by the A/THR for climb or acceleration, in all flight phases (e.g. CLB, CRZ, DES or APPR ).

## TO SET AUTOTHRUST TO OFF

HOW TO SET A/THR OFF

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### 1) USE OF INSTINCTIVE DISCONNECT (I/D) PUSHBUTTON

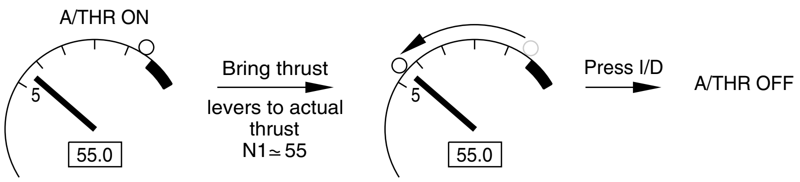
If the I/D pushbutton is pressed when the thrust levers are in CLB detent, thrust will increase to MAX CLB. This may cause a not desired thrust change. For example, during approach, A/THR in SPEED mode, commands approximately N1 55 %. If the PF presses the I/D pushbutton, the A/THR is set to off, and thrust goes to MAX CLB. This will perturbate the approach.

Therefore, the recommended technique for setting A/THR to off is:

- Return the thrust levers to approximately the current thrust setting, by observing the TLA symbol on the thrust gauge
- Press the I/D pushbutton

This technique minimizes thrust discontinuity, when setting A/THR to off.

RECOMMENDED TECHNIQUE TO SET A/THR OFF

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**2) THRUST LEVERS SET TO IDLE**

If thrust levers are set to IDLE, A/THR is set to off. This technique is usually used in descent, when the A/THR is in THR IDLE, or at landing. During flare, with the A/THR active, the thrust levers are set to the CLB detent. Then, when thrust reduction is required for landing, the thrust levers should be moved smoothly and set to the IDLE stop. This will retard thrust, and set A/THR to off. As a reminder, the "RETARD" aural alert will sound. In flare, this aural alert will occur at 20 feet, except in the case of autoland, where it occurs at 10 feet.

It should be noted that, when the thrust levers are set back to IDLE and A/THR set to off: The A/THR can be reactivated by pressing the pushbutton on the FCU, and returning the thrust levers to the applicable detent. The thrust levers should be immediately returned to the applicable detent, in order to avoid an ECAM "AUTOTHRUST LIMITED" message

**3) USE OF THE FCU PUSHBUTTON**

Use of the FCU pushbutton is considered to be an involuntary A/THR off command (e.g. in the case of a failure). When pressed, thrust is frozen and remains locked at the value it had when the flight crew pressed the A/THR pushbutton, as long as the thrust levers remain in the CLB or MCT detent.

If thrust levers are out of detent, thrust is manually controlled and, therefore, unlocked.

An ECAM caution and an FMA message trigger during thrust lock:

⇒ THR LK appears in amber on the FMA

⇒ The ECAM caution is:
**AUTOFLT**: A/THR OFF
THR LEVERS.........MOVE
**ENG**: THRUST LOCKED
THR LEVERS.........MOVE

In this case, when the flight crew moves the thrust levers out of detent, full manual control is recovered, and the THRUST LOCKED message disappears from the FMA.

This feature should not be used, unless the instinctive disconnect pushbuttons are inoperative.

## ALPHA FLOOR

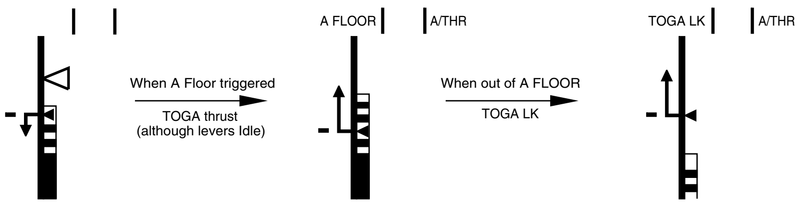
When the aircraft's angle-of-attack goes beyond the ALPHA FLOOR threshold, this means that the aircraft has decelerated significantly (below ALPHA PROT speed): A/THR activates automatically and orders TOGA thrust, regardless of the thrust lever position.

The example below illustrates that:

. The aircraft is in descent with the thrust levers manually set to IDLE.

. The aircraft decelerates, during manual flight with the FD off, as indicated on the FMA.

SPEED SCALE AND FMA INDICATIONS IN A TYPICAL A FLOOR CASE

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When the speed decreases, so that the angle-of-attack reaches the ALPHA FLOOR threshold, A/THR activates and orders TOGA thrust, despite the fact that the thrust levers are at IDLE.

When the aircraft accelerates again, the angle-of-attack drops below the ALPHA FLOOR threshold. TOGA thrust is maintained or locked. This enables the flight crew to reduce thrust, as necessary. TOGA LK appears on the FMA to indicate that TOGA thrust is locked. The desired thrust can only be recovered by setting A/THR to off, with the instinctive disconnect pushbutton.

ALPHA floor is available, when the flight controls are in NORMAL LAW, from liftoff to 100 ft R/A at landing. It is inhibited in some cases of engine failure.

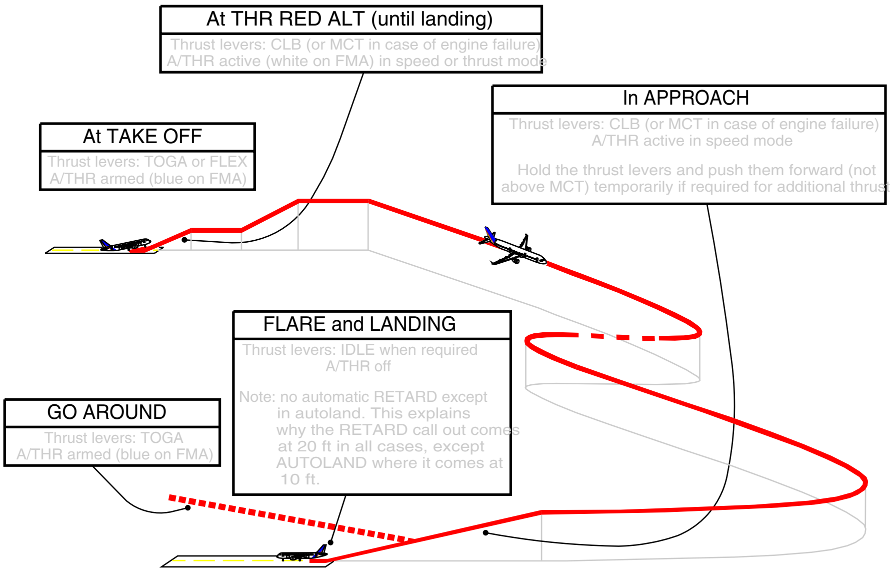
## A/THR USE - SUMMARY

Use of A/THR is recommended during the entire flight. It may be used in most failures cases, including:

. Engine failure, even during autoland

. Abnormal configurations

A/THR USE IN FLIGHT

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A/THR should be monitored via the:

. FMA SPEED / SPEED TREND on the PFD

. N1/N1 command (EPR) on the ECAM E/WD.

## AP, FD, A/THR MODE CHANGES AND REVERSIONS

MSN 0002-0030 0033 0035-0039 0042-0068 0073-0077 0080-0082 0084-0085 0087-0091 0095-0103 0108-0109 0112-0115 0119-0120 0122-0124 0126-0134 0136 0138-0146 0148-0151 0154-0159 0163-0164 0167-0170 0173-0177 0179-0191 0193 0195-0196 0199 0203-0205 0207 0210-0212 0214-0215 0219-0257 0259-0261 0264-0266 0270 0274-0280 0283-0296 0299-0305 0308-0317 0320-0328 0330-0338 0341-0345 0347-0350 0352-0354 0356-0357 0359 0361-0365 0368-0371 0373-0379 0383-0386 0389-0398 0402-0407 0409 0411 0413-0416 0419-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0534 0537-0540 0542-0543 0546 0549-0552 0554-0558 0561 0565 0568-0573 0575 0579-0582 0584 0587 0589-0592 0594 0597 0601 0604-0607 0611 0613-0615 0617 0619-0620 0622 0624 0626 0628 0630-0634 0638-0639 0645-0646 0648-0650 0654-0656 0658-0659 0661-0662 0666-0667 0669-0672 0674-0675 0677-0678 0682-0685 0688 0691 0693 0695 0697 0702 0711 0714 0719 0721 0726 0728 0731-0732 0735-0736 0739-0740 0742-0743 0746 0751-0752 0756-0759 0762-0763 0769-0770 0772-0773 0775 0779-0781 0784-0785 0787 0791-0792 0794-0795 0799-0800 0802-0803 0805 0808 0811-0814 0816-0817 0820 0822-0824 0826 0828-0829 0831 0834 0836 0839-0840 0842 0845 0851-0852 0856-0857 0865-0866 0869 0877 0880 0888 0963 1008 1042 1204 1227

## INTRODUCTION

The flight crew manually engages the modes. However, they may change automatically, depending on the:

- AP, FD, and A/THR system integration
- Logical sequence of modes
- So-called "mode reversions".

## AP, FD, ATHR SYSTEM INTEGRATION

There is a direct relationship between aircraft pitch control, and engine thrust control. This relationship is designed to manage the aircrafts energy.

- If the AP/FD pitch mode controls a vertical trajectory (e.g. ALT, V/S, FPA, G/S): A/THR controls speed
- If the AP/FD pitch mode controls a speed (e.g. OP CLB, OP DES): A/THR controls thrust (THR CLB, THR IDLE)
- If no AP/FD pitch mode is engaged (i.e. AP is off and FD is off): A/THR controls speed

Therefore, any change in the AP/FD pitch mode is associated with a change in the A/THR mode.

*Note: For this reason, the FMA displays the A/THR mode and the AP/FD vertical mode columns next to each other.*

## THE LOGICAL SEQUENCE OF MODES

In climb, when the flight crew selects a climb mode, they usually define an altitude target, and expect the aircraft to capture and track this altitude. Therefore, when the flight crew selects a climb mode, the next logical mode is automatically armed.

For example:

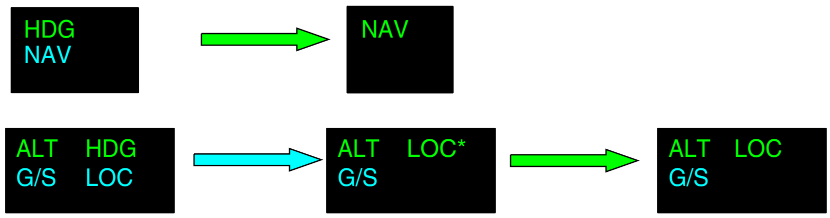
AP/FD MODE CAPTURE AND TRACKING (1)


NOF 01030 04596 0001

The flight crew may also manually arm a mode in advance, so that the AP/FD intercepts a defined trajectory.

Typically, the flight crew may arm NAV, LOC-G/S, and APPNAV-FINAL. When the capture or tracking conditions occur, the mode will change sequentially.

AP/FD MODE CAPTURE AND TRACKING (2)




NOF 01030 04597 0001

These logical mode changes occur, when the modes are armed. They appear in blue on the FMA.

## MODE REVERSIONS

## GENERAL

Mode reversions are automatic mode changes that unexpectedly occur, but are designed to ensure coherent AP, FD, and A/THR operations, in conjunction with flight crew input (or when entering a F-PLN discontinuity).

For example, a reversion will occur, when the flight crew:

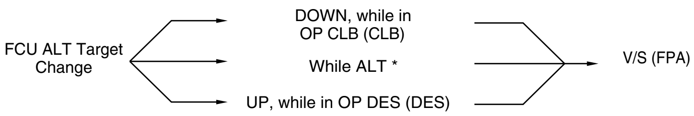
. Changes the FCU ALT target in specific conditions

. Engages a mode on one axis, that will automatically disengage the associated mode on the other axis

Due to the unexpected nature of their occurrence, the FMA should be closely-monitored for mode reversions.

## FLIGHT CREW CHANGE OF FCU ALT TARGET ► ACTIVE VERTICAL MODE NOT POSSIBLE

<u>FCU CHANGE RESULTING REVERSION TO VS MODE</u>




NOF 01030 04598 0001

This reversion to the V/S (FPA) mode on the current V/S target does not modify the pitch behaviour of the aircraft.

It is the flight crew's responsibility to change it as required.

## FLIGHT CREW HDG OR TRK MODE ENGAGEMENT ► DISENGAGEMENT OF ASSOCIATED MODE ON THE VERTICAL AXIS

This reversion is due to the integration of the AP, FD, and A/THR with the FMS.

When the flight crew defines a F-PLN, the FMS considers this F-PLN as a whole (lateral + vertical). Therefore, the AP will guide the aircraft along the entire F-PLN:

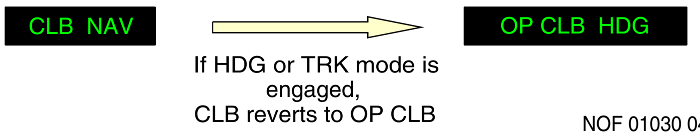
. Along the LAT F-PLN (NAV   APP NAV modes)

. Along the VERT F-PLN (CLB   DES   FINAL modes).

Vertical managed modes can only be used, if the lateral managed NAV mode is used. If the flight crew decides to divert from the lateral F-PLN, the autopilot will no longer guide the aircraft along the vertical F-PLN.

Therefore, in climb:

<u>LATERAL MODE CHANGE AND VERTICAL MODE REVERSION</u>

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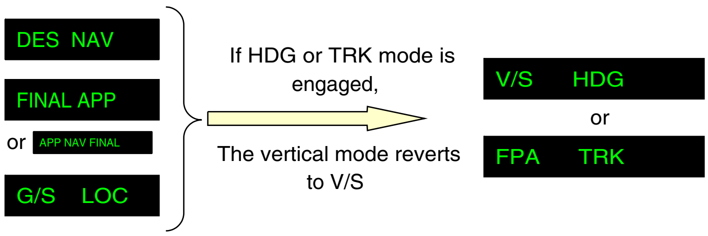
In descent:

LATERAL MODE CHANGE AND VERTICAL MODE REVERSION

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This reversion to V/S (FPA) mode on the current V/S target does not modify the pitch behavior of the aircraft. It is the flight crews responsibility to adapt pitch, if necessary.

**THE AIRCRAFT ENTERS A F-PLN DISCONTINUITY**

NAV mode is lost, when entering a F-PLN discontinuity. On the lateral axis, the aircraft reverts to HDG (or TRK) mode. On the vertical axis, the same reversion (as the one indicated above) occurs.

**THE PF MANUALLY FLIES THE AIRCRAFT WITH THE FD ON, AND DOES NOT FOLLOW THE FD PITCH ORDERS**

If the flight crew does not follow the FD pitch orders, an A/THR mode reversion occurs. This reversion is effective, when the A/THR is in THRUST MODE (THR IDLE, THR CLB), and the aircraft reaches the limits of the speed envelope (VLS, VMAX):

REVERSION TO SPEED MODE

| FD ON | | If the flight crew pitches The aircraft up, → And the speed decreases To VLS | FD ON | |
|---|---|---|---|---|
| THR IDLE | OP DES | | SPEED | V/S |
| THR IDLE | DES | | SPEED | V/S |

A/THR REVERTS TO SPEED MODE

| FD ON | | If the flight crew pitches The aircraft down, → And the speed increases To VMAX | FD ON | |
|---|---|---|---|---|
| THR CLB | OP CLB | | SPEED | V/S |
| THR CLB | CLB | | SPEED | V/S |

A/THR REVERTS TO SPEED MODE

NOF 01030 04234 0001

MSN 0031-0032 0034 0040-0041 0069-0072 0078 0083 0086 0093-0094 0104 0110-0111 0116-0118 0121 0125 0135 0137 0147 0152-0153 0160-0162 0165-0166 0171-0172 0178 0192 0194 0197-0198 0200-0202 0206 0208-0209 0213 0216-0218 0258 0262-0263 0267-0269 0272-0273 0281-0282 0297-0298 0306-0307 0318-0319 0329 0339-0340 0346 0351 0355 0358 0360 0366-0367 0372 0380-0382 0387-0388 0399-0401 0408 0410 0412 0417-0418 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532-0533 0535 0541 0544-0545 0548 0553 0559-0560 0562-0564 0566-0567 0574 0576-0578 0583 0585-0586 0588 0593 0595-0596 0598-0600 0603 0608-0610 0612 0616 0618 0621 0623 0625 0627 0629 0635-0637 0640-0644 0647 0651-0653 0657 0660 0663-0665 0668 0673 0676 0679-0681 0686-0687 0689-0690 0692 0694 0696 0698-0701 0703-0710 0712-0713 0715-0718 0720 0722-0725 0727 0729-0730 0733-0734 0737-0738 0741 0744-0745 0747-0750 0753-0755 0760-0761 0764-0768 0771 0774 0776-0778 0782-0783 0786 0788-0790 0793 0796-0798 0801 0804 0806-0807 0809-0810 0815 0818-0819 0821 0825 0827 0830 0832-0833 0835 0837-0838 0841 0843-0844 0846-0850 0853-0855 0858-0864 0867-0868 0870-0876 0878-0879 0881-0887 0889-0962 0964-1007 1009-1041 1043-1203 1205-1226 1228-3260

## INTRODUCTION

The flight crew manually engages the modes. However, they may change automatically, depending on the:

. AP, FD, and A/THR system integration

. Logical sequence of modes

. So-called "mode reversions".

## AP, FD, ATHR SYSTEM INTEGRATION

There is a direct relationship between aircraft pitch control, and engine thrust control. This relationship is designed to manage the aircrafts energy.

. If the AP/FD pitch mode controls a vertical trajectory (e.g. ALT, V/S, FPA, G/S): A/THR controls speed

. If the AP/FD pitch mode controls a speed (e.g. OP CLB, OP DES): A/THR controls thrust (THR CLB, THR IDLE)

. If no AP/FD pitch mode is engaged (i.e. AP is off and FD is off): A/THR controls speed

Therefore, any change in the AP/FD pitch mode is associated with a change in the A/THR mode.

*Note: For this reason, the FMA displays the A/THR mode and the AP/FD vertical mode columns next to each other.*

## THE LOGICAL SEQUENCE OF MODES

In climb, when the flight crew selects a climb mode, they usually define an altitude target, and expect the aircraft to capture and track this altitude. Therefore, when the flight crew selects a climb mode, the next logical mode is automatically armed.

For example:

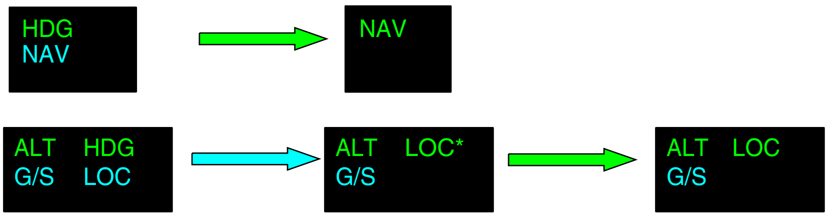
AP/FD MODE CAPTURE AND TRACKING (1)


NOF 01030 04590 0001

The flight crew may also manually arm a mode in advance, so that the AP/FD intercepts a defined trajectory.

Typically, the flight crew may arm NAV, LOC-G/S, and APPNAV-FINAL. When the capture or tracking conditions occur, the mode will change sequentially.

AP/FD MODE CAPTURE AND TRACKING (2)




NOF 01030 04591 0001

These logical mode changes occur, when the modes are armed. They appear in blue on the FMA.

## MODE REVERSIONS

### GENERAL

Mode reversions are automatic mode changes that unexpectedly occur, but are designed to ensure coherent AP, FD, and A/THR operations, in conjunction with flight crew input (or when entering a F-PLN discontinuity).

For example, a reversion will occur, when the flight crew:

. Changes the FCU ALT target in specific conditions

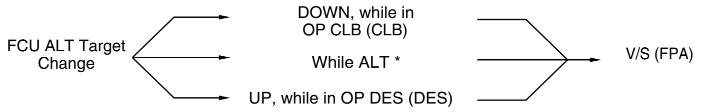
. Engages a mode on one axis, that will automatically disengage the associated mode on the other axis

. Manually flies the aircraft with the FD on, but does not follow the FD orders, which leads to the aircraft to the limits of the flight envelope.

Due to the unexpected nature of their occurrence, the FMA should be closely-monitored for mode reversions.

**FLIGHT CREW CHANGE OF FCU ALT TARGET ► ACTIVE VERTICAL MODE NOT POSSIBLE**

FCU CHANGE RESULTING REVERSION TO VS MODE




NOF 01030 04592 0001

This reversion to the V/S (FPA) mode on the current V/S target does not modify the pitch behaviour of the aircraft.

It is the flight crew's responsibility to change it as required.

**FLIGHT CREW HDG OR TRK MODE ENGAGEMENT ► DISENGAGEMENT OF ASSOCIATED MODE ON THE VERTICAL AXIS**

This reversion is due to the integration of the AP, FD, and A/THR with the FMS.

When the flight crew defines a F-PLN, the FMS considers this F-PLN as a whole (lateral + vertical). Therefore, the AP will guide the aircraft along the entire F-PLN:

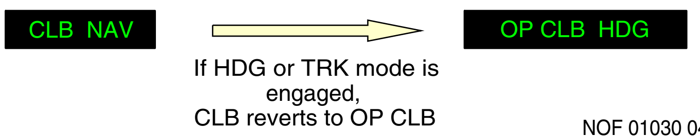
. Along the LAT F-PLN (NAV APP NAV modes)

. Along the VERT F-PLN (CLB DES FINAL modes).

Vertical managed modes can only be used, if the lateral managed NAV mode is used. If the flight crew decides to divert from the lateral F-PLN, the autopilot will no longer guide the aircraft along the vertical F-PLN.

Therefore, in climb:

LATERAL MODE CHANGE AND VERTICAL MODE REVERSION

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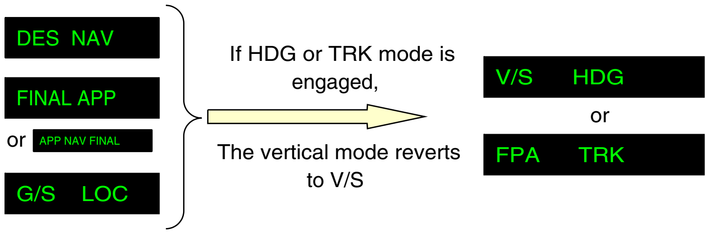
In descent:

LATERAL MODE CHANGE AND VERTICAL MODE REVERSION




NOF 01030 04106 0001

This reversion to V/S (FPA) mode on the current V/S target does not modify the pitch behavior of the aircraft. It is the flight crews responsibility to adapt pitch, if necessary.

**THE AIRCRAFT ENTERS A F-PLN DISCONTINUITY**

NAV mode is lost, when entering a F-PLN discontinuity. On the lateral axis, the aircraft reverts to HDG (or TRK) mode. On the vertical axis, the same reversion (as the one indicated above) occurs.

**THE PF MANUALLY FLIES THE AIRCRAFT WITH THE FD ON, AND DOES NOT FOLLOW THE FD PITCH ORDERS**

If the flight crew does not follow the FD pitch orders, an A/THR mode reversion occurs. This reversion is effective, when the A/THR is in THRUST MODE (THR IDLE, THR CLB), and the aircraft reaches the limits of the speed envelope (VLS, VMAX):

<u>REVERSION TO SPEED MODE</u>

| FD ON | | If the flight crew pitches The aircraft up, → And the speed decreases To VLS | FD ON | |
|---|---|---|---|---|
| THR IDLE | OP DES | | SPEED | V/S |
| THR IDLE | DES | | SPEED | V/S |

A/THR REVERTS TO SPEED MODE

| FD ON | | If the flight crew pitches The aircraft down, → And the speed increases To VMAX | FD ON | |
|---|---|---|---|---|
| THR CLB | OP CLB | | SPEED | V/S |
| THR CLB | CLB | | SPEED | V/S |

A/THR REVERTS TO SPEED MODE

NOF 01030 04234 0001

A/THR in SPEED mode automatically readjusts thrust to regain the target speed. The FD bars will disappear, because they are not being followed by the PF.

## TRIPLE CLICK

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0033 0036 0044 0061-0063 0100-0102 0108 0115 0128-0131 0133 0144-0145 0155-0156 0184 0186-0188 0203 0214-0215 0220 0226-0228 0235-0239 0244 0270 0278 0285-0287 0337 0352 0377 0491 0498 0509 0521 0529 0544 0598 0600 0608 0618 0625 0637 0644 0647 0660 0777 0796 0938 0985 0998 1000 1020 1025 1036 1133 1137 1150-1151 1189-1190 1201 1216 1267 1271 1299 1344 1387 1404 1415 1444 1449 1458 1471 1476 1478 1502 1505 1524 1599 1616 1622 1640 1645 1658 1660 1677 1691 1699 1733 1794 1859 1873 1878-1879 1885 1894 1900 1924 1928 1938-1939 1949 1952-1953 1956 1967 1977 1991 2015 2017 2019 2021 2023 2026 2028 2030 2032-2033 2035 2037 2039 2041 2043 2045 2047 2050-2053 2055 2057 2059-2060 2062 2064 2066-2067 2069 2071-2072 2074 2076-2103 2105-2136 2138-2142 2144-2156 2158-2224 2226-2241 2243-2247 2249-2251 2253-2310 2312-2380 2382-2390 2392-2471 2473-2487 2489-2562 2564-2598 2600-3260

The "triple click" is an aural alert. It is an attention-getter, designed to draw the flight crew's attention to the FMA.

The PFD FMA highlights a mode change or reversion with a white box around the new mode, and the pulsing of its associated FD bar.

The reversions, described in the previous paragraph, are also emphasized via the triple click aural alert.

*<u>Note</u>: The triple click also appears in the following, less usual, cases:*

- *SRS ► CLB (OPCLB) reversion: If, the flight crew selects a speed on the FCU*
- *The V/S selection is "refused" during ALT *: The flight crew pulls the V/S knob, while in ALT**
- *The V/S target is not followed, because the selected target is too high, and leads to VMIN/VMAX.*

## PURPOSE OF THE ECAM

ALL

The Electronic Centralized Aircraft Monitoring (ECAM) system is a main component of Airbus two-crewmember cockpit, which also takes the "dark cockpit" and "forward-facing crew" philosophies into account.

The purpose of the ECAM is to:

. Display aircraft system information

. Monitor aircraft systems

. Indicate required flight crew actions, in most normal, abnormal and emergency situations.

As the ECAM is available in most failure situations, it is a significant step in the direction towards a paperless cockpit and the removal of memory items.

ALL

## MAIN PRINCIPLES

### INFORMATION PROVIDED WHEN NEEDED

One of the main advantages of the ECAM is that it displays applicable information to the flight crew, on an "as needed" basis. The following outlines the ECAMs operating modes:

. **Normal Mode**:
Automatically displays systems and memos, in accordance with the flight phase.

. **Failure Mode**:
Automatically displays the appropriate emergency/abnormal procedures, in addition to their associated system synoptic.

. **Advisory Mode**:
Automatically displays the appropriate system synoptic, associated with a drifting parameter.

. **Manual Mode**:

Enables the flight crew to manually select any system synoptic via the ECAM Control Panel (ECP).

Most warnings and cautions are inhibited during critical phases of flight (T/O INHIBIT  LDG INHIBIT), because most system failures will not affect the aircrafts ability to continue a takeoff or landing.

## FAILURE LEVELS

The ECAM has three levels of warnings and cautions. Each level is based on the associated operational consequence(s) of the failure. Failures will appear in a specific color, according to defined color-coding system, that advises the flight crew of the urgency of a situation in an instinctive, unambiguous manner. In addition, Level 2 and 3 failures are accompanied by a specific aural warning: A Continuous Repetitive Chime (CRC) indicates a Level 3 failure, and a Single Chime (SC) indicates a Level 2 failure.

| Failure Level | Priority | Color Coding | Aural Warning | Recommended Crew Action |
|---|---|---|---|---|
| Level 3 | Safety | Red | CRC | Immediate |
| Level 2 | Abnormal | Amber | SC | Awareness, then action |
| Level 1 | Degradation | Amber | None | Awareness, then Monitoring |

When there are several failures, the FWC displays them on the Engine Warning Display (E/WD) in an order of priority, determined by the severity of the operational consequences. This ensures that the flight crew sees the most important failures first.

## FEEDBACK

The ECAM provides the flight crew with feedback, after action is taken on affected controls:

. **The System Synoptic**:
Displays the status change of affected components.

. **The Memo**:
Displays the status of a number of systems selected by the flight crew (e.g. anti ice).

. **The Procedures**:
When the flight crew performs a required action on the cockpit panel, the ECAM usually clears the applicable line of the checklist (except for some systems or actions, for which feedback is not available).

The ECAM reacts to both failures and pilot action.

## ECAM HANDLING

ALL

Task sharing is essential to effective ECAM operation, particularly in the case of abnormal operations.

### NORMAL OPERATIONS

On ground, the ECAM MEMO is reviewed for feedback on temporarily-selected items (e.g. SEAT BELTS/IGNITION/ENG A/I), and to check whether IRs are aligned. If alignment is not complete, the time remaining will be displayed. It is, therefore, not necessary to refer to the OVHD panel.

In cruise, the main systems should periodically be reviewed during flight (ENG, BLEED, ELEC AC/DC, HYD, FUEL, F/CTL), to ensure that they are operating normally, and to detect any potential problem in advance.

The ECAM MEMO must be included in the instrument review. In cruise, in most of the cases, it should be blank. It helps to make the flight crew aware of any system that a flight crewmember temporarily selected, but forgot to deselect.

A STS label, displayed at the bottom of the E/WD, indicates that there is a STATUS to be reviewed. Therefore, when a C/L calls for STATUS review, press STS, only if the label appears.

If there is a STS at engine shutdown, it will pulse at the bottom of the E/WD. If this is the case, the STATUS page should be reviewed for help in completing the technical log.

### ADVISORY MODE

The flight crewmember that first notices an advisory announces: "ADVISORY on XYZ system". Then, the PF requests the PNF to review the drifting parameter. If time permits, the PNF may refer to the QRH Part 2, containing recommended actions in various advisory situations.

### FAILURE MODE

## TASK SHARING RULES

When the ECAM displays a warning or a caution, the first priority is to ensure that a safe flight path is maintained. The successful outcome of any ECAM procedure depends on: Correct reading and application of the procedure, effective task sharing, and conscious monitoring and crosschecking.

It is important to remember that, after ECAM ACTIONS announcement by the PF:

. The PFs task is to fly the aircraft, navigate, and communicate.

. The PNFs task is to manage the failure, on PF command.

The PF usually remains the PF for the entire flight, unless the Captain decides to take control.

The PF will then control the aircrafts flight path, speed, configuration, and engines. The PF will also manage navigation and communication, and initiate the ECAM actions to be performed by the PNF, and check that the actions are completed correctly.

The PNF has a considerable workload: Managing ECAM actions and assisting the PF on request. The PNF reads the ECAM and checklist, performs ECAM actions on PF command, requests PF confirmation to clear actions, and performs actions required by the PF. The PNF never touches the thrust levers, even if requested by the ECAM.

Some selectors or pushbuttons (including the ENG MASTER switch, FIRE pushbutton, IR, IDG and, in general, all guarded switches) must be completely crosschecked by both the PF and PNF, before they are moved or selected, to prevent the flight crew from inadvertently performing irreversible actions.

To avoid mistakes in identifying the switches, Airbus overhead panels are designed to be uncluttered. When the ECAM requires action on overhead panel pushbuttons or switches, the correct system panel can be identified by referring to the white name of the system on the side of each panel. Before performing any action, the PNF should keep this sequence in mind: "System, then procedure/selector, then action" (e.g. "air, crossbleed, close"). This approach, and announcing an intended selection before action, enables the PNF to keep the PF aware of the progress of the procedure.

It is important to remember that, if a system fails, the associated FAULT light on the system pushbutton (located on the overhead panel) will come on in amber, and enable correct identification.

When selecting a system switch or pushbutton, the PNF should check the SD to verify that the selected action has occurred (e.g. closing the crossbleed valve should change the indications that appear on the SD).

GENERAL OVERVIEW OF ASSIGNED ACTIONS

| PF | PNF |
| --- | --- |
| First pilot who notices:<br>MASTER CAUTION/MASTER WARNING ....... RESET<br>ANNOUCE ............................... "TITLE OF FAILURE" | |
| FLIGHT THE AIRCRAFT<br><br>ORDER ................ ECAM ACTION (2) | ECAM ............................. CONFIRM (1) |
| (3)<br><br>ECAM ACTION COMPLETE .... CHECK<br>CONFIRM ................................. CLEAR | ECAM ACTIONS .................. PERFORM<br>REQUEST ...... CLEAR "name of SYS"?<br><br>ECAM ........................................ CLEAR |
| (4)<br><br>CONFIRM ................................. CLEAR | SYSTEM PAGE .................... ANALYSE<br>REQUEST ...... CLEAR "name of SYS"?<br>SYSTEM DISPLAY .................... CLEAR |
| CONFIRM .......................... STATUS (5)<br><br>CONFIRM ................... CLEAR STATUS | ANNOUNCE .......................... STATUS?<br>STATUS ...................................... READ<br>REQUEST ................ CLEAR STATUS?<br>STATUS .............................. CLEAR (6)<br>ANNOUNCE ............. ECAM ACTIONS COMPLETED |
| SITUATION ASSESMENT/DECISION | |

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1. The PNF should review the overhead panel and/or associated SD to analyze and confirm the failure, prior to taking any action, and should bear in mind that the sensors used for the SD are different from the sensors that trigger failure.
2. In case of a failure during takeoff or go-around, ECAM actions should be delayed until the aircraft reaches approximately 400 feet, and is stabilized on a safe trajectory. This is an appropriate compromise between stabilizing the aircraft and delaying action.
3. When the ECAM displays several failures, the sequence (action, then request and confirmation, before clearance) should be repeated for each failure. When all necessary actions are completed, amber messages and red titles will no longer appear on the E/WD.
4. When the ECAM displays several system pages, the sequence (request and confirmation before clearance) should be repeated for each system page.

5. The PF may call out "STOP ECAM" at any time, if other specific actions must be performed (normal C/L, application of an OEB, or performing a computer reset). When the action is completed, the PF must call out: "CONTINUE ECAM".
6. When the flight crew selects CONF 1 for approach, or sets QNH (QFE) during descent (when APPR C/L should be requested), the SD automatically displays the STATUS. The STS should be carefully reviewed, and the required procedure applied.
7. When ECAM actions have been completed, and the ECAM status has been reviewed, the PNF may refer to the FCOM procedure for supplementary information, if time permits. However, in critical situations the flight should not be prolonged only to consult the FCOM.

**IF THE ECAM WARNING (OR CAUTION) DISAPPEARS WHILE APPLYING THE PROCEDURE**

If an ECAM warning disappears, while a procedure is being applied, the warning can be considered no longer applicable. Application of the procedure can be stopped.

For example, during the application of an engine fire procedure, if the fire is successfully extinguished with the first fire extinguisher bottle, the ENG FIRE warning disappears, and the procedure no longer applies. Any remaining ECAM procedures should be performed as usual.

**SOME ADDITIONAL REMARKS**

. There are very few memory items:
  - Emergency descent initiation
  - First reaction, in case of an unreliable speed indication
  - Loss of braking
  - Windshear (reactive and predictive)
  - EGPWS and GPWS
  - TCAS

. LAND ASAP(As Soon As Possible):
  - RED LAND ASAP :
    Land as soon as possible at the nearest suitable airport at which a safe approach and landing can be made.
  - AMBER LAND ASAP:
    Advice to the flight crew to consider landing at the nearest suitable airport.

. OEB Reminder
  Some Operational Engineering Bulletins (OEBs) contain information that may impact flight crew action, in the event of a system failure. OEBs are filed in the QRH.

If the OEB reminder function is activated for an ECAM warning/caution, the ECAM will display the : "Refer to QRH Proc" line, when necessary. This line may appear instead of the procedure, or it may be added to the ECAM STATUS.
In such failure cases, the flight crew should refer to the applicable procedure in the QRH.

. Some procedures require reference to the QRH

## IN CASE OF AN ECAM SYSTEM FAULT

### DISPLAY UNIT FAILURE

If one ECAM screen fails, the remaining one will display the E/WD. However, in such a case, if a failure or advisory occurs, the system or status page are not displayed automatically. The PNF can display a system synoptic on the remaining display unit, by pressing the assigned system pushbutton on the ECP. The synoptic will appear, as long as the pushbutton is pressed.

Therefore, in the case of an advisory and/or failure (indicated by an ADV flag that pulses in white on the bottom of the E/WD), the PNF must call up the affected system synoptic, by pressing the related pushbutton.

To review two or three pages of status messages: The PNF should release the STS pushbutton for less than two seconds, then press and hold it again.

A double ECAM screen configuration can be recovered using the ECAM/ND switching selector:

. If the Captain is the PNF, the switch should be set to "CPT".

. If the First Officer is the PNF, the switch should be set to "F/O".

The applicable ND screen will then display the second ECAM image.

### DMC FAILURES

In case all of the ECAM DMC channels fail, each flight crewmember may display the engine standby page on their respective ND (generated by the DMCs EFIS channel).

### ECP FAILURE

In the case of an ECP failure, the CLR, RCL, STS, ALL and EMER CANCEL keys will continue to operate, because they are hardwired to the FWC/DMC. Therefore, the "ALL" key can be used to scroll all SD pages and display the desired one (by releasing the key, when the desired SD page appears).

### FLUCTUATING CAUTION

Any fluctuating caution can be deleted with the EMER CANCEL pushbutton. When pressed, the EMER CANCEL pushbutton deletes both the aural alert, and the caution for the remainder of the flight. This is indicated on the STATUS page, by the "CANCELLED CAUTION" title. Any caution messages that have been inhibited via the EMER CANCEL pushbutton can be recalled by pressing and holding the RCL key for more than three seconds.

The EMER CANCEL pushbutton inhibits any aural warning that is associated with a red warning, but does not affect the warning itself.

ALL

## USE OF SUMMARIES

### GENERAL

Summaries consist of QRH procedures, and are designed to assist the flight crew to manage applicable actions, in the event of an EMER ELEC CONFIG or a dual hydraulic failure.

In any case, **ECAM actions should be applied first** (actions and STATUS review). The PNF should refer to the applicable QRH summary, only after announcing: "ECAM ACTIONS COMPLETED".

When a failure occurs, and after performing the ECAM actions, the PNF should refer to the "CRUISE" section of the summary, to determine the landing distance coefficient. Due to the fact that normal landing distances also appear on this page, the PNF can compute the landing distance with the failure, **and decide whether or not to divert**.

### APPROACH PREPARATION

As usual, approach preparation includes a review of the ECAM STATUS.

After reviewing the STATUS, the PNF should refer to the "CRUISE" section of the summary, to determine the VREF correction, and compute the VAPP.

This assumes that the PNF is aware of the computation method, and uses the VREF displayed on the MCDU (with the updated destination). The summary provides a VREF table, in the event that failure results in the loss of the MCDU.

The LANDING and GO-AROUND sections of the summary should be used for the **approach briefing**.

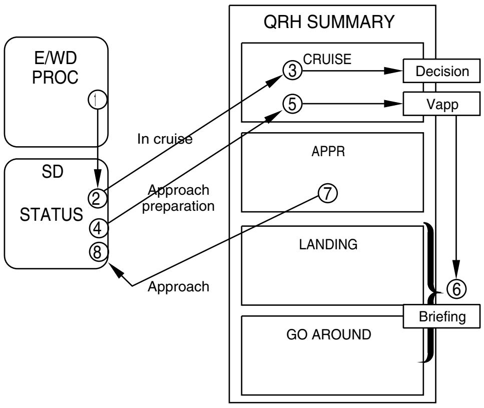
## APPROACH

To perform the APPR PROC, the APPROACH section of the summary should be read (mainly because of the flap extension procedure, that does not entirely appear on the ECAM).

This assumes that the recommendations, provided in this part of the summary are sufficient for understanding, and that it will not be necessary for the flight crew to consult the "LANDING WITH FLAPS (SLATS) JAMMED" paper procedure.

**The PNF should then review the ECAM STATUS**, and check that all the APPR PROC actions have been completed.

SEQUENCE

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## INTRODUCTION

ALL

The NORMAL OPERATIONS Chapter outlines the techniques that should be applied for each flight phase, in order to optimize the use of Airbus aircraft. This chapter must be read in parallel with the FCOM, which provides normal procedures, and their associated tasksharing, callouts, and checklists.

All of these flying techniques are applicable to normal conditions.

Other techniques applicable to adverse weather conditions, are addressed in the ADVERSE WEATHER section of Chapter 4.

There are flow patterns at the end of some flight phases to indicate where the actions are to be performed. All flight crewmembers must apply the flow patterns, to ensure that the flight crew performs the actions necessary for a specific flight phase, before completing an applicable checklist.

## USE OF NORMAL CHECK LIST

ALL

Airbus' NORMAL CHECKLIST takes into account ECAM information, and includes only those items that can directly impact flight safety and efficiency, if actions are not correctly performed. These checklists are of a "non-action" type (i.e. all actions should be completed from memory before the flight crew performs the checklist).

The NORMAL CHECKLIST includes eight flight phases. The BEFORE START, BEFORE TAKEOFF, and AFTER TAKEOFF checklists are divided in two sections: The "Down to the Line" section, and the "Below the Line" section. This format is designed to help flight crews to manage the workload.

For example, the "BEFORE START - Down to the Line" checklist may be called out, as soon as the Load and Trim Sheet is available and takeoff data is set. On the other hand, the "BEFORE START - Below the Line" checklist may called out after obtaining start-up clearance.

The Pilot Flying (PF) requests the NORMAL CHECKLIST, and the Pilot Non Flying (PNF) reads it. The checklist actions are referred to as "challenge/response"-type actions. The PF "responds" to the "challenge" only after checking the configuration.

If the configuration does not correspond to the checklist response, the PF must take corrective action before "responding" to the "challenge". If corrective action is not possible, then the PF must modify the response to reflect the real situation (with a specific answer). When necessary, the other flight crewmember must crosscheck the validity of the response. The challenger (PNF) waits for a response before proceeding with the checklist. For the checklist items that are identified as "AS RQRD", the response should correspond to the real condition or configuration of the system.

The PNF must announce "LANDING CHECKLIST COMPLETED", after reading and completing the checklist.

## COMMUNICATION

ALL

### EMERGENCY CALL

Some abnormal/emergency procedures require flight and cabin crews to use specific phraseology when communicating with each other. To ensure effective communication between the flight and cabin crews, the standard phraseology may be recalled at the preflight phase.

| FROM | TO | PHRASEOLOGY | REMARKS |
|---|---|---|---|
| cockpit | cabin | Passenger Address (PA) System: "PURSER TO COCKPIT, PLEASE!" | The Purser, or any other cabin crewmember, must go to the cockpit |
| Cockpit | Cabin | Passenger Address (PA) System: "ATTENTION CREW! AT STATIONS!" | An emergency evacuation may soon be required. |
| cockpit | cabin | Passenger Address (PA) System: "CABIN CREW and PASSENGERS REMAIN SEATED!" | The captain decides that an evacuation is not required |
| cockpit | cabin | Passenger Address (PA) System: "PASSENGERS EVACUATE!" | The captain orders an immediate evacuation |

| | | | |
|---|---|---|---|
| cabin | cockpit | Interphone: "PRIO CAPT" | Any crew member can make such a call. The flight crew must reply. |

## CROSS-COCKPIT COMMUNICATION

The term "cross-cockpit communication" refers to communication between the PF and the PNF. This communication is vital for any flight crew. Each time one flight crewmember adjusts or changes information and/or equipment on the flight deck, the other flight crewmember must be notified, and an acknowledgement must be obtained.

Such adjustments and changes include:

. FMGS alterations

. Changes in speed or Mach

. Tuning navigation aids

. Flight path modifications

. System selections (e.g. anti-ice system).

When using cross-cockpit communication, standard phraseology is essential to ensure effective flight crew communication. This phraseology should be concise and exact, and is defined in the FCOM 3.03.90.

The flight crew must use the headset:

. From the ENGINE START phase until the TOP OF CLIMB phase

. From The TOP OF DESCENT phase until the aircraft is parked.

## STERILE COCKPIT RULE

When the aircraft is below 10 000 feet, any conversation that is not essential should be avoided: This includes conversations that take place in the cockpit, or between the flight and cabin crewmembers. It is important to adhere to this policy, in order to facilitate communication between both of the flight crew, and to ensure the effective communication of emergency or safety-related information, between flight and cabin crew members.

**MEL**

ALL

## GENERAL

The Master Minimum Equipment List (MMEL) is published by the aircraft manufacturer. It is a certified document that enables an aircraft to be dispatched, with some equipment, or functions inoperative. Some limitations, operational procedures and/or maintenance procedures may have to be performed. The Minimum Equipment List (MEL) is published by the operator, and approved by local authorities. It must be at least as restrictive as MMEL. The MMEL cannot be used to replace the MEL.

Aircraft can be dispatched with one, or more, secondary airframe part/parts missing. In this case, the flight crew must refer to the Configuration Deviation List (CDL), in the Aircraft Flight Manual.

## MMEL PHILOSOPHY

To introduce an item in the MMEL, the manufacturer must demonstrate first that the consequences of the system failure are no more than minor on the flight. The manufacturer must demonstrate then, that the next critical failure, i.e. the failure that has the most critical effect on aircraft operation when added to the initial failure, maintains the level of safety.

In some cases, this level of safety is maintained provided (o) or (m) procedures are observed.

As an example, the aircraft dispatch with one pack inoperative induces a flight level limitation whereas a pack failure in flight does not induce a flight level limitation.

## ATA 100 FORMAT

All items/equipment listed in the MEL are identified using the Air Transport Association (ATA) format. The ATA is the official reference for the classification of aircraft systems and/or functions. The aircraft systems/functions are classified with six digits. For example, 21-52-01 refers to:

21: ATA 21: Air conditioning

52: Air-cooling system

01: Air conditioning pack

## MEL DESCRIPTION

The MEL has four parts:

. ECAM warnings/ MEL entry

. List of items that may be inoperative for dispatch

. Associated operational procedures

. Associated maintenance procedures

## MEL OPERATIONAL USE

The MEL usually applies to revenue flights, and should be consulted before taxi out. If a failure occurs during taxi out, and before the take off roll starts, the decision to continue the flight is subject to pilot judgment and good airmanship. The Captain may consult the MEL before deciding to continue the flight (particularly if the failure has an effect on the takeoff performance).

During preliminary cockpit preparation, the flight crew must press the RCL P/B, for at least 3 seconds, in order to recall any previous cautions or warnings that have been cleared or cancelled. The flight crew should consult the technical logbook to confirm that the indications are compatible with the MEL.

A failure may occur if a Circuit Breaker (C/B) disengages. When on ground, do not re-engage any fuel pump C/Bs. The flight crew may re-engage any other tripped C/Bs, provided that the action is coordinated with the maintenance team, and the cause of the tripped C/B is identified.

The MMEL section 0 is called ECAM Warnings/MMEL Entry. The purpose of this section is to help the flight crew to determine the MMEL entry point, when an ECAM caution/warning message triggers. The ECAM Warnings/MMEL Entry section provides the relationship between the ECAM caution/warnings, and MMEL items, if applicable.

If a failed item does not appear in the MEL, it is not possible to dispatch the aircraft. However, items that do not affect the airworthiness of the aircraft, such as galley equipment, entertainment systems, or passenger convenience items, do not appear in the MEL: The dispatch applicability of these items is not relevant to the MEL.

In most cases, if the failed item appears in the MEL, the dispatch of the aircraft is authorized, provided that all dispatch conditions are fulfilled:

. Check the rectification time interval has not expired

. Consider location and, where repair is possible

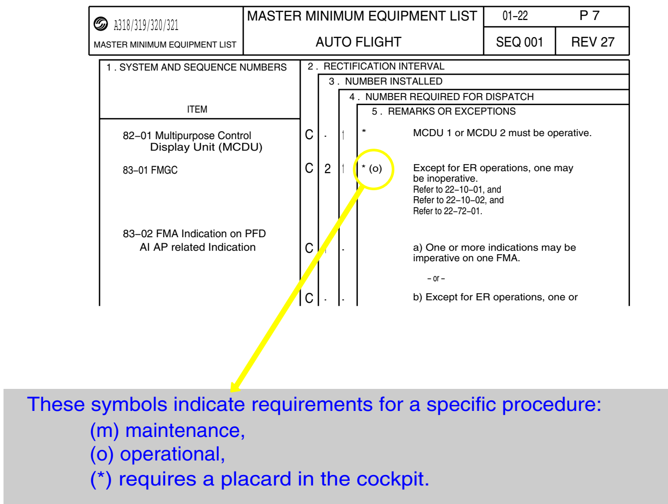
. (*) Means that an INOP placard is required

. (O) Means that a specific operational procedure or limitation is required (Refer to MEL chapter 2)

. (M) Means that a specific maintenance procedure is required.

When the MEL requires both maintenance and operational procedures, the maintenance procedures must be performed before applying the operational procedures.

MMEL SYMBOL

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If some items are mandatory for ETOPS dispatch, a mention "ER" (Extended Range) is added but mandatory items for CATII, CATIII operations, RNP and RVSM may be not mentioned in the MMEL. However, the MEL should include these requirements. If it is not the case,

. Mandatory items for CATII/III are available in QRH

. Mandatory items for RVSM are available in FCOM 2.04.50

. Mandatory items for RNP are available in FCOM 2.04.51

## HANDLING OF MAINTENANCE MESSAGES ON ECAM STATUS PAGE

MSN 0006 0008 0011 0017-0018 0039 0042 0087-0088 0103 0109 0120 0132 0163-0164 0168-0169 0174-0175 0179 0189 0193 0210 0221-0222 0225 0230-0232 0247 0257-0259 0279-0280 0283-0284 0294 0299 0301-0302 0305 0308-0309 0313-0314 0338 0343-0345 0347 0349 0354 0357 0373 0376 0386 0391 0405 0407 0411

Dispatch with maintenance message displayed on ECAM STATUS page is allowed without specific conditions except for:

. BLUE RSVR: Refer to MEL 29-00-01

. AIR BLEED: Refer to MEL 36-00-01.

MSN 0002-0005 0007 0010 0012-0016 0019-0038 0040-0041 0043-0086 0089-0102 0104-0108 0110-0119 0121-0131 0133-0162 0165-0167 0170-0173 0176-0178 0180-0188 0190-0192 0194-0209 0211-0220 0223-0224 0226-0229 0233-0246 0248-0256 0260-0278 0281-0282 0285-0293 0295-0298 0300 0303-0304 0306-0307 0310-0312 0315-0337 0339-0342 0346 0348 0350-0353 0355-0356 0358-0372 0375 0377-0385 0387-0390 0392-0404 0406 0408-0410 0412-3260

Dispatch with maintenance message displayed on ECAM STATUS page is allowed without specific conditions except for:

. AIR BLEED: Refer to MEL 36-00-01.

## SECURED AND TRANSIT STOP

ALL

If the last checklist performed by the flight crew is SECURING THE AIRCRAFT C/L, the aircraft is in SECURED STOP. After a SECURED STOP, the flight crew must perform all items in the Standard Operations Procedure (SOP), for the next flight.

If the last checklist performed by the flight crew is PARKING C/L, the aircraft is in TRANSIT STOP.

After a TRANSIT STOP, items indicated by (*), are the only steps to be completed for TRANSIT PREPARATION. i.e. PRELIMINARY COCKPIT PREPARATION, EXTERIOR INSPECTION, and COCKPIT PREPARATION.

## SAFETY EXTERIOR INSPECTION

ALL

Safety exterior inspection is performed to ensure that the aircraft and its surroundings are safe for operations. Items that should be checked include:

- Chocks in place
- Doors status
- Ground mechanic present
- Aircraft environment

## PRELIMINARY COCKPIT PREPARATION

ALL

### OBJECTIVES

The objectives of the preliminary cockpit preparation are:

- To ensure that all safety checks are performed before applying electrical power:
  - The RCL pb is pressed for at least 3 seconds to display the cautions and warnings from the previous flight.
  - The technical logbook and MEL are checked at this stage.
- To check the liquid levels i.e. oil, hydraulic and oxygen pressure using
  - The HYD pb is pressed to check the hydraulic level
  - The ENG pb is pressed to check engine oil level (Refer to FCOM 3.03.04)
  - The DOOR pb is pressed, to check the oxygen pressure level
- To check the position of surface control levers e.g. slats/flaps, parking brake.

### OXYGEN

The ECAM S/D DOOR page displays the oxygen pressure. When the oxygen pressure is below a defined threshold, an amber half box highlights the value. This advises the flight crew that the bottle should be refilled. The flight crew should refer to the minimum flight crew oxygen pressure that is provided in the

FCOM 3.01.35. The prolonged dispatch of the aircraft in such condition is not recommended.

## EXTERIOR INSPECTION

ALL

Standard Operating Procedures (SOP) outline the various elements that the flight crew must review in greater detail. The objectives of the exterior inspection are:

. To obtain a global assessment of the aircraft status. Any missing parts or panels will be checked against the Configuration Deviation List (CDL) for possible dispatch and any potential operational consequences.

. To ensure that main aircraft surfaces are in adequate position relative surface control levers.

. To check that there are no leaks e.g. engine drain mast, hydraulic lines.

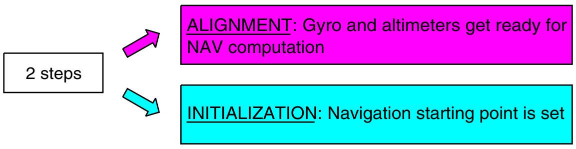
. To check the status of the essential visible sensors i.e. AOA, pitot and static probes.

. To observe any possible abnormalities on the landing gear status:
  - Wheels and tires status (cut, wear, cracks)
  - Safety pins are removed
  - Brakes status (Brake wear pin length with parking brake ON)
  - Length of oleo. Any difference between the two main landing gears shall be reported.

. To observe any possible abnormality on the engines:
  - Fan blades, turbine exhaust, engine cowl and pylon status
  - Access door closed

## ADIRS INITIALIZATION

MSN 0002-2210 2212-2215 2217-2276 2278-2287 2289-2295 2297-2334 2336-2340 2342-2361 2363-2382 2384-2395 2397-2403 2405-2409 2411-2413 2415-2430 2432-2451 2453-2466 2469-2718 2720-2735 2737-2755 2757 2759-2775 2777-2788 2790-2800 2802-2806 2808-2812 2814-2832 2834-2842 2844 2846-2857 2859-2863 2865-2869 2871 2873-2885 2888 2890-2891 2893 2895-2896 2898-2906 2908-2923 2925-2930 2932-2954 2956-2975 2977-2995 2998-3000 3003-3010 3012-3015 3017-3029 3034 3036-3042 3044-3046 3048-3053 3055-3057 3059 3061 3063-3065 3067-3070 3073 3075-3077 3079-3084 3086-3090 3092-3093 3095-3096 3098-3101 3103-3105 3107-3108 3110 3112-3118 3120-3126 3129 3131-3137 3139-3141 3144 3147-3148 3152-3155 3157-3159 3162-3165 3167-3168 3170 3173 3175-3176 3178 3181-3189 3191-3192 3194-3202 3204-3208 3210 3213 3215 3222 3226-3238 3243-3260




NOF 02020 04153 0001

## ALIGNMENT

At the beginning of the pre-flight checks, the crew sets the ADIRS selectors to NAV, in order to start alignment.

The alignment takes approximately 10 minutes, and must be completed before pushback (before any aircraft movement).

**In transit:**
ADIRS re-alignment is only necessary, if one of the ADIRS displays a residual ground speed greater than 5 kt.

In this case, a rapid re-alignment should be performed on all 3 IRSs (by setting all the ADIRS to OFF, then all back to ON within 5 seconds). The fast alignment takes approximately one minute. It involves setting the ground speed to 0, and updating the IRS position to the position of the coordinates on the INITA page (usually airport reference coordinates).

A complete re-alignment is only recommended for Long-range flights, especially if flown outside radio NAVAID coverage with Aircraft not equipped with GPS.

## INITIALIZATION

The F-PLN origin airport coordinates are extracted from the FMS database. These coordinates appear on the MCDU INITA page, and are normally used for initialization. They are the airport reference coordinates.

If a high navigation performance is desired, (i.e. for long-range flights without GPS and without radio navigation updates, or if low RNP operation is expected), the crew should adjust the airport reference coordinates to the gate coordinates, provided that this data is published or available on board. In this case, the flight crew should use the slew keys successively for Latitude and Longitude, instead of inserting the coordinates on the scratchpad, (in order to avoid errors).

When performing the BEFORE START C/L, the flight crew will check that the IRS IN ALIGN ECAM MEMO no longer appears, to indicate that the ADIRS are in NAV mode.

The crew will check on the POSITION MONITOR page, that the distance between IRS and FMS position is lower than 5NM. This will permit to detect any gross error for IRS initialization, which is not visible as long as GPS PRIMARY is available.

Checking runway and SID display on the ND in comparison with the aircraft symbol representing the aircraft present position, (ARC or NAV mode, range 10 NM) during taxi, is a good way to check the global consistency of FMGS entries (Position and flight plan).

## "RESET IRS TO NAV" MCDU MESSAGE

When the ADIRS are in NAV mode, and new origin airport coordinates are inserted, the RESET IRS TO NAV message triggers.

This occurs in transit, when the flight crew enters a new CO-RTE, or enters a new FROM-TO city pair on the INIT A page, and does not re-align the ADIRS.

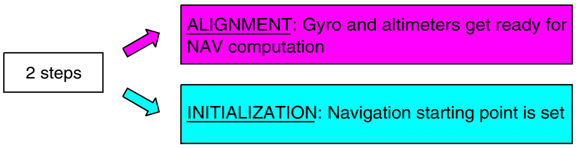
In this case, check the coordinates on the INITA page and compare them with:

. The coordinates of the origin airport, that are provided on the Airport chart, in order to detect a possible error in airport entry

. The ADIRS position (IRS monitor page).

In most cases the ADIRS position and the airport position do not differ significantly. Therefore, the message may be cleared without realigning the IRSs.

MSN 2211 2216 2277 2288 2296 2335 2341 2362 2383 2396 2404 2410 2414 2431 2452 2467-2468 2719 2736 2756 2758 2776 2789 2801 2807 2813 2833 2843 2845 2858 2864 2870 2872 2886-2887 2889 2892 2894 2897 2907 2924 2931 2955 2976 2996-2997 3001-3002 3011 3016 3030-3033 3035 3043 3047 3054 3058 3060 3062 3066 3071-3072 3074 3078 3085 3091 3094 3097 3102 3106 3109 3111 3119 3127-3128 3130 3138 3143 3145-3146 3149-3151 3156 3160-3161 3166 3169 3171-3172 3174 3177 3179-3180 3190 3193 3203 3209 3212 3214 3216-3220 3225 3241




NOF 02020 04155 0001

## ALIGNMENT

At the beginning of the pre-flight checks, the crew sets the ADIRS selectors to NAV, in order to start alignment.

The alignment takes approximately 10 minutes, and must be completed before pushback (before any aircraft movement).

**In transit:**
ADIRS re-alignment is only necessary, if one of the ADIRS displays a residual ground speed greater than 5 kt.

In this case, a rapid re-alignment should be performed on all 3 IRSs (by setting all the ADIRS to OFF, then all back to ON within 5 seconds). The fast alignment takes approximately one minute. It involves setting the ground speed to 0, and updating the IRS position to the position of the coordinates on the INITA page (usually airport reference coordinates).

## INITIALIZATION

The ADIRS are automatically initialized at the GPS position. These GPS coordinates are displayed on the MCDU INIT A page, in replacement of the airport reference coordinates, after the pilot entered the FROM-TO city pair.

When performing the BEFORE START C/L, the crew will check that the IRS IN ALIGN ECAM MEMO has disappeared, as a confirmation that the ADIRS are in NAV mode.

Checking runway and SID display on the ND in comparison with the aircraft symbol representing the aircraft present position, (ARC or NAV mode, range 10 NM) during taxi, is a good way to check the global consistency of FMGS entries (Position and flight plan).

## "RESET IRS TO NAV" MCDU MESSAGE

When the ADIRS are in NAV mode, and new origin airport coordinates are inserted, the RESET IRS TO NAV message triggers.

This occurs, in transit, when the crew performs a fast alignment, since this fast alignment is usually completed before the crew enters the FROM-TO city pair.

Check the validity of the IRS initialization, before clearing this message.

## COCKPIT PREPARATION

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892 1902 1987 2058 2104 2115 2143 2252

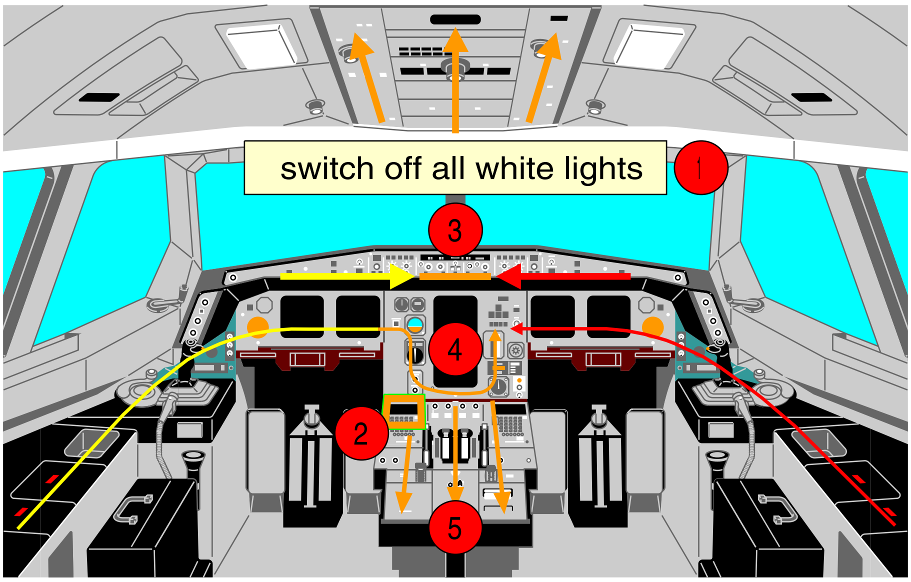
### FLOW PATTERN

The scan pattern varies, depending on the pilot status, i.e PF, PNF, CM1, or CM2, and the areas of responsibility:

1. Overhead panel: Extinguish any white lights (PF)

2. FMGS programming (PF)
3. Glare shield, ECP (CM1/2) and FCU (PF)
4. Lateral console (CM1/2)
5. Centre instrument panel and pedestal (PF)

COCKPIT PREPARATION FLOW PATTERN




NOF 02020 04156 0001

**FMGS PROGRAMMING**

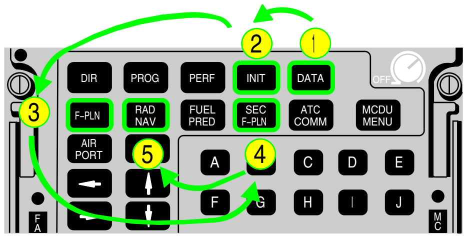
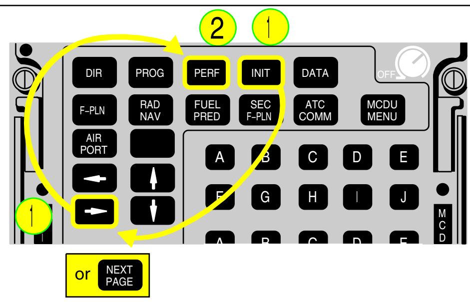
FMGS programming involves inserting navigation data, then performance data. It is to be noted that:

- Boxed fields must be filled
- Blue fields inform the crew that entry is permitted
- Green fields are used for FMS generated data, and cannot be changed
- Magenta characters identify limits (altitude, speed or time), that FMS will attempt to meet
- Yellow characters indicate a temporary flight plan display

. Amber characters signify that the item being displayed is important and requires immediate action

. Small font signifies that data is FMS computed

. Large font signifies manually entered data.

| | | |
|---|---|---|
| Navigation | Status<br>Init A<br>F–PLN<br>(SEC F–PLN)<br>RAD NAV |   |
| Performance | Init B<br>PERF |   |

NOF 02020 04157 0001

This sequence of entry is the most practical. INIT B should not be filled immediately after INIT A, because the FMGS would begin to compute F-PLN predictions. These computations would slow down the entry procedure.

To obtain correct predictions, the fields of the various pages must be completed correctly, with available planned data for the flight:

. DATA
The database validity, NAVAIDs and waypoints (possibly stored in previous flight), and PERF FACTOR must be checked on the STATUS page.

. INIT A
The INIT A page provides access to aircraft present position. The flight crew will check that it corresponds to the real aircraft position. (Refer to ADIRS INITIALIZATION part).

The history wind is the vertical wind profile that has been encountered during the previous descent and should be entered at this stage if it is representative of the vertical wind profile for the next flight.

. F-PLN
The F-PLN A page is to be completed thoroughly including:
- The take-off runway
- SID
- Altitude and speed constraints
- Correct transition to the cruise waypoint
- Intended step climb/descents, according to the Computerized Flight Plan (CFP).

If time permits, the wind profile along the flight plan may be inserted using vertical revision through wind prompt.
The flight crew should also check the overall route distance (6th line of the F-PLN page), versus CFP distance.

. SEC F-PLN
The SEC F-PLN should be used to consider an alternate runway for take-off, a return to departure airfield or a routing to a take-off alternate.

. RAD NAV
The RAD NAV page is checked, and any required NAVAID should be manually entered using ident. If a NAVAID is reported on NOTAM as unreliable, it must be deselected on the MCDU DATA/POSITION MONITOR/SEL NAVAID page.

. INIT B
The flight crew:
- Inserts the expected ZFWCG/ZFW, and block fuel to initialize a F-PLN computation.
- Checks fuel figures consistent with flight preparation fuel figures.

The flight crew will update weight and CG on receipt of the load sheet.
After Engine start, the INIT B page is no longer available. The flight crew should use the FUEL PRED page for weight and fuel data insertion, if required.

. PERF
The thrust reduction altitude/acceleration altitude (THR RED /ACC) are set to default at 1500ft, or at a value defined by airline policy. The THR RED/ACC may be changed in the PERF TAKE-OFF page, if required. The flight crew should consider the applicable noise abatement procedure.
The one-engine-out acceleration altitude must:
- Be at least 400 ft above airport altitude
- Ensure that the net flight path is 35 ft above obstacles
- Ensure that the maximum time for takeoff thrust is not exceeded.

Therefore, there are generally a minimum and a maximum one engine out acceleration altitude values. The minimum value satisfies the first two criteria. The maximum value satisfies the last one. Any value between those two may be retained.

The one engine out acceleration altitude is usually defaulted to 1500 ft AGL and will be updated as required.
The flight crew uses the PERF CLB page to pre-select a speed. For example, "Green Dot" speed for a sharp turn after take-off.

The crew may also check on the PROG page the CRZ FL, MAX REC FL and OPT FL.

Once the FMGS has been programmed, the PNF should then cross check the information prior to the take-off briefing.

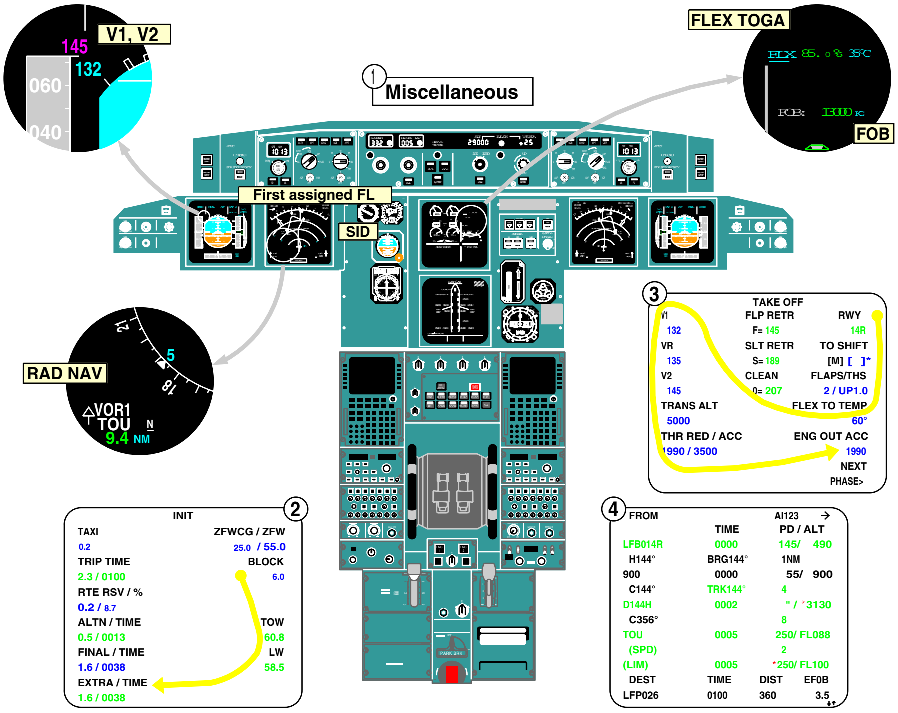
When the predictions are available, the crew may print the PREFLIGHT DATA (if installed). This listing provides all the predictions which may be used during the initial part of the flight.

## TAKE-OFF BRIEFING

The PF should perform the takeoff briefing at the gate , when the flight crew workload permits, Cockpit preparation has been completed and, before engine start.

The takeoff briefing should be relevant, concise and chronological. When a main parameter is referred to by the PF, both flight crewmembers must crosscheck that the parameter has been set or programmed correctly. The takeoff briefing covers the following:

TAKE OFF BRIEFING WITH ASSOCIATED CHECKS

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| | |
|---|---|
| Miscellaneous ① | Aircraft type and model (Tail strike awareness)<br>Aircraft technical status (MEL and CDL considerations, relevant OEB)<br>NOTAMS<br>Weather<br>RWY conditions<br>Use of ENG/Wings Anti Ice<br>ENG Start Procedure<br>Push Back<br>Expected Taxi Clearence<br>Use of Radar<br>Use of Packs for Takeoff |
| INT B PAGE ② | Block Fuel ........ (FOB on EW/D)<br>Estimated TOW<br>Extra time at destination |
| TAKEOFF PERF PAGE ③ | T/O RWY<br>T/O CONF<br>FLEX / TOGA ........ FLEX TOGA on EW/D)<br>V1, VR, V2 ........ (V1, V2 on PFD)<br>TRANS ALT<br>THR RED / ACC Altitude |
| FLIGHT PLAN ④ | Minimum Safe Altitude<br>First assigned FL ........ (altitude target in blue on PFD)<br>Flight Plan description ........ (SID on MCDU FPLN page)<br>RAD NAV ........ (RAD NAV on ND) |
| Abnormal operations | For any failure before V1:<br>CAPT will call "STOP" or "GO"<br>In case of failure after V1:<br>Continue T/O, No action before 400ft AGL except gear up<br>Reaching 400ft AGL, ECAM actions<br>Reaching EO ACC altitude, Stop ECAm, Push for ALT, acceleration and clean up<br>At green dot: OP CLB, MCT, continue ECAM, after T/O C/L, status<br>ENG Out routing: EOSID, SID, radar vector, immediate return... |

items that must be cross–checked on associated display.

NOF 02020 04159 0001

**()Items that must be cross-checked on the associated display.**

## FMS UPDATING

When the load and trim sheet is available, the crew will:

. Updates the ZFWCG/ZFW

. Checks TOW consistent with load sheet

. Checks updated fuel figures

. Modify the FLEX TEMP and the take-off speeds as required

. Enter the THS position in PERF TAKE OFF page

When the predictions are available, the crew will print the pre-flight data.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-1901 1903-1986 1988-2057 2059-2103 2105-2114 2116-2142 2144-2251 2253-3260

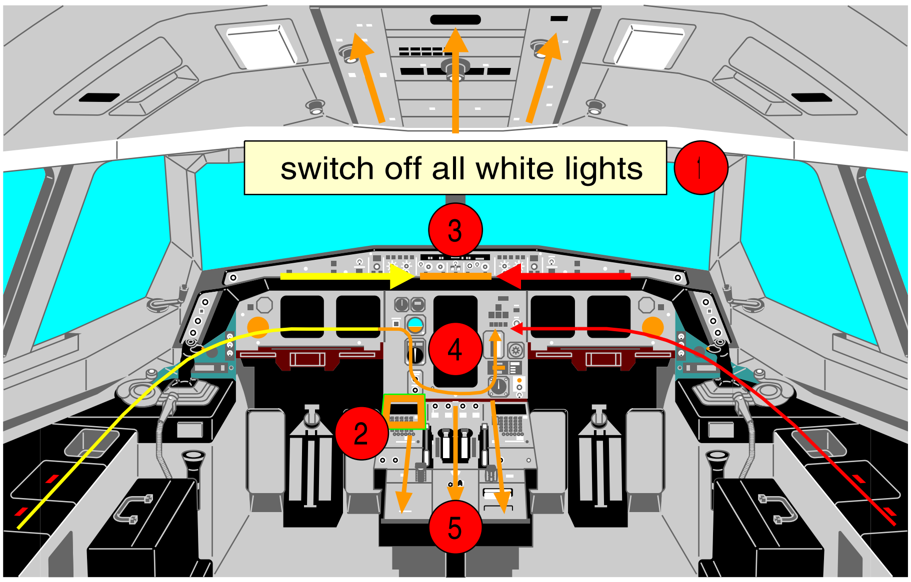
## FLOW PATTERN

The scan pattern varies, depending on the pilot status, i.e PF, PNF, CM1, or CM2, and the areas of responsibility:

1. Overhead panel: Turn off any white lights (PF)
2. FMGS programming (PF)

3. Glare shield, ECP (CM1/2) and FCU (PF)
4. Lateral console (CM1/2)
5. Centre instrument panel and pedestal (PF)

COCKPIT PREPARATION FLOW PATTERN




NOF 02020 04164 0001

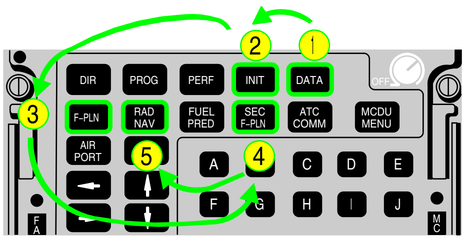
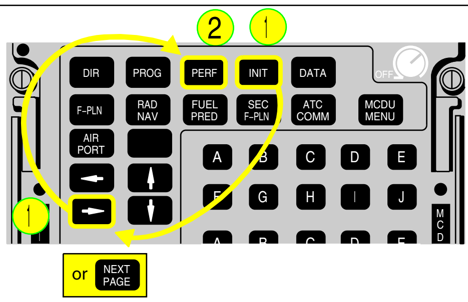
**FMGS PROGRAMMING**

FMGS programming involves inserting navigation data, then performance data. It is to be noted that:

- Boxed fields must be filled
- Blue fields inform the crew that entry is permitted
- Green fields are used for FMS generated data, and cannot be changed
- Magenta characters identify limits (altitude, speed or time), that FMS will attempt to meet
- Yellow characters indicate a temporary flight plan display
- Amber characters signify that the item being displayed is important and requires immediate action

. Small font signifies that data is FMS computed

. Large font signifies manually entered data.

| | | |
|---|---|---|
| Navigation | Status<br>Init A<br>F-PLN<br>(SEC F-PLN)<br>RAD NAV |  |
| Performance | Init B<br>PERF |  |

NOF 02020 04165 0001

This sequence of entry is the most practical. INIT B should not be filled immediately after INIT A, because the FMGS would begin to compute F-PLN predictions. These computations would slow down the entry procedure.

To obtain correct predictions, the fields of the various pages must be completed correctly, with available planned data for the flight:

. DATA
The database validity, NAVAIDs and waypoints (possibly stored in previous flight), and PERF FACTOR must be checked on the STATUS page.

. INIT A
The INIT A page provides access to aircraft present position. The flight crew will check that it corresponds to the real aircraft position. (Refer to ADIRS INITIALIZATION part).
The history wind is the vertical wind profile, that has been encountered during the previous descent and should be entered at this stage if it is representative of the vertical wind profile for the next flight.

. P-PLN

P-PLN
The F-PLN A page is to be completed thoroughly including:
- The take-off runway
- SID
- Altitude and speed constraints
- Correct transition to the cruise waypoint
- Intended step climb/descents, according to the Computerized Flight Plan (CFP).

If time permits, the wind profile along the flight plan may be inserted using vertical revision through wind prompt.
The flight crew should also check the overall route distance (6th line of the F-PLN page), versus CFP distance.

. SEC F-PLN
The SEC F-PLN should be used to consider an alternate runway for take-off, a return to departure airfield or a routing to a take-off alternate.

. RAD NAV
The RAD NAV page is checked, and any required NAVAID should be manually entered using ident. If a NAVAID is reported on NOTAM as unreliable, it must be deselected on the MCDU DATA/POSITION MONITOR/SEL NAVAID page.

. INIT B
The flight crew:
- Inserts the expected ZFWCG/ZFW, and block fuel to initialize a F-PLN computation.
- Checks fuel figures consistent with flight preparation fuel figures.

The flight crew will update weight and CG on receipt of the load sheet.
The FMS uses the trip wind for the entire flight from origin to destination. The trip wind is an average wind component that may be extracted from the CFP. The trip wind facility is available if the wind profile has not already been entered.
After Engine start, the INIT B page is no longer available. The flight crew should use the FUEL PRED page for weight and fuel data insertion, if required.
The Init B page should not be completed immediately after Init A, because the FMGS would begin to compute F-PLN predictions. This would slow down the entry procedure.

. PERF
The thrust reduction altitude/acceleration altitude (THR RED /ACC) are set to default at 1500ft, or at a value defined by airline policy. The THR RED/ACC may be changed in the PERF TAKE-OFF page, if required. The flight crew should consider the applicable noise abatement procedure.
The one-engine-out acceleration altitude must:
- Be at least 400 ft above airport altitude
- Ensure that the net flight path is 35 ft above obstacles
- Ensure that the maximum time for takeoff thrust is not exceeded.

Therefore, there are generally a minimum and a maximum one engine out acceleration altitude values. The minimum value satisfies the first two criteria.

The maximum value satisfies the last one. Any value between those two may be retained.
The one engine out acceleration altitude is usually defaulted to 1500 ft AGL and will be updated as required.
The flight crew uses the PERF CLB page to pre-select a speed. For example, "Green Dot" speed for a sharp turn after take-off.

The crew may also check on the PROG page the CRZ FL, MAX REC FL and OPT FL.

Once the FMGS has been programmed, the PNF should then cross check the information prior to the take-off briefing.

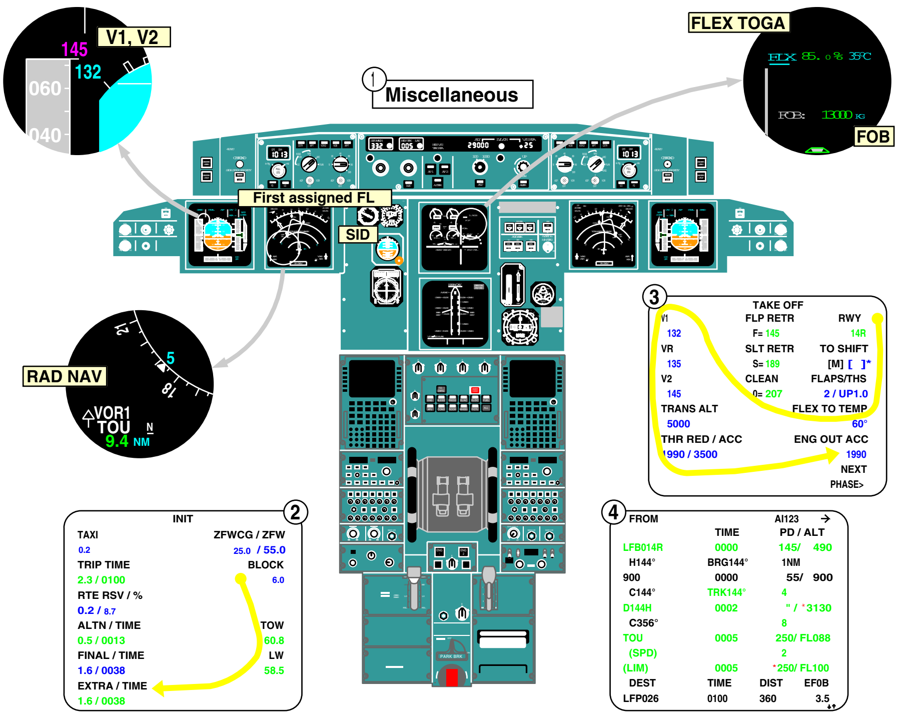
When the predictions are available, the crew may print the PREFLIGHT DATA (if installed). This listing provides all the predictions which may be used during the initial part of the flight.

## TAKE-OFF BRIEFING

The PF should perform the takeoff briefing at the gate , when the flight crew workload permits, Cockpit preparation has been completed and, before engine start.

The takeoff briefing should be relevant, concise and chronological. When a main parameter is referred to by the PF, both flight crewmembers must crosscheck that the parameter has been set or programmed correctly. The takeoff briefing covers the following:

TAKE OFF BRIEFING WITH ASSOCIATED CHECKS




NOF 02020 04158 0001

| | |
|---|---|
| Miscellaneous ① | Aircraft type and model (Tail strike awareness)<br>Aircraft technical status (MEL and CDL considerations, relevant OEB)<br>NOTAMS<br>Weather<br>RWY conditions<br>Use of ENG/Wings Anti Ice<br>ENG Start Procedure<br>Push Back<br>Expected Taxi Clearence<br>Use of Radar<br>Use of Packs for Takeoff |
| INT B PAGE ② | Block Fuel ................................................................. (FOB on EW/D)<br>Estimated TOW<br>Extra time at destination |
| TAKEOFF PERF PAGE ③ | T/O RWY<br>T/O CONF<br>FLEX / TOGA .................................................... FLEX TOGA on EW/D)<br>V1, VR, V2 ................................................................... (V1, V2 on PFD)<br>TRANS ALT<br>THR RED / ACC Altitude |
| FLIGHT PLAN ④ | Minimum Safe Altitude<br>First assigned FL ................................ (altitude target in blue on PFD)<br>Flight Plan description ............................ (SID on MCDU FPLN page)<br>RAD NAV ................................................................ (RAD NAV on ND) |
| Abnormal operations | For any failure before V1:<br>CAPT will call "STOP" or "GO"<br>In case of failure after V1:<br>Continue T/O, No action before 400ft AGL except gear up<br>Reaching 400ft AGL, ECAM actions<br>Reaching EO ACC altitude, Stop ECAm, Push for ALT, acceleration and clean up<br>At green dot: OP CLB, MCT, continue ECAM, after T/O C/L, status<br>ENG Out routing: EOSID, SID, radar vector, immediate return... |

items that must be cross–checked on associated display.

NOF 02020 04159 0001

**()Items that must be cross-checked on associated display.**

## FMS UPDATING

When the load and trim sheet is available, the flight crew:

- Updates the ZFWCG/ZFW
- Checks that the TOW is consistent with the load sheet
- Checks the updated fuel figures
- Changes the FLEX TEMP and the take-off speeds as required
- Enters the THS position on the PERF TAKE OFF page

When the predictions are available, the flight crew prints out the pre-flight data.

## MISCELLANEOUS

ALL

### SEATING POSITION

To achieve a correct seating position, the aircraft is fitted with an eye-position indicator on the centre windscreen post. The eye-position indicator has two balls on it. When the balls are superimposed on each other, they indicate that the pilot's eyes are in the correct position.

The flight crew should not sit too low, to avoid increasing the cockpit cut-off angle, therefore reducing the visual segment. During Low Visibility Procedures (LVP), it is important that the pilot's eyes are positioned correctly, in order to maximize the visual segment, and consequently, increase the possibility of achieving the required visual reference for landing as early as possible.

After adjusting the seat, each pilot should adjust the outboard armrest, so that the forearm rests comfortably on it, when holding the sidestick. There should be no gaps between the pilot's forearm and the armrest. The pilot's wrist should not be bent when holding the sidestick. This ensures that the pilot can accomplish flight maneuvers by moving the wrist instead of lifting the forearm from the armrest.

Symptoms of incorrect armrest adjustment include over-controlling, and not being able to make small, precise inputs.

The rudder pedals must then be adjusted to ensure the pilot can achieve both full rudder pedal displacement and full braking simultaneously on the same side.

The armrest and the rudder pedals have position indicators. These positions should be noted and set accordingly for each flight.

### MCDU USE

When clear for start up and taxi, the PF will preferably display the MCDU PERF TAKE OFF page whereas the PNF will display the MCDU F-PLN page.

## ENGINE AUTO START

ALL

Engines usually start using the Automatic Starting function. The Full Authority Digital Engine Control (FADEC) systems control this engine Automatic Starting function, and takes appropriate action, if engine parameters are exceeded. This function extends significantly the duration of engine life.

The thrust levers must be confirmed at "idle" before engine-start. If the thrust levers are not at "idle", the thrust increases above idle after engine-start, and can result in a hazardous situation. However, an ENG START FAULT ECAM warning triggers, to indicate that the flight crew must set the thrust levers to "idle".

The engines are started in sequence, preferably engine 2 first, in order to pressurize yellow hydraulic system, which supplies the parking brake accumulator.

When the ENG START selector is set to "START", the FADECs are electrically-supplied. When there is sufficient BLEED PRESS, the PF begins the start sequence by setting the ENG MASTER switch to ON. The flight crew should monitor the start sequence:

. Start valve opens

. N2 increases

. IGN A(B)

. Fuel flow

. EGT

. N1

. Oil pressure increases

. Start valve closes.

After reaching the peak EGT, or when AVAIL is displayed, the PF can start engine 1.

The flight crew should check the relative engine vibration level.

When the ENG START selector is set to NORM, the packs return to the OPEN position. APU Bleed should immediately be turned off, to avoid engine ingestion of exhaust gas.

If the start is not successful, the flight crew must use the ECAM as usually done, and avoid instinctively selecting the ENG MASTER switch to OFF. This would interrupt the FADEC protective actions (e. g. cranking after hot start).

MSN 0002-0021 0023-0034 0036 0039-0042 0044 0059-0063 0068-0073 0078 0083-0088 0093-0094 0100-0112 0115-0162 0167 0170-0177 0181-0192 0195-0197 0199-0224 0226-0229 0231-0242 0244-0246 0248 0253-0255 0258 0262-0274 0277-0279 0281-0290 0293-0294 0297-0303 0305-0307 0309-0313 0318-0319 0323-0325 0328-0331 0333 0337 0339-0343 0345-0346 0348-0350 0352 0355-0356 0358-0360 0365 0367 0370-0372 0375 0377-0384 0387-0392 0395 0399-0404 0407-0410 0413 0417-0422 0426-0427 0434 0436 0438 0445-0446 0459 0466 0477 0482 0488 0491 0494-0495 0497-0498 0501 0507 0509 0511 0513-0516 0521 0524-0526 0528-0529 0531-0532 0534 0537 0544 0546 0549 0554 0569 0572 0576 0578-0579 0583 0586 0588 0590 0593-0594 0598-0601 0605 0607-0612 0615-0619 0621-0630 0634 0636-0637 0639 0641 0644-0651 0653-0654 0656-0658 0660 0662 0664-0666 0669-0675 0677 0679 0682 0684-0685 0688-0689 0691 0693-0695 0697 0700 0706-0707 0711 0713-0714 0716-0717 0719 0721 0723-0724 0726-0730 0732 0734-0738 0740 0742 0744-0745 0749-0750 0752-0755 0757 0761 0763-0767 0769 0772-0775 0778-0779 0781 0785-0786 0790 0793-0796 0799-0801 0807-0809 0813-0815 0817-0819 0821 0823 0828-0833 0837-0838 0840-0841 0844-0846 0848 0852-0854 0860-0861 0863 0868-0869 0875-0876 0879-0880 0883-0885 0888 0890 0894 0896-0897 0903-0907 0909 0911 0914 0917 0921-0923 0925-0926 0929 0933 0936-0940 0945-0946 0949 0951 0956-0960 0962 0964 0967 0971-0973 0975 0978-0979 0981-0982 0984-0986 0988 0991-0992 0994 0996-1000 1002 1005-1006 1009 1011 1016-1021 1023 1025 1027-1030 1033-1034 1036-1038 1040-1041 1044 1046-1048 1051-1052 1055 1058-1059 1061-1063 1065 1067-1073 1077-1078 1084 1086-1087 1089-1091 1093-1095 1097 1099-1102 1106-1109 1112 1114 1119-1122 1124 1126-1127 1129-1131 1133-1136 1138 1141 1145 1147-1149 1151-1152 1154-1155 1157 1160 1164-1165 1167-1172 1175-1176 1180-1182 1184 1187 1190-1191 1198 1200-1201 1203 1205-1206 1208-1210 1213 1216-1217 1219-1221 1224 1226 1229-1231 1233 1237-1238 1242 1245 1247 1249-1250 1252 1254-1255 1262-1265 1267-1269 1271 1275 1277 1283 1285-1289 1292 1294 1296-1299 1301 1303 1305-1307 1309-1320 1324-1326 1328 1330-1331 1336-1337 1340 1342 1344-1348 1352 1354 1357-1358 1360-1362 1364-1365 1367 1369 1371-1372 1377-1379 1381-1382 1385-1386 1388-1394 1396 1399 1402-1404 1412 1414-1417 1425 1429-1431 1434 1436-1437 1441-1444 1447-1449 1451 1453-1457 1461-1462 1465 1467 1471-1473 1476 1479-1481 1483-1485 1488-1489 1492-1494 1496 1498-1499 1501-1505 1515-1517 1519-1521 1524-1525 1530-1532 1535-1536 1539-1543 1549-1551 1553-1554 1556 1560 1562 1564 1567 1570-1572 1577-1579 1582-1583 1592 1597-1599 1601-1603 1605 1607 1611-1612 1615-1616 1618 1622-1623 1625 1629-1630 1632-1634 1637-1641 1645-1646 1651 1654-1655 1657-1660 1662 1666-1668 1673-1674 1677 1679 1681 1683-1686 1691-1694 1699-1701 1704 1706 1709 1713-1714 1716-1720 1722 1724-1726 1733 1736 1738 1740 1742-1748 1750-1753 1756-1757 1759 1761-1762 1765-1767 1769-1770 1772 1774-1775 1777-1781 1783 1786-1787 1789 1791 1793 1795-1797 1799-1800 1803

MSN 1805-1806 1808-1812 1815-1816 1819-1820 1824 1828 1833 1836 1838-1839 1841 1846 1851-1853 1859-1860 1863-1864 1866-1867 1870 1872-1876 1879 1881-1882 1884-1887 1889-1890 1894 1897 1900-1901 1905-1906 1908 1911 1916 1920-1921 1923-1925 1929-1932 1936-1940 1942-1943 1949 1951 1954 1959-1961 1963-1966 1968 1972-1973 1975-1976 1980-1983 1988 1990-1991 1994 1997 1999 2001-2003 2005 2009-2013 2017-2019 2022 2024-2026 2028 2030 2033-2037 2039 2043 2046-2054 2056-2057 2059-2062 2064 2066 2068-2069 2071-2072 2074 2076 2078 2081-2083 2086-2087 2091-2093 2095 2100-2101 2103-2104 2106 2109 2113-2117 2119-2120 2122-2124 2126-2127 2129 2131 2133-2134 2140 2142-2145 2151 2155 2158 2162-2163 2165-2166 2170-2171 2174-2176 2178-2184 2186-2187 2189 2191 2196 2198-2199 2206-2207 2209 2212-2214 2217-2222 2224-2225 2227-2228 2230 2233 2235-2237 2239-2245 2248-2251 2253 2256 2258 2260 2262 2264-2266 2269-2272 2274 2276 2278-2279 2283 2285 2287 2289 2291 2293-2294 2298 2300 2306 2309 2311 2315 2317-2319 2325 2327-2328 2330 2332-2333 2337 2342 2344 2346-2347 2349-2350 2353-2354 2357-2358 2360-2361 2364-2365 2367 2369-2370 2373-2374 2377-2378 2380-2382 2385 2387-2388 2390-2392 2394 2398-2400 2402 2406-2407 2409 2411-2412 2416 2419-2420 2425 2427 2432 2436-2437 2439-2440 2442 2446 2448 2450-2451 2456 2460 2463-2465 2471-2472 2474 2477-2478 2481 2483-2484 2486-2488 2492-2495 2497-2499 2503 2506-2508 2511-2512 2514 2516 2518-2519 2523 2525 2527-2529 2532 2538-2552 2554-2558 2561-2563 2565 2569 2575 2578 2581-2584 2586 2588 2591-2593 2596 2599 2601 2605-2607 2611-2612 2616-2620 2623-2625 2627-2629 2632-2633 2635-2638 2641 2644 2646 2652 2654 2656 2658 2662 2665 2668 2672 2674-2675 2677-2678 2681 2683-2686 2691 2693 2695-2696 2699-2700 2702 2705-2709 2712 2715-2716 2719 2721 2726-2727 2729 2733 2735-2736 2740 2742-2746 2748-2751 2754 2756-2758 2760-2765 2768-2770 2773-2774 2776-2779 2782 2785-2786 2788-2790 2792 2794-2796 2798 2800-2801 2803 2805-2807 2810-2812 2816 2818-2822 2824-2827 2829-2831 2834-2837 2839 2841-2843 2846-2847 2849 2851-2855 2857 2860-2861 2865-2867 2869-2870 2873 2875-2879 2881-2882 2884-2885 2889-2891 2895 2897 2899 2902-2903 2905 2907 2909-2910 2912-2913 2915 2918 2920-2921 2923-2926 2930-2932 2935 2937-2939 2944 2946-2947 2949-2951 2954-2957 2959-2962 2964-2968 2972-2973 2975 2980 2985-2986 2988-2989 2991 2993-2996 2998 3000 3002-3003 3006 3008-3009 3014 3016 3018-3019 3021 3023-3025 3027-3028 3031 3035-3038 3040-3041 3043-3044 3046-3048 3051-3056 3058-3061 3063-3065 3068 3070 3073 3076 3078-3080 3082-3085 3087-3088 3090 3092-3102 3107-3111 3115 3117-3118 3121-3123 3129-3140 3145-3149 3151-3155 3157 3160-3161 3163-3164 3168-3171 3173-3174 3176 3178-3182 3184 3186-3189 3191 3194 3197 3199 3201-3206 3209 3212-3213 3215 3226 3233 3238 3243-3260

## AVERAGE IDLE ENGINE PARAMETERS

As soon as the engine-start is complete, the flight crew should check the stabilized parameters. At ISA sea level:

N1 about 19.5%  N2 about 58.5%  EGT about 390 °C  FF about 275 kg/h -600lb/h

MSN 0035 0037-0038 0045-0058 0064-0067 0074-0077 0080-0082 0089-0091 0095-0099 0113-0114 0163-0166 0168-0169 0178-0180 0193-0194 0198 0225 0230 0243 0247 0249-0252 0256-0257 0259-0261 0275-0276 0280 0291-0292 0295-0296 0304 0308 0314-0317 0320-0322 0326-0327 0332 0334-0336 0338 0344 0347 0351 0353-0354 0357 0361-0363 0366 0368-0369 0373 0376 0386 0393-0394 0396-0398 0405-0406 0411 0414-0416 0423-0424 0428-0432 0437 0440-0441 0443-0444 0447 0449 0451 0467 0469 0476 0478 0480 0486 0490 0492 0499

## AVERAGE IDLE ENGINE PARAMETERS

As soon as the engine-start is complete, the flight crew should check the stabilized parameters. At ISA sea level:

EPR about 1.01  N1 about 23.8%  N2 about 57.7%  EGT about 385 °C  FF about 330 kg/h -730lb/h

MSN 0364 0385 0412 0425 0435 0439 0442 0448 0450 0452-0458 0460-0465 0468 0470-0475 0479 0483-0485 0487 0489 0493 0496 0500 0502-0506 0508 0510 0512 0518 0523 0527 0530 0538-0540 0542-0543 0550-0551 0555-0558 0560-0561 0563-0565 0567-0568 0571 0573 0575 0580 0582 0584 0587 0589 0591-0592 0595 0597 0604 0606 0613-0614 0620 0631-0633 0638 0640 0652 0655 0659 0661 0663 0667-0668 0676 0678 0680 0683 0686-0687 0690 0692 0696 0698-0699 0702 0704-0705 0709-0710 0712 0715 0718 0720 0722 0725 0731 0733 0739 0741 0743 0746-0748 0751 0756 0758-0760 0762 0770-0771 0780 0783-0784 0787-0789 0791-0792 0798 0802-0806 0810-0812 0816 0820 0822 0824-0826 0834-0836 0839 0842-0843 0847 0849-0851 0855-0859 0862 0864-0867 0871-0874 0877-0878 0881-0882 0886-0887 0889 0892-0893 0895 0898-0902 0908 0910 0912-0913 0915-0916 0918-0919 0924 0927-0928 0930-0932 0934 0943-0944 0948 0950 0952-0955 0963 0965-0966 0968-0969 0974 0976-0977 0980 0983 0989-0990 0993 1001 1003-1004 1007-1008 1010 1013-1015 1022 1024 1031-1032 1035 1039 1042-1043 1045 1049-1050 1053 1056-1057 1060 1064 1066 1074-1076 1079-1080 1082-1083 1085 1088 1092 1096 1098 1103-1105 1110-1111 1113 1115-1118 1123 1128 1139-1140 1142-1143 1146 1153 1156 1158-1159 1161 1163 1166 1173-1174 1177-1178 1183 1188 1192-1197 1199 1202 1204 1207 1211-1212 1214-1215 1218 1222-1223 1225 1227-1228 1232 1234-1236 1239-1240 1243 1246 1248 1251 1253 1256-1258 1260-1261 1266 1270 1272-1274 1276 1279-1282 1284 1290-1291 1293 1295 1300 1302 1304 1321 1323 1327 1329 1332-1335 1338-1339 1341 1343 1349-1351 1353 1355-1356 1359 1363 1366 1368 1373-1376 1380 1383-1384 1395 1397-1398 1400-1401 1406-1411 1418-1424 1426-1428 1432-1433 1435 1438 1440 1445-1446 1452 1459-1460 1463-1464 1466 1468-1469 1474-1475 1477 1482 1486-1487 1490-1491 1495 1497 1500 1506-1514 1518 1522-1523 1526-1529 1533-1534 1537-1538 1545-1548 1552 1555 1557-1559 1561 1563 1565-1566 1568-1569 1573-1576 1580-1581 1584-1587 1589-1591 1593-1596 1600 1604 1606 1608-1610 1613-1614 1617 1619-1621 1624 1626-1628 1631 1635-1636 1642-1644 1647-1650 1652-1653 1656 1661 1663-1665 1669-1672 1675-1676 1680 1682 1687-1690 1695-1698 1702-1703 1705 1707-1708 1710-1711 1715 1721 1723 1727-1732 1734 1737 1739 1741 1749 1754-1755 1758 1760 1763-1764 1768 1771 1773 1776 1782 1784-1785 1788 1790 1792 1794 1798 1801-1802 1804 1807 1814 1817-1818 1821-1823 1825-1827 1829-1832 1834-1835 1837 1840 1842-1845 1847-1850 1854-1858 1861-1862 1865 1868-1869 1871 1877-1878 1880 1883 1888 1891-1893 1895-1896 1898-1899 1902-1904 1907 1909-1910 1912 1914-1915 1917-1918 1922 1926-1928 1933-1935 1941 1944-1948 1950 1952-1953 1955-1958 1962 1967 1969-1971 1974 1977 1979 1984-1987 1993 1995-1996 1998 2000 2004 2006-2008 2014-2016 2020-2021 2023 2027 2029 2031-2032 2038 2040-2042 2044-2045 2055 2058 2063 2067 2070 2073 2075 2077 2079-2080 2084-2085 2088-2090 2094 2096-2099 2102 2105 2107-2108 2110-2112 2118 2121 2125 2128 2130 2132 2135-2139 2141 2147-2150 2152-2153 2156-2157 2159-2161 2164 2167-2169

MSN 2172-2173 2177 2185 2188 2190 2192-2195 2197 2200-2205 2210-2211 2215-2216 2223 2226 2229 2231-2232 2234 2238 2246-2247 2252 2254-2255 2257 2259 2261 2263 2267-2268 2273 2275 2277 2280-2282 2284 2286 2288 2290 2292 2295-2297 2299 2301-2305 2307-2308 2310 2312-2314 2316 2320-2324 2326 2329 2331 2334-2336 2338-2341 2343 2345 2348 2351-2352 2355-2356 2359 2362-2363 2366 2368 2371-2372 2375-2376 2379 2383-2384 2386 2389 2393 2395-2397 2401 2403-2405 2408 2410 2413-2415 2417-2418 2421-2424 2426 2428-2431 2433-2435 2438 2441 2443-2445 2447 2449 2452-2455 2457-2459 2461-2462 2466-2470 2473 2475-2476 2479-2480 2482 2485 2489-2491 2496 2500-2502 2504-2505 2509-2510 2513 2515 2517 2520-2522 2524 2526 2530-2531 2533-2537 2553 2559-2560 2564 2566-2568 2570-2574 2576-2577 2579-2580 2585 2587 2589-2590 2594-2595 2597-2598 2600 2602-2604 2608-2610 2613-2615 2621-2622 2626 2630-2631 2634 2639-2640 2642-2643 2645 2647-2651 2653 2655 2657 2659-2661 2663-2664 2666-2667 2669-2671 2673 2676 2679-2680 2682 2687-2690 2692 2694 2697-2698 2701 2703-2704 2710-2711 2713-2714 2717-2718 2720 2723-2725 2728 2730-2732 2734 2737-2739 2741 2747 2752-2753 2755 2759 2766-2767 2771-2772 2775 2780-2781 2783-2784 2787 2791 2793 2797 2799 2802 2804 2808-2809 2813-2815 2817 2823 2828 2832-2833 2838 2840 2844-2845 2848 2850 2856 2858-2859 2862-2864 2868 2871-2872 2874 2880 2883 2886-2888 2892-2894 2896 2898 2900-2901 2904 2906 2908 2911 2914 2916-2917 2919 2922 2927-2929 2933-2934 2936 2940-2943 2945 2948 2952-2953 2958 2963 2969-2971 2974 2976-2979 2981-2984 2987 2990 2992 2997 2999 3004-3005 3007 3010-3013 3015 3017 3020 3022 3026 3029 3032-3034 3039 3042 3045 3049-3050 3057 3066-3067 3069 3071-3072 3074-3075 3077 3081 3086 3089 3091 3103-3106 3112-3114 3116 3119-3120 3124-3128 3141-3144 3150 3156 3158-3159 3162 3165-3167 3172 3175 3177 3183 3185 3190 3192-3193 3195-3196 3198 3200 3207-3208 3210 3217 3222 3229-3231 3235 3241

## AVERAGE IDLE ENGINE PARAMETERS

As soon as the engine-start is complete, the flight crew should check the stabilized parameters. At ISA sea level:

EPR about1.01    N1 about 21.4%    N2 about 57.8%    EGT about 414 °C    FF about 350 kg/h - 775lb/h

MSN 0517 0519-0520 0522 0533 0535 0541 0545 0548 0552-0553 0559 0562 0566 0570 0574 0577 0581 0585 0596 0603 0635 0642-0643 0681 0701 0703 0768 0776 0782 0797 0827 0870 0891 0920 0935 0941-0942 0947 0961 0970 0987 0995 1012 1026 1054 1081 1125 1132 1137 1144 1150 1162 1179 1185 1189 1241 1244 1259 1308 1322 1370 1387 1405 1413 1439 1450 1458 1470 1478 1544 1588 1678 1712 1735 1913 1978 1989 2065 2146 2154 2208

## AVERAGE IDLE ENGINE PARAMETERS

As soon as the engine-start is complete, the flight crew should check the stabilized parameters. At ISA sea level:

N1 about 19.5%    N2 about 58.5%    EGT about 640 °C    FF about 345 kg/h -760lb/h

## ENGINE START MALFUNCTION

ALL

Following an aborted engine start, the crew will consider an engine dry cranking prior resuming a new engine start attempt. Starter limitations in FCOM 3.01.70 must be observed.

## MANUAL ENGINE START

ALL

The flight crew should only perform a manual start if:

. The EGT margins are low

. The residual EGT is high

. A dry crank is performed.

It may be appropriate to perform a manual start in high altitude operations, or after an aborted engine start.

The MANUAL ENGINE START procedure is a "read and do" procedure. Refer to the FCOM 3.04.70 before starting a manual engine start.

The FADEC has limited control over the manual start process. It ensures that the engine start valve closes at 50% N2. It monitors engine parameters, and generates an associated warning when necessary.

It is recommended that the flight crew use the stopwatch to ensure that the starter engagement time remains within the limits.

## TAILPIPE FIRE

ALL

An engine tailpipe fire may occur at engine-start, and may be the result of either excess fuel in the combustion chamber, or an oil leak in the low-pressure turbine. A tailpipe fire is an internal fire within the engine. No critical areas are affected.

If the ground crew reports a tailpipe fire, the flight crew must perform the following actions:

. Shut down the engine (MASTER switch set to OFF)

. Do NOT press the ENG FIRE pushbutton

. Crank the engine, by using either the bleed opposite the engine, the APU bleed, or external pneumatic power (Set ENG START selector to CRANK, then set the MAN START switch to ON).

Do NOT use the ENG FIRE pushbutton, this would stop power to the FADECs, and would stop the motoring sequence. The fire extinguisher must not be used, as it will not extinguish an internal engine fire. As a first priority, the engine must be ventilated.

If the ground crew reports a tailpipe fire, and bleed air is not readily available, a ground fire-extinguisher should can be used as last resort: Chemical or dry chemical powder causes serious corrosive damage to the engine.

## ENGINES WARM UP PERIOD

ALL

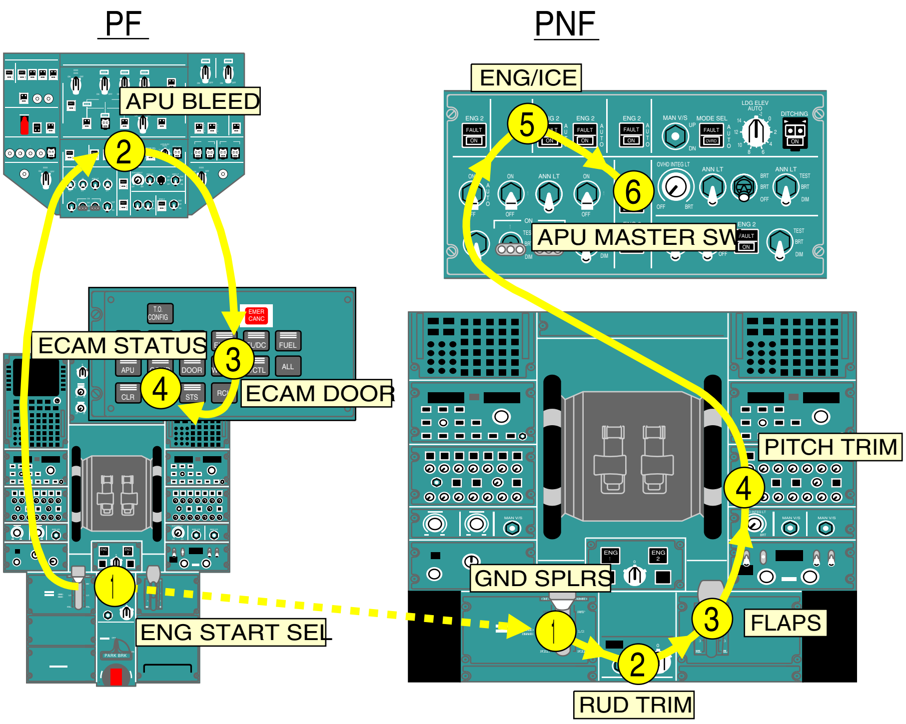
After engine-start, and in order to avoid thermal shock of the engine, the engine should be operated at idle or near idle (Ref. FCOM 3.03.09) before setting the thrust lever to high power. The warm-up can include any taxi time at idle.

## AFTER START FLOW PATTERN

ALL

When the engines have started, the PF sets the ENG START selector to NORM to permit normal pack operation. At this time, the After Start Flow Pattern begins.

AFTER START FLOW PATTERN




NOF 02030 04173 0001

## POWERPUSH

MSN 0002-0044 0052-0055 0059-0073 0076-0078 0081-0088 0091-0094 0098-0162 0165-0167 0170-0178 0180-0192 0194-0395 0399-0415 0417-0422 0424-0430 0434-0450 0452-0468 0470-0485 0487-0489 0491 0493-0498 0500-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036 2038-2042 2044-2049 2052 2054-2058 2060-2061 2063-2070 2072-2080 2082-2099 2101-2108 2110-2118 2121-2128 2130-2169 2171-2175 2177-2180 2182-2183 2185 2187-2188 2190-2195 2197-2212 2215-2217 2219-2223 2225-2227 2229 2231-2244 2246-2248 2250 2252-2256 2258-2264 2266-2267 2269-2270 2272-2275 2278 2280 2282 2284-2288 2290 2293-2295 2298 2301-2305 2307 2309-2316 2318 2320-2321 2323-2325 2327 2330-2331 2334 2336-2337 2339-2343 2345 2347-2349 2351-2352 2356-2357 2359 2363-2365 2368-2369 2371-2374 2381 2384 2386 2388-2391 2393 2397 2399 2405 2407-2411 2415-2416 2421-2422 2425-2426 2428-2430 2432 2435 2437 2447 2449 2451 2454 2458-2459 2461-2462 2464 2466 2472 2474 2478-2480 2482 2486 2488-2489 2491 2493-2494 2498-2499 2504-2505 2507-2510 2517 2520-2521 2525 2530 2532 2534-2536 2542-2543 2545 2547 2549 2551 2559 2562-2563 2568 2570 2574 2577 2579-2580 2583 2589 2591 2595 2597 2599 2606 2613-2615 2618 2627 2630 2635 2639-2641 2643 2647 2652 2667 2669 2671 2682 2690 2710 2725 2755 2775 2781 2802 2805 2814-2815 2819 2832 2839 2847-2848 2871 2880 2890 2900-2901 2940 2945 2948 2969-2970 2977 2992 3020 3029 3039 3072 3091 3104 3106 3119 3144 3150 3190 3195 3200 3226

If a Power Push Unit (PPU) is to be used for pushback, the PPU will be placed on the left main landing gear and engine 2 will be started at the gate. This will pressurize the yellow hydraulic circuit for parking brake. The nose wheel steering, on green hydraulic circuit, is ensured via the PTU. Prior push back, check that there is no NWS DISC memo on the EWD.

The flight crew is in charge of the steering according to ground indications through the interphone. Due to a face-to-face situation between ground personnel and flight crew, a clear understanding of directional phraseology is essential. The engine 1 will be started when the power push is completed and PPU removed.

During power push, the crew will not use the brakes, unless required due to an emergency and will not move flight controls or flap lever.

In case of emergency, the PPU should be immediately removed out of the evacuation area. Nevertheless, cabin evacuation is possible with the PPU in place.

MSN 1599 1660 1939 1991 2017 2035 2037 2043 2050-2051 2053 2059 2062 2071 2081 2100 2109 2119-2120 2129 2170 2176 2181 2184 2186 2189 2196 2213-2214 2218 2224 2228 2230 2245 2249 2251 2257 2265 2268 2271 2276-2277 2279 2281 2283 2289 2291-2292 2296-2297 2299-2300 2306 2308 2317 2319 2322 2326 2328-2329 2332-2333 2335 2338 2344 2346 2350 2353-2355 2358 2360-2362 2366-2367 2370 2375-2380 2382-2383 2385 2387 2392 2394-2396 2398 2400-2404 2406 2412-2414 2417-2420 2423-2424 2427 2431 2433-2434 2436 2438-2446 2448 2450 2452-2453 2455-2457 2460 2463 2465 2467-2471 2473 2475-2477 2481 2483-2485 2487 2490 2492 2495-2497 2500-2503 2506 2511-2516 2518-2519 2522-2524 2526-2529 2531 2533 2537-2541 2544 2546 2548 2550 2552-2558 2560-2561 2564-2567 2569 2571-2573 2575-2576 2578 2581-2582 2584-2588 2590 2592-2594 2596 2598 2600-2605 2607-2612 2616-2617 2619-2626 2628-2629 2631-2634 2636-2638 2642 2644-2646 2648-2651 2653-2666 2668 2670 2672-2681 2683-2689 2691-2709 2711-2724 2726-2754 2756-2774 2776-2780 2782-2801 2803-2804 2806-2813 2816-2818 2820-2831 2833-2838 2840-2846 2849-2870 2872-2879 2881-2889 2891-2899 2902-2939 2941-2944 2946-2947 2949-2968 2971-2976 2978-2991 2993-3019 3021-3028 3030-3038 3040-3071 3073-3090 3092-3103 3105 3107-3118 3120-3143 3145-3149 3151-3189 3191-3194 3196-3199 3201-3225 3229-3260

If a Power Push Unit (PPU) is to be used for pushback, the PPU will be placed on the left main landing gear and engine 2 will be started at the gate. This will pressurize the yellow hydraulic circuit for parking brake and NWS. Prior push back, check that there is no NWS DISC memo on the EWD.

The flight crew is in charge the steering according to ground indications through the interphone. Due to a face-to-face situation between ground personnel and flight crew, a clear understanding of directional phraseology is essential.

The engine 1 will be started when the power push is completed and PPU removed.

During power push, the crew will not use the brakes, unless required due to an emergency and will not move flight controls or flap lever.

In case of emergency, the PPU should be immediately removed out of the evacuation area. Nevertheless, cabin evacuation is possible with the PPU in place.

## TAXI ROLL AND STEERING

ALL

Before taxi, check that the amber "NWS DISC" ECAM message is off, to ensure that steering is fully available.

### THRUST USE

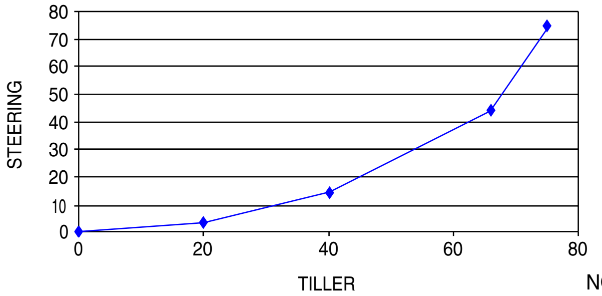
Only a little power is needed above thrust idle, in order to get the aircraft moving (N1 40%). Excessive thrust application can result in exhaust-blast damage or Foreign Object Damage (FOD). Thrust should normally be used symmetrically.

## TILLER AND RUDDER PEDALS USE

Pedals control nosewheel steering at low speed (± 6 degrees with full pedal deflection). Therefore, on straight taxiways and on shallow turns, the pilot can use the pedals to steer the aircraft, keeping a hand on the tiller. In sharper turns, the pilot must use the tiller.

## STEERING TECHNIQUE

The Nosewheel steering is "by-wire" with no mechanical connection between the tiller and the nosewheel. The relationship between tiller deflection and nosewheel angle is not linear and the tiller forces are light.

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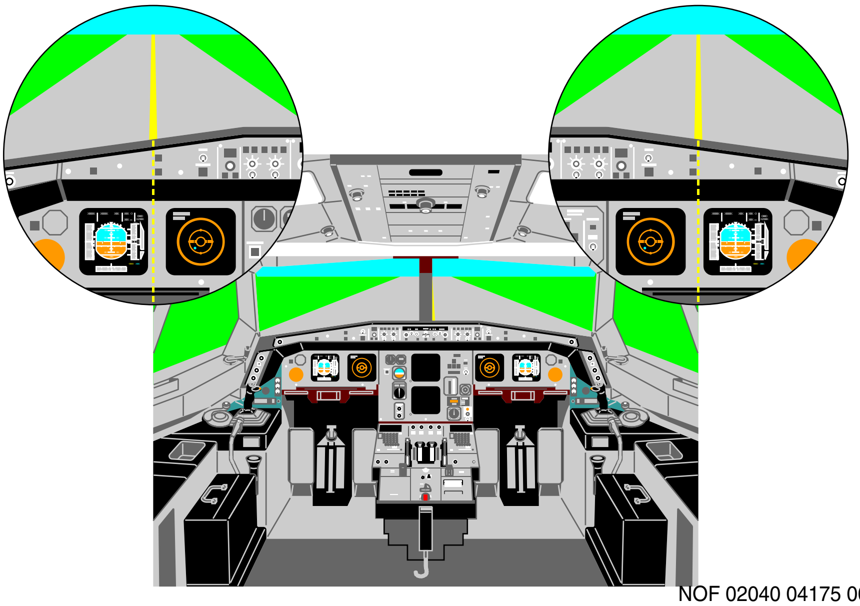
Therefore, the PF should move the tiller smoothly and maintain the tiller's position. Any correction should be small and smooth, and maintained for enough time to enable the pilot to assess the outcome. Being over-active on the tiller will cause uncomfortable oscillations.

On straight taxiways, the aircraft is correctly aligned on the centerline, when the centerline is lined-up between the PFD and ND.

PROPER CENTERLINE FOLLOWING



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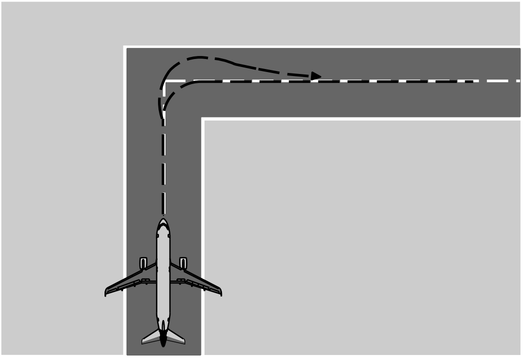
If both pilots act on the tiller or pedals, their inputs are added until the maximum value of the steering angle (programmed within the BSCU) is reached.

When the seating position is correct, the cut-off angle is 20 degrees, and the visual ground geometry provides an obscured segment of 42 feet (12.5 meters). During taxi, a turn must be initiated before an obstacle approaches the obscured segment. This provides both wing and tail clearance, with symmetric thrust and no differential braking.

Asymmetric thrust can be used to initiate a tight turn and to keep the aircraft moving during the turn. If nosewheel lateral skidding occurs while turning, reduce taxi speed or increase turn radius. Avoid stopping the aircraft in a turn, because excessive thrust will be required to start the aircraft moving again.

The flight crew should be aware that the main gear on the inside of a turn will always cut the corner and track inside of the nosewheel track. For this reason, the oversteering technique may be considered especially for A321 where main gear is 20 meters behind the pilot.

OVERSTEERING TECHNIQUE



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When exiting a tight turn, the pilot should anticipate the steer out. Additionally, the pilot should allow the aircraft to roll forward for a short distance to minimize the stress on the main gears.

In the event that one or more tires is/are deflated on the main landing gear, the maximum permitted steering angle will be limited by the aircraft speed. Therefore, with one tire deflated, the aircraft speed is limited to 7 knots and nosewheel steering can be used. With two tires deflated, the aircraft speed is limited to 3 knots and nosewheel steering angle should be limited to 30 degrees.

For turns of 90 degrees or more, the aircraft speed should be less than 10 knots.

## 180 DEGREE TURN

In order to make an effective 180-degree turn, the Captain should proceed as follows:

. Taxi on the right hand side of the runway and turn left to establish a 25° divergence from the runway axis (using the ND or PFD) with a maximum ground speed of 10 kts.

. When the aircraft is physically over the edge of the runway, smoothly initiate a full-deflection turn to the right.

. Asymmetric thrust should be used during the turn. Anticipation is required to ensure that asymmetric thrust is established before starting the turn, [50%N1 or 1.05EPR], to maintain a continuous speed of approximately 5 to 8 kts throughout the manoeuvre.

. During the turn, it is essential to maintain minimum ground speed. This will avoid the need to significantly increase thrust, in order to continue moving.

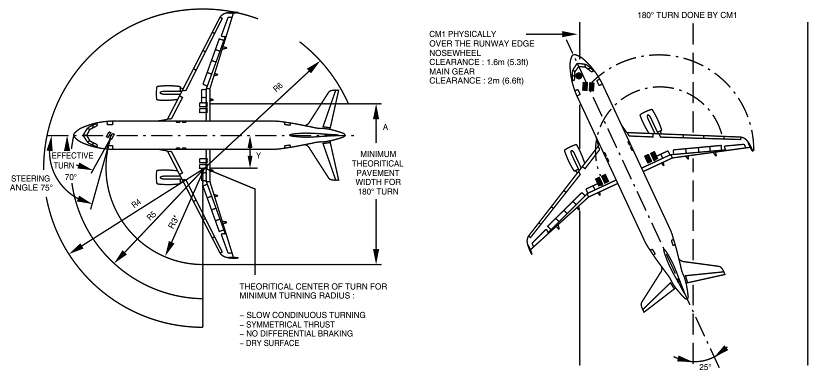
When the aircraft is turning, the PNF should observe the ND, and call out the indicated Ground Speeds (GS)

. Differential braking is allowed, but a braked pivot-turn is **NOT** permitted (i.e. braking to fully stop the wheels on one main gear), to avoid stress on the landing gear assembly.

. When turning on a wet or contaminated runway, (and to be more specific, when turning on the white or yellow marking that is painted on the runway) tight turns can cause the nosewheel to jerk. This can be noisy and uncomfortable.

The First Officer symmetrically performs the procedure (i.e. Taxi on the left-hand side of the runway).

AIRCRAFT DIMENSIONS

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MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

## FIGURES

| Y Ft/inm | R3 Ft/in m | R4 Ft/in m | R5 Ft/in m | R6 Ft/in m | NWS Limit Angle | Minimum Runway Width with Asymmetric Thrust |
|---|---|---|---|---|---|---|
| 10.17<br>3.10 | 36.42<br>11.10 | 67.59<br>20.60 | 51.18<br>15.60 | 58.73<br>17.90 | 75 ° | **30 m**<br>**99 ft** |

MSN 0546 0572 0578 0588 0598 0600 0608-0610 0612 0616 0618 0621 0623 0625
0627 0629 0634 0636-0637 0639 0641 0644 0646-0647 0649 0651 0654 0656 0660 0670
0672 0679 0682 0686 0688-0691 0693-0695 0697 0700 0711 0713 0717 0719 0721 0723
0727-0729 0732 0734 0736 0738 0740 0742 0744 0748 0750 0752 0755 0757 0759 0763
0767 0769 0773 0779 0783 0785 0788 0790 0794 0798 0800 0804 0813 0817 0821
0825 0829 0831 0833 0837 0840 0843 0845 0847 0850 0853 0858 0860 0862 0867
0869 0871 0873 0875 0880 0882 0885 0889-0890 0893 0896 0898 0904 0906 0910 0913
0917 0922 0924 0929 0931 0933 0938 0944 0946 0948-0949 0952 0965 0972 0976
0979-0980 0985 0989 0997-0998 1000 1002 1010 1016 1018-1020 1022 1025 1029 1031
1033-1034 1036 1038 1040 1043 1046 1048-1049 1051 1053 1055-1056 1058 1062 1064
1066 1068-1069 1071 1073-1074 1077-1078 1082 1084 1086 1088-1092 1095-1098 1100
1102-1103 1106-1107 1109 1111 1113 1115-1116 1118 1120 1122 1124 1126-1127 1129 1131
1135-1136 1139-1140 1142 1145 1147 1149 1151 1154-1155 1157 1159-1160 1164-1165 1167
1169-1170 1172 1176 1178 1180 1182 1184 1190-1191 1193 1197 1201 1203 1205 1209
1211-1212 1216 1222-1223 1225 1228 1230 1232 1236 1239 1243 1245 1247 1249 1252
1254 1256 1258 1261 1263 1265 1267 1269 1271 1275 1277-1279 1281 1283 1285 1287
1289 1291 1295 1297 1301 1303 1305 1309 1311 1313 1315 1317 1319 1321 1323-1326
1328-1329 1331 1335-1336 1338 1340 1342 1344 1346 1348 1350 1352 1354 1358 1360
1362 1364 1369 1371 1373 1375 1377-1378 1380 1382 1384 1386 1388-1389 1391-1393
1395 1397 1401 1404 1406 1410 1414-1415 1420 1423 1426 1429 1434 1440 1444-1445
1449 1453 1456 1460 1463 1466 1468 1471 1474 1477 1479 1483 1485 1488 1490
1494 1498 1501 1505 1507 1510 1513 1515 1520 1522 1524 1527 1529 1534 1537
1541 1543 1545 1547 1549 1551-1552 1556 1558 1560 1562-1563 1565 1567 1569-1570
1573-1577 1579 1581-1583 1585 1589-1590 1592 1594 1598 1600-1601 1603-1604 1606
1608 1612 1616 1618 1622 1625 1627 1630 1634 1640 1643 1645 1647 1649 1653-1654
1656 1659 1662 1664 1668 1671 1673 1677 1679 1683-1685 1688 1693 1698-1699 1703
1706 1709 1714 1718 1722 1727 1729 1731 1733 1737-1738 1740 1742-1743 1745-1746
1750 1752-1753 1756 1758-1759 1761 1765-1766 1768 1770 1774 1778-1779 1781 1786
1790-1791 1795-1796 1800-1801 1803 1805 1808 1810 1815 1819-1820 1824 1826 1828
1831 1833 1837 1839 1841 1844 1846 1851 1853 1855 1863 1866 1870 1872 1875-1876
1880 1882 1884 1886 1890 1893 1897 1901 1908 1912 1916 1923 1925 1934 1936 1938
1943 1947 1952 1955 1959 1962-1963 1971 1976 1980 1982 1986 1990 1997 1999-2000
2002 2004 2007-2008 2010 2012-2013 2015 2019 2023 2026 2028 2030 2032-2033 2037
2039 2043 2047 2050 2052-2053 2057 2062 2066 2069 2072 2074 2078 2083 2086-2087
2089 2091 2093 2095-2096 2098 2101 2103 2113 2119-2120 2122 2124 2126-2127 2129
2131 2170 2172 2174 2176 2179 2181 2184 2186 2188 2192 2194 2196 2198 2200
2202-2203 2205 2209 2213-2214 2222 2224 2228 2230 2232 2236-2237 2240-2241 2243
2245 2249 2251 2253 2258 2260 2262-2266 2268-2269 2271 2273 2277

MSN 2279 2281 2283 2285 2287 2289 2293 2295-2296 2298 2300 2302 2304 2306 2308 2311 2313 2318-2319 2321 2326 2332 2335 2339 2341 2346 2348 2353 2355 2360 2362 2365 2369-2371 2373 2375 2378-2380 2382-2383 2385 2387 2389 2392 2396 2398 2400 2402 2404 2406 2408 2412 2414 2416 2418 2420-2421 2424 2426-2427 2429 2431 2433 2435-2436 2438 2440 2442 2444 2446 2448 2450 2452 2454 2456 2458 2460 2463-2471 2473-2474 2477 2481 2483 2485 2487 2490 2492 2494-2495 2497 2499 2501 2503 2505 2507-2508 2510 2512 2514 2516 2518-2519 2525 2527-2528 2532 2534 2538 2541 2545-2548 2550-2551 2554-2561 2565 2567-2568 2570 2572 2574 2578-2579 2581 2585-2586 2588 2592-2593 2595 2597 2603 2605 2607 2611 2614-2615 2617-2618 2621-2622 2624-2625 2628-2629 2631-2632 2634 2636 2638-2639 2641 2643-2644 2646 2648 2650 2652 2655 2657 2659-2660 2662 2664 2666-2667 2669 2672-2673 2675 2677 2679 2681 2684 2690-2691 2693-2694 2697-2698 2700 2702 2704 2706 2709 2711 2715-2716 2718 2720 2723 2727 2729 2733 2735 2738-2739 2742 2744 2746 2748 2751 2754 2757 2762-2763 2765 2769 2771 2773-2774 2777 2779-2780 2782 2784 2786 2788 2790 2795 2797 2801 2803 2805-2806 2811-2813 2815 2818-2819 2821 2825 2827 2829 2831 2833 2836-2837 2839 2841 2843 2845 2847 2849-2850 2852 2854 2857-2858 2860 2864 2866 2870 2872-2873 2876 2878-2879 2884 2886-2894 2897-2898 2901 2905 2907 2913 2921 2923 2925 2929 2935 2938 2940 2942 2946 2948-2949 2954 2959 2961 2963 2969 2976 2978-2979 2981 2983 2985 2997 3003 3007 3011 3017 3019-3020 3024 3026 3028 3032 3036 3041 3043 3045-3046 3049 3053-3054 3057 3059 3061 3065 3069 3073 3077-3078 3082 3084-3085 3088 3090 3094 3096 3102 3104 3108 3114 3116 3118 3122 3124 3128 3133-3134 3137 3139 3144 3165 3168-3169 3171-3172 3175-3176 3179 3181 3184 3186 3188 3193 3195 3200 3202 3204 3209 3226 3231 3243-3260

## FIGURES

| Y<br>Ft/in<br>m | R3<br>Ft/in<br>m | R4<br>Ft/in<br>m | R5<br>Ft/in<br>m | R6<br>Ft/in<br>m | NWS Limit<br>Angle | Minimum Runway<br>Width with<br>Asymmetric Thrust |
|---|---|---|---|---|---|---|
| 13.2<br>4.01 | 39.9<br>12.11 | 70.10<br>21.58 | 54.6<br>16.6 | 64.1<br>19.77 | 75 ° | **30 m**<br>**99 ft** |

MSN 0002-0363 0365-0384 0386-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545 0548-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571 0573-0575 0577 0579-0580 0582 0584-0585 0587 0589-0590 0592 0594 0596 0601-0603 0605 0607 0611 0613 0615 0617 0619 0622 0624 0626 0628 0630 0635 0638 0640 0643 0645 0648 0650 0653 0655 0657-0659 0661-0662 0665 0667 0669 0671 0673 0676 0678 0681 0683 0685 0696 0698 0701-0710 0712 0714 0716 0718 0720 0722 0724 0726 0730 0733 0735 0737 0739 0741 0743 0745 0747 0749 0751 0753-0754 0756 0758 0760 0762 0764 0766 0768 0770 0772 0774 0776 0778 0780 0782 0784 0786 0789 0791 0793 0795 0797 0799 0801 0803 0805 0807 0809 0812 0814 0816 0818 0820 0822 0824 0826 0828 0830 0832 0834 0836 0838-0839 0842 0844 0846 0849 0851 0854 0856-0857 0859 0861 0863 0865-0866 0868 0870 0872 0874 0876-0877 0879 0881 0883-0884 0886 0888 0892 0894-0895 0897 0899-0900 0902-0903 0905 0907 0909 0911-0912 0914 0916 0918-0919 0921 0923 0925 0927-0928 0930 0932 0934 0936-0937 0939 0942-0943 0945 0947 0950-0951 0953 0955 0957-0958 0960 0962 0964 0966-0967 0969 0971 0973 0975 0977-0978 0981-0982 0984 0986 0988 0990 0992 0994 0996 0999 1001 1003 1005 1007 1009 1011 1013-1014 1026 1028 1030 1032 1035 1037 1039 1041 1044 1047 1050 1052 1054 1057 1059 1061 1063 1065 1067 1070 1072 1075-1076 1079 1081 1083 1085 1087 1093 1099 1101 1104-1105 1108 1110 1112 1114 1117 1119 1121 1123 1125 1128 1130 1132 1134 1137-1138 1141 1143 1146 1148 1150 1152 1156 1158 1162-1163 1166 1168 1171 1173 1175 1177 1179 1181 1183 1187 1189 1192 1194 1196 1198 1200 1206 1208 1210 1213 1215 1217 1221 1224 1226 1229 1231 1234-1235 1237 1240 1242 1244 1246 1248 1251 1253 1255 1257 1259 1262 1264 1266 1268 1270 1272 1274 1280 1282 1284 1286 1288 1290 1292 1294 1296 1298 1300 1302 1304 1306 1308 1310 1312 1314 1316 1318 1320 1322 1327 1330 1332 1334 1337 1339 1341 1343 1345 1347 1349 1351 1353 1355 1357 1359 1361 1363 1365 1367-1368 1370 1372 1374 1376 1379 1381 1383 1385 1387 1390 1394 1396 1398 1400 1402 1405 1407 1409 1411 1413 1416 1418-1419 1422 1424 1427 1430 1432 1435 1437 1439 1441 1443 1446 1448 1450 1452 1454 1457 1459 1461 1464 1467 1469-1470 1473 1475 1478 1480 1482 1484 1486 1489 1491 1493 1495 1497 1500 1502 1504 1506 1508-1509 1512 1514 1516 1518 1523 1526 1528 1530 1532-1533 1535 1538 1540 1542 1544 1546 1548 1550 1553 1555 1557 1559 1561 1564 1566 1568 1571 1578 1580 1584 1586 1588 1591 1593 1595 1597 1605 1609-1610 1613 1615 1617 1620-1621 1624 1626 1628 1631 1633 1635 1637 1639 1641 1644 1646 1648 1650 1652 1655 1657 1661 1663 1665 1667 1669 1672 1674 1676 1678 1680 1682 1686-1687 1689 1692 1694 1696-1697 1700 1702 1705 1708 1710 1712 1715 1717 1719 1721 1723 1725 1728 1730 1732 1735-1736 1739 1741 1744 1747 1749 1751 1754-1755 1757 1760 1762 1764 1767 1769 1771 1773 1775 1777 1780 1782 1784-1785

MSN 1787 1789 1792-1793 1797 1799 1802 1804 1806 1809 1812-1814 1816 1818 1821-1823 1825 1827 1829 1832 1834-1835 1838 1840 1842 1845 1847 1849 1852 1854 1856-1858 1860-1862 1864-1865 1867-1868 1871 1873-1874 1877 1879 1883 1885 1888-1889 1891-1892 1894-1896 1898-1900 1902-1904 1906-1907 1909-1911 1913-1915 1917-1920 1922 1924 1927 1929-1931 1933 1935 1937 1940 1942 1944-1945 1948-1949 1951 1954 1957-1958 1961 1964-1965 1968-1969 1973 1975 1979 1981 1983 1987 1989 1993 1996 1998 2001 2003 2006 2009 2011 2014 2016 2018 2020 2022 2024 2027 2029 2031 2034 2036 2038 2040 2042 2044 2046 2048-2049 2054 2056 2058 2061 2063 2065 2068 2070 2073 2075 2077 2079 2082 2084-2085 2088 2090 2092 2094 2097 2099 2102 2104 2106 2108 2112 2114 2116 2118 2121 2123 2125 2128 2130 2132-2169 2171 2173 2175 2177-2178 2180 2182-2183 2185 2187 2189 2191 2193 2195 2197 2199 2201 2204 2206-2207 2210 2212 2215 2217 2219 2221 2223 2225 2227 2229 2231 2233 2235 2238-2239 2242 2244 2246 2248 2250 2252 2254 2256-2257 2259 2272 2274-2275 2278 2280 2282 2284 2286 2288 2291-2292 2294 2297 2299 2301 2307 2310 2312 2314 2316 2322 2325 2327 2329 2331 2334 2336 2338 2340 2343 2345 2347 2349 2352 2354 2356 2359 2361 2364 2366 2368 2372 2374 2376 2384 2386 2388 2390-2391 2393 2395 2397 2399 2401 2403 2405 2407 2409 2411 2413 2415 2417 2419 2422-2423 2425 2428 2430 2432 2434 2437 2439 2441 2443 2445 2447 2449 2451 2453 2455 2457 2459 2461 2475 2478-2479 2482 2484 2486 2489 2491 2493 2496 2498 2500 2502 2504 2506 2509 2511 2513 2515 2517 2520 2522 2524 2526 2529 2531 2533 2535 2537 2539-2540 2542 2562 2564 2566 2569 2571 2573 2576-2577 2580 2583-2584 2587 2589 2591 2594 2596 2598 2600 2602 2604 2606 2608-2609 2612-2613 2616 2619-2620 2623 2626-2627 2630 2633 2635 2637 2640 2642 2645 2647 2649 2651 2654 2656 2658 2661 2663 2665 2668 2670-2671 2674 2676 2678 2680 2683 2685 2688-2689 2692 2695-2696 2699 2701 2703 2705 2708 2710 2712 2714 2717 2719 2721 2724-2725 2728 2731-2732 2734 2737 2740 2743 2745 2747 2749 2752-2753 2755 2758 2760-2761 2764 2766 2768 2770 2772 2775-2776 2778 2781 2783 2785 2787 2789 2791-2792 2794 2796 2798 2800 2802 2804 2807-2808 2810 2814 2816-2817 2820 2822 2824 2826 2828 2830 2832 2834-2835 2838 2840 2842 2844 2846 2848 2851 2853 2855-2856 2859 2861 2863 2865 2867 2869 2871 2874-2875 2877 2880-2881 2883 2885 2896 2899-2900 2902 2904 2906 2908-2909 2911 2914-2915 2917 2920 2922 2924 2926 2928 2930 2932 2934 2937 2939 2941 2943-2945 2947 2950 2952-2953 2956 2958 2960 2962 2964 2966 2968 2970 2973 2975 2977 2980 2982 2984 2986-2995 2998 3000 3002 3004 3006 3008 3010 3012 3014 3016 3018 3021 3023 3025 3027 3029 3031 3033 3035 3037 3039-3040 3042 3044 3047-3048 3050 3052 3055-3056 3058 3060 3063-3064 3066 3068 3071-3072 3074 3076 3079-3080 3083 3086-3087 3089 3091 3093 3095 3097 3099 3101 3103 3105 3107 3109 3111 3113 3115 3117 3119 3121 3123 3125 3127 3129 3131-3132 3135-3136 3138 3140-3143 3145 3147-3162 3164 3166-3167 3170 3173-3174 3177-3178 3180 3182-3183 3185 3187

MSN 3189-3190 3192 3194 3196-3197 3199 3201 3203 3205-3206 3208 3210 3213 3215

**FIGURES**

| Y Ft/inm | R3 Ft/in m | R4 Ft/in m | R5 Ft/in m | R6 Ft/in m | NWS Limit Angle | Minimum Runway Width with Asymmetric Thrust |
|---|---|---|---|---|---|---|
| 15.1<br>4.61 | 45.5<br>13.84 | 72.2<br>21.99 | 60<br>18.3 | 71.1<br>21.91 | 75 ° | **30 m**<br>**99 ft** |

MSN 0364 0385 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532 0535 0538 0541 0544 0550 0552 0555 0557 0560 0563-0564 0567 0570 0576 0581 0583 0586 0591 0593 0595 0597 0599 0604 0606 0614 0620 0631-0633 0642 0652 0663-0664 0666 0668 0674-0675 0677 0680 0684 0687 0692 0699 0715 0725 0731 0746 0761 0765 0771 0775 0777 0781 0787 0792 0796 0802 0806 0808 0810-0811 0815 0819 0823 0827 0835 0841 0848 0852 0855 0864 0878 0887 0891 0901 0908 0915 0920 0926 0935 0940-0941 0954 0956 0959 0961 0963 0968 0970 0974 0983 0987 0991 0993 0995 1004 1006 1008 1012 1015 1017 1021 1023-1024 1027 1042 1045 1060 1080 1094 1133 1144 1153 1161 1174 1185 1188 1195 1199 1202 1204 1207 1214 1218-1220 1227 1233 1238 1241 1250 1260 1273 1276 1293 1299 1307 1333 1356 1366 1399 1403 1408 1412 1417 1421 1425 1428 1431 1433 1436 1438 1442 1447 1451 1455 1458 1462 1465 1472 1476 1481 1487 1492 1496 1499 1503 1511 1517 1519 1521 1525 1531 1536 1539 1554 1572 1587 1596 1602 1607 1611 1614 1619 1623 1629 1632 1636 1638 1642 1651 1658 1666 1670 1675 1681 1690-1691 1695 1701 1704 1707 1711 1713 1716 1720 1724 1726 1734 1748 1763 1772 1776 1783 1788 1794 1798 1807 1811 1817 1836 1843 1848 1850 1859 1869 1878 1881 1887 1905 1921 1926 1928 1932 1941 1946 1950 1953 1956 1960 1966-1967 1970 1972 1974 1977-1978 1984 1988 1994-1995 2005 2021 2041 2045 2055 2060 2064 2067 2076 2080 2105 2107 2110 2115 2117 2190 2208 2211 2216 2220 2226 2234 2247 2255 2261 2267 2270 2290 2303 2305 2309 2315 2320 2323-2324 2330 2337 2342 2351 2357 2363 2381 2410 2462 2472 2476 2480 2488 2521 2530 2536 2543 2549 2553 2563 2590 2599 2610 2653 2682 2687 2707 2713 2726 2730 2736 2741 2756 2759 2767 2793 2799 2809 2823 2862 2868 2882 2895 2903 2912 2916 2919 2927 2933 2936 2957 2965 2971 2974 2996 2999 3005 3013 3015 3022 3034 3051 3067 3070 3075 3081 3098 3106 3112 3120 3126 3130 3146 3191 3198 3207 3212 3217 3222 3229 3233-3235 3241

## FIGURES

| Y Ft/in m | R3 Ft/in m | R4 Ft/in m | R5 Ft/in m | R6 Ft/in m | NWS Limit Angle | Minimum Runway Width with Asymmetric Thrust |
|---|---|---|---|---|---|---|
| 16.9<br>5.1 | 59.1<br>18 | 74.6<br>22.7 | 74.2<br>22.6 | 80.5<br>24.5 | 75 ° | **32 m**<br>**105 ft** |

It must be noted that since R6 > R4, wing obstacle clearance does not imply tail obstacle clearance

## BRAKE CHECK

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036 2038-2042 2044-2049 2052 2054-2058 2060-2061 2063-2070 2072-2080 2082-2099 2101-2108 2110-2118 2121-2128 2130-2169 2171-2175 2177-2180 2182-2183 2185 2187-2188 2190-2195 2197-2212 2215-2217 2219-2223 2225-2227 2229 2231-2244 2246-2248 2250 2252-2256 2258-2264 2266-2267 2269-2270 2272-2275 2278 2280 2282 2284-2288 2290 2293-2295 2298 2301-2305 2307 2309-2316 2318 2320-2321 2323-2325 2327 2330-2331 2334 2336-2337 2339-2343 2345 2347-2349 2351-2352 2356-2357 2359 2363-2365 2368-2369 2371-2374 2381 2384 2386 2388-2391 2393 2397 2399 2405 2407-2411 2415-2416 2421-2422 2425-2426 2428-2430 2432 2435 2437 2447 2449 2451 2454 2458-2459 2461-2462 2464 2466 2472 2474 2478-2480 2482 2486 2488-2489 2491 2493-2494 2498-2499 2504-2505 2507-2510 2517 2520-2521 2525 2530 2532 2534-2536 2542-2543 2545 2547 2549 2551 2559 2562-2563 2568 2570 2574 2577 2579-2580 2583 2589 2591 2595 2597 2599 2606 2613-2615 2618 2627 2630 2635 2639-2641 2643 2647 2652 2667 2669 2671 2682 2690 2710 2725 2755 2775 2781 2802 2805 2814-2815 2819 2832 2839 2847-2848 2871 2880 2890 2900-2901 2940 2945 2948 2969-2970 2977 2992 3020 3029 3039 3072 3091 3104 3106 3119 3144 3150 3190 3195 3200 3226

When cleared to taxi, the PF should set the Parking Brake to "OFF". When the aircraft starts to move, the PF should check the efficiency of the normal braking system by gently pressing the brake pedals, to ensure that the aircraft slows down. The PNF should also check the triple brake indicator to ensure that brake pressure drops to zero. This indicates a successful changeover to the normal braking system.

MSN 1599 1660 1939 1991 2017 2035 2037 2043 2050-2051 2053 2059 2062 2071 2081 2100 2109 2119-2120 2129 2170 2176 2181 2184 2186 2189 2196 2213-2214 2218 2224 2228 2230 2245 2249 2251 2257 2265 2268 2271 2276-2277 2279 2281 2283 2289 2291-2292 2296-2297 2299-2300 2306 2308 2317 2319 2322 2326 2328-2329 2332-2333 2335 2338 2344 2346 2350 2353-2355 2358 2360-2362 2366-2367 2370 2375-2380 2382-2383 2385 2387 2392 2394-2396 2398 2400-2404 2406 2412-2414 2417-2420 2423-2424 2427 2431 2433-2434 2436 2438-2446 2448 2450 2452-2453 2455-2457 2460 2463 2465 2467-2471 2473 2475-2477 2481 2483-2485 2487 2490 2492 2495-2497 2500-2503 2506 2511-2516 2518-2519 2522-2524 2526-2529 2531 2533 2537-2541 2544 2546 2548 2550 2552-2558 2560-2561 2564-2567 2569 2571-2573 2575-2576 2578 2581-2582 2584-2588 2590 2592-2594 2596 2598 2600-2605 2607-2612 2616-2617 2619-2626 2628-2629 2631-2634 2636-2638 2642 2644-2646 2648-2651 2653-2666 2668 2670 2672-2681 2683-2689 2691-2709 2711-2724 2726-2754 2756-2774 2776-2780 2782-2801 2803-2804 2806-2813 2816-2818 2820-2831 2833-2838 2840-2846 2849-2870 2872-2879 2881-2889 2891-2899 2902-2939 2941-2944 2946-2947 2949-2968 2971-2976 2978-2991 2993-3019 3021-3028 3030-3038 3040-3071 3073-3090 3092-3103 3105 3107-3118 3120-3143 3145-3149 3151-3189 3191-3194 3196-3199 3201-3225 3229-3260

When cleared to taxi, the PF should set the Parking Brake to "OFF". When the aircraft starts to move, the PF should check the efficiency of the normal braking system by gently pressing the brake pedals.

## CARBON BRAKE WEAR

ALL

Carbon brake wear depends on the number of brake applications and on brake temperature. It does not depend on the applied pressure, or the duration of the braking. The temperature at which maximum brake wear occurs depends on the brake manufacturer. Therefore, the only way the pilot can minimize brake wear is to reduce the number of brake applications.

## TAXI SPEED AND BRAKING

ALL

On long, straight taxiways, and with no ATC or other ground traffic constraints, the PF should allow the aircraft to accelerate to 30 knots, and should then use one smooth brake application to decelerate to 10 knots. The PF should not "ride" the brakes. The GS indication on the ND should be used to assess taxi speed.

MSN 0002-0042 0044-0112 0115-0564 0566-0574 0576-0579 0581-0658 0660 0662-0666 0668-0933 0935-0950 0952-0989 0991-0998 1000-1013 1015-1137 1139-1167 1169-1176 1178-1182 1184-1216 1218-1225 1227-1382 1384-1406 1408-1417 1419-1423 1425-1458 1460-1696 1698-1731 1733-1986 1988-3260

## BRAKE TEMPERATURE

The FCOM limits brake temperature to 300 Deg C. before takeoff is started.

This limit ensures that, in the case of hydraulic fluid leakage, any hydraulic fluid, that may come into contact with the brake units, will not be ignited in the wheelwell.

This limit does not ensure that, in the case of a high energy rejected takeoff, the maximum brake energy limitation will be respected.

Thermal oxidation increases at high temperatures. Therefore, if the brakes absorb too much heat, carbon oxidation will increase. This is the reason why the brakes should not be used repeatedly at temperatures above 500 Deg. C. during normal operation. In addition, after heavy braking, the use of brake fans can increase oxidation of the brake surface hot spots, if the brakes are not thermally equalized.

MSN 0043 0113-0114 0565 0575 0580 0659 0661 0667 0934 0951 0990 0999 1014 1138 1168 1177 1183 1217 1226 1383 1407 1418 1424 1459 1697 1732 1987

## BRAKE TEMPERATURE

The FCOM limits brake temperature to 260 °C before take-off is started.

This limit ensures that, in the case of hydraulic fluid leakage, any hydraulic fluid, that may come into contact with the brake units, will not be ignited in the wheelwell.

This limit does not ensure that, in the case of a high energy rejected takeoff, the maximum brake energy limitation will be respected.

Thermal oxidation increases at high temperatures. Therefore, if the brakes absorb too much heat, carbon oxidation will increase. This is the reason why the brakes should not be used repeatedly at temperatures above 500 Deg. C. during normal operation. In addition, after heavy braking, the use of brake fans can increase oxidation of the brake surface hot spots, if the brakes are not thermally equalized.

## BRAKING ANOMALIES

MSN 0002-0024 0026-0034 0036 0039-0042 0044 0051-0055 0059-0067 0069-0072 0076-0078 0081-0086 0090-0094 0098-0111 0115-0131 0133-0139 0141-0167 0169-0178 0181-0221 0223-0242 0244-0246 0248-0255 0257-0278 0280-0292 0294 0296-0298 0300 0302-0307 0309-0313 0315 0317-0325 0328-0343 0345-0347 0349-0361 0363-0378 0380-0391 0393-0394 0398-0402 0404-0406 0408-0413 0415-0421 0423-0426 0428-0429 0431 0435-0436 0439-0450 0452-0468 0470-0475 0478-0485 0487 0489 0491 0493 0497-0512 0518-0527 0529-0534 0537 0539 0541-0546 0549 0553-0554 0557-0569 0571-0572 0574-0575 0577-0578 0580 0583-0590 0592 0594-0596 0598 0600-0605 0607-0623 0625 0627 0629 0633-0641 0643-0645 0647-0653 0655-0665 0667-0670 0672-0705 0707-0715 0717-0729 0731-0734 0736-0738 0740-0742 0744 0746-0749 0751-0752 0754-0755 0757-0762 0764-0766 0768-0774 0777-0783 0785-0790 0792-0793 0795-0804 0806-0811 0813-0814 0817-0821 0823-0826 0828-0832 0834-0840 0842-0871 0873-0876 0879-0880 0882-0885 0887-0890 0892-0901 0903-0907 0909 0911 0913-0914 0916-0917 0921-0925 0929 0931-0940 0942-0959 0962-0968 0971-0981 0984-0990 0992 0994 0996-1006 1010-1012 1014 1017-1022 1025-1028 1030-1031 1033-1052 1054-1067 1069-1072 1074-1075 1077-1080 1082-1084 1086-1093 1095-1099 1101-1105 1108-1116 1118-1120 1122-1126 1128-1135 1138-1144 1146 1148-1149 1151 1153-1157 1159-1171 1173-1174 1176-1183 1187-1188 1190-1197 1199-1211 1213-1214 1216-1230 1232-1236 1238-1240 1243-1251 1254-1255 1257-1295 1297-1306 1308 1310-1334 1336-1351 1353-1363 1365-1375 1377-1378 1380 1382 1384 1386 1388-1389 1391-1393 1395 1397

If the ACCU PRESS drops below 1 500 PSI, the flight crew should be aware that the Parking Brake can, quite suddenly, become less efficient. This explains the amber range on the hydraulic pressure gauge of the ACCU PRESS.

If the flight crew encounters any braking problems during taxi, they should set the A/SKID & N/W STRG Sw to OFF. They should not apply pressure to the pedals while setting the A/SKID & N/W STRG Sw to OFF. Then, the PF should refer to the triple brake indicator and modulate the pressure as necessary.

When parking brake is ON, pressing the pedals has no effect on braking. Consequently, if for any reason the aircraft moves forward while the park brake is ON, the parking brake must be released in order to get braking efficiency from the pedals.

MSN 0025 0035 0037-0038 0043 0045-0050 0056-0058 0068 0073-0075 0080 0087-0089 0095-0097 0112-0114 0132 0140 0168 0179-0180 0222 0243 0247 0256 0279 0293 0295 0299 0301 0308 0314 0316 0326-0327 0344 0348 0362 0379 0392 0395-0396 0403 0407 0414 0422 0427 0430 0432-0434 0437-0438 0451 0469 0476-0477 0486 0488 0490 0492 0494-0496 0513-0517 0528 0535 0538 0540 0548 0550-0552 0555-0556 0570 0573 0576 0579 0581-0582 0591 0593 0597 0599 0606 0624 0626 0628 0630-0631 0642 0646 0654 0666 0671 0706 0716 0730 0735 0739 0743 0745 0750 0753 0756 0763 0767 0775-0776 0784 0791 0794 0805 0812 0815-0816 0822 0827 0833 0841 0872 0877-0878 0881 0886 0891 0902 0908 0910 0912 0915 0918-0920 0926-0928 0930 0941 0960-0961 0969-0970 0982-0983 0991 0993 0995 1007-1009 1013 1015-1016 1023-1024 1029 1032 1053 1068 1073 1076 1081 1085 1094 1100 1106-1107 1117 1121 1127 1136-1137 1145 1147 1150 1152 1158 1172 1175 1184-1185 1189 1198 1212 1215 1231 1237 1241-1242 1252-1253 1256 1296 1307 1309 1335 1352 1364 1376 1379 1381 1383 1385 1387 1390 1394 1396 1398-3260

If the ACCU PRESS drops below 1 500 PSI, the flight crew should be aware that the Parking Brake can, quite suddenly, become less efficient. This explains the amber range on the hydraulic pressure gauge of the ACCU PRESS.

If the flight crew encounters any braking problems during taxi, they should set the A/SKID & N/W STRG Sw to OFF. They should not apply pressure to the pedals while setting the A/SKID & N/W STRG Sw to OFF. Then, the PF should refer to the triple brake indicator and modulate the pressure as necessary.

## BRAKE FANS

ALL

Brake fans cool the brakes, and the brake temperature sensor. Therefore, when the brake fans are running, the indicated brake temperature will be significantly lower than the indicated brake temperature when the brake fans are off.

Therefore, as soon as the brake fans are switched on, the indicated brake temperature decreases almost instantaneously. On the other hand, when the brake fans are switched off, it will take several minutes for the indicated brake temperature to increase and match the real brake temperature.

When the fans are running, the difference between the indicated and the actual brake temperature can range from 50 Deg. C. (when the actual brake temperature is 100 Deg. C) to 150 Deg. C. (when the actual brake temperature is 300 Deg. C). Therefore, before takeoff, if the fans are running, the flight crew should refer to the indicated brake temperature. When the indicated brake temperature is above 150 °C, takeoff must be delayed.

Brake fans should not be used during takeoff, in order to avoid Foreign Object Damage to fans and brakes.

## FLIGHT CONTROL CHECK

ALL

At a convenient stage, before or during taxi, and before arming the autobrake, the PF silently applies full longitudinal and lateral sidestick deflection. On the F/CTL page, the PNF checks and calls out full travel of elevators and ailerons, and correct deflection and retraction of spoilers. As each full travel/neutral position is reached, the PNF calls out:

. "Full up, full down, neutral"

. "Full left, full right, neutral"

The PF silently checks that the PNF calls are in accordance with the sidestick order. The PF then presses the PEDAL DISC pb on the nose wheel tiller and silently applies full left and full right rudder and then returns the rudder to neutral. The PNF follows on the rudder pedals and, when each full travel/neutral position is reached, calls out:

. "Full left, full right, neutral"

Full control input must be held for sufficient time for full travel to be reached and indicated on F/CTL page.

The PNF then applies full longitudinal and lateral sidestick deflection, and on the F/CTL page, silently checks full travel and correct sense of all elevators and ailerons, and correct deflection and retraction of all spoilers.

If this check is carried out during taxiing, it is essential that the PF remains head-up throughout the procedure.

## TAKE-OFF BRIEFING CONFIRMATION

ALL

Takeoff briefing should usually be a brief confirmation of the full takeoff briefing made at the parking bay and should include any changes that may have occurred, e.g. change of SID, change in runway conditions etc.

If ATC clears the aircraft to maintain a specific heading after takeoff, turn the FCU HDG selector to disarm the NAV. The current aircraft heading will be displayed on the FCU and the ND, and the flight crew can then set the cleared heading. Once airborne, and above 30 feet, RA, RWY TRK engages. To follow clearance, the FCU HDG knob should be pulled. Once cleared to resume the SID, a HDG adjustment may be necessary to intercept the desired track for NAV capture.

## TAXI WITH ONE ENGINE SHUTDOWN

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036 2038-2042 2044-2049 2052 2054-2058 2060-2061 2063-2070 2072-2080 2082-2099 2101-2108 2110-2118 2121-2128 2130-2169 2171-2175 2177-2180 2182-2183 2185 2187-2188 2190-2195 2197-2212 2215-2217 2219-2223 2225-2227 2229 2231-2244 2246-2248 2250 2252-2256 2258-2264 2266-2267 2269-2270 2272-2275 2278 2280 2282 2284-2288 2290 2293-2295 2298 2301-2305 2307 2309-2316 2318 2320-2321 2323-2325 2327 2330-2331 2334 2336-2337 2339-2343 2345 2347-2349 2351-2352 2356-2357 2359 2363-2365 2368-2369 2371-2374 2381 2384 2386 2388-2391 2393 2397 2399 2405 2407-2411 2415-2416 2421-2422 2425-2426 2428-2430 2432 2435 2437 2447 2449 2451 2454 2458-2459 2461-2462 2464 2466 2472 2474 2478-2480 2482 2486 2488-2489 2491 2493-2494 2498-2499 2504-2505 2507-2510 2517 2520-2521 2525 2530 2532 2534-2536 2542-2543 2545 2547 2549 2551 2559 2562-2563 2568 2570 2574 2577 2579-2580 2583 2589 2591 2595 2597 2599 2606 2613-2615 2618 2627 2630 2635 2639-2641 2643 2647 2652 2667 2669 2671 2682 2690 2710 2725 2755 2775 2781 2802 2805 2814-2815 2819 2832 2839 2847-2848 2871 2880 2890 2900-2901 2940 2945 2948 2969-2970 2977 2992 3020 3029 3039 3072 3091 3104 3106 3119 3144 3150 3190 3195 3200 3226

Brake life and fuel savings may govern company policy on permitting aircraft to taxi with one engine shut down. However, if taxiing out with one engine shutdown, the crew should be aware of the following:

. It is recommended to retain the use of engine 1 during taxi to maintain the green hydraulic system for normal braking and NWS.

. Before releasing the parking brake, the yellow electrical pump will be set ON to pressurize the yellow hydraulic system (ALT/PARK BRK) and avoid PTU operation. The crew will check the hydraulic yellow accumulator pressure

. Slow or tight turns in the direction of the operating engine may not be possible at high gross weights.

. It is not possible for ground personnel to protect the engine against fire, when the aircraft moves away from the ramp.

. The remaining engines should be started with sufficient time for engine warm-up before takeoff

. Any faults encountered during or after starting the remaining engine may require a return to the gate for maintenance and thus generate a further departure delay.

. Taxi with one engine shut down may require higher thrust than usual. Caution must, therefore, be exercised to avoid excessive jet-blast and the risk of Foreign Object Damage (FOD).

. The use of APU is recommended but the APU bleed should be switched off to avoid ingestion of exhaust gases by the air conditioning system.

. Before ENG2 start,
  - The yellow pump is set off to check correct operation of the PTU
  - APU BLEED is set back to ON for ENG2 bleed start.

MSN 1599 1660 1939 1991 2017 2035 2037 2043 2050-2051 2053 2059 2062 2071 2081 2100 2109 2119-2120 2129 2170 2176 2181 2184 2186 2189 2196 2213-2214 2218 2224 2228 2230 2245 2249 2251 2257 2265 2268 2271 2276-2277 2279 2281 2283 2289 2291-2292 2296-2297 2299-2300 2306 2308 2317 2319 2322 2326 2328-2329 2332-2333 2335 2338 2344 2346 2350 2353-2355 2358 2360-2362 2366-2367 2370 2375-2380 2382-2383 2385 2387 2392 2394-2396 2398 2400-2404 2406 2412-2414 2417-2420 2423-2424 2427 2431 2433-2434 2436 2438-2446 2448 2450 2452-2453 2455-2457 2460 2463 2465 2467-2471 2473 2475-2477 2481 2483-2485 2487 2490 2492 2495-2497 2500-2503 2506 2511-2516 2518-2519 2522-2524 2526-2529 2531 2533 2537-2541 2544 2546 2548 2550 2552-2558 2560-2561 2564-2567 2569 2571-2573 2575-2576 2578 2581-2582 2584-2588 2590 2592-2594 2596 2598 2600-2605 2607-2612 2616-2617 2619-2626 2628-2629 2631-2634 2636-2638 2642 2644-2646 2648-2651 2653-2666 2668 2670 2672-2681 2683-2689 2691-2709 2711-2724 2726-2754 2756-2774 2776-2780 2782-2801 2803-2804 2806-2813 2816-2818 2820-2831 2833-2838 2840-2846 2849-2870 2872-2879 2881-2889 2891-2899 2902-2939 2941-2944 2946-2947 2949-2968 2971-2976 2978-2991 2993-3019 3021-3028 3030-3038 3040-3071 3073-3090 3092-3103 3105 3107-3118 3120-3143 3145-3149 3151-3189 3191-3194 3196-3199 3201-3225 3229-3260

Brake life and fuel savings may govern company policy on permitting aircraft to taxi with one engine shut down. However, if taxiing out with one engine shutdown, the crew should be aware of the following:

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. Before releasing the parking brake, the yellow electrical pump will be set ON to pressurize the yellow hydraulic circuit (ALT/PARK BRK and NWS) and avoid PTU operation. The crew will check the hydraulic yellow accumulator pressure

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. Before ENG2 start,
   – The yellow is set off to check correct operation of the PTU

– APU BLEED is set back to ON for ENG2 bleed start.

## MISCELLANEOUS

ALL

### STROBE LIGHT (IF INSTALLED)

When the STROBE lights are set to AUTO, they come on automatically when the aircraft is airborne. The ON position can be used to turn on the lights on ground for crossing, backtracking or entering a runway.

### PACKS

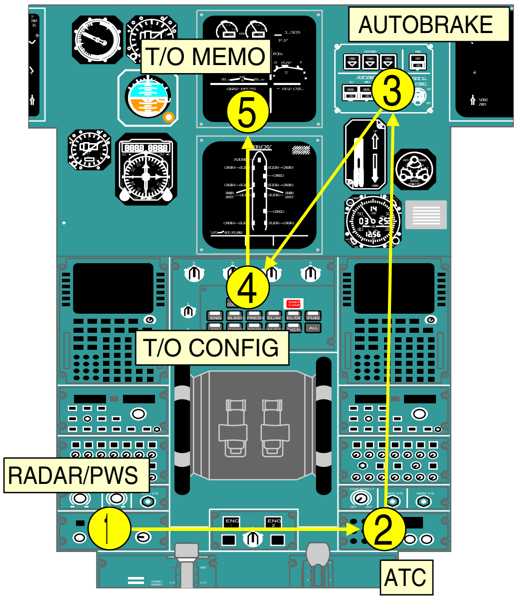
If the take-off has to be achieved without air bleed fed from the engines for performance reasons, but air conditioning desired, the APU bleed may be used with packs ON, thus maintaining engine performance level and passenger comfort. In case of APU auto shut down during take-off, the engine thrust is frozen till the thrust is manually reduced. The packs revert to engine bleed which causes an increase of EGT to keep N1/EPR.

If the take-off is performed with one pack unserviceable, the procedure states to set the failed pack to OFF. The take-off may be performed with the other pack ON (if performances permit) with TOGA or FLEX thrust, the pack being supplied by the onside bleed. In this asymmetric bleed configuration, the N1 take-off value is limited to the value corresponding to the bleed ON configuration and take-off performances must be computed accordingly.

## BEFORE TAKE-OFF FLOW PATTERN

ALL

BEFORE TAKE-OFF FLOW PATTERN




NOF 02050 04178 0001

## THRUST SETTING

MSN 0002-0034 0036 0039-0044 0059-0063 0068-0073 0078 0083-0088 0093-0094 0100-0112 0115-0162 0167 0170-0177 0181-0192 0195-0197 0199-0224 0226-0229 0231-0242 0244-0246 0248 0253-0255 0258 0262-0274 0277-0279 0281-0290 0293-0294 0297-0303 0305-0307 0309-0313 0318-0319 0323-0325 0328-0331 0333 0337 0339-0343 0345-0346 0348-0350 0352 0355-0356 0358-0360 0365 0367 0370-0372 0375 0377-0384 0387-0392 0395 0399-0404 0407-0410 0413 0417-0422 0426-0427 0434 0436 0438 0445-0446 0459 0466 0477 0482 0488 0491 0494-0495 0497-0498 0501 0507 0509 0511 0513-0517 0519-0522 0524-0526 0528-0529 0531-0537 0541 0544-0549 0552-0554 0558-0559 0561-0562 0566 0569-0570 0572 0574 0576-0579 0581 0583 0585-0586 0588 0590 0593-0594 0596 0598-0603 0605 0607-0612 0615-0619 0621-0630 0634-0637 0639 0641-0651 0653-0654 0656-0658 0660 0662 0664-0666 0669-0675 0677 0679 0681-0682 0684-0685 0688-0689 0691 0693-0695 0697 0700-0701 0703 0706-0707 0711 0713-0714 0716-0717 0719 0721 0723-0724 0726-0730 0732 0734-0738 0740 0742 0744-0745 0749-0750 0752-0755 0757 0761 0763-0769 0772-0779 0781-0782 0785-0786 0790 0793-0797 0799-0801 0807-0809 0813-0815 0817-0819 0821 0823 0827-0833 0837-0838 0840-0841 0844-0846 0848 0852-0854 0857 0860-0861 0863 0868-0870 0875-0876 0879-0880 0883-0885 0888 0890-0891 0894 0896-0897 0903-0907 0909 0911 0914 0917 0920-0923 0925-0926 0929 0933 0935-0942 0945-0947 0949 0951 0956-0962 0964 0967 0970-0973 0975 0978-0979 0981-0982 0984-0988 0991-0992 0994-1000 1002 1005-1006 1009 1011-1012 1016-1021 1023 1025-1030 1033-1034 1036-1038 1040-1041 1044 1046-1048 1051-1052 1054-1055 1058-1059 1061-1063 1065 1067-1073 1077-1078 1081 1084 1086-1087 1089-1091 1093-1095 1097 1099-1102 1106-1109 1112 1114 1119-1122 1124-1127 1129-1138 1141 1144-1145 1147-1152 1154-1155 1157 1160 1162 1164-1165 1167-1172 1175-1176 1179-1182 1184-1187 1189-1191 1198 1200-1203 1205-1206 1208-1210 1213 1216-1217 1219-1221 1224 1226 1229-1231 1233 1237-1238 1241-1242 1244-1245 1247 1249-1250 1252 1254-1255 1259 1262-1265 1267-1269 1271 1275 1277 1283 1285-1289 1292 1294 1296-1299 1301 1303 1305-1320 1322 1324-1326 1328 1330-1331 1336-1337 1340 1342 1344-1348 1352 1354 1357-1358 1360-1362 1364-1365 1367 1369-1372 1377-1379 1381-1382 1385-1394 1396 1399 1402-1405 1411-1417 1425 1429-1431 1434 1436-1437 1439 1441-1444 1447-1451 1453-1458 1461-1462 1465 1467 1470-1473 1476 1478-1481 1483-1485 1488-1489 1492-1494 1496 1498-1499 1501-1505 1515-1517 1519-1521 1524-1525 1530-1532 1535-1536 1539-1544 1549-1551 1553-1554 1556 1560 1562 1564 1567 1570-1572 1577-1579 1582-1583 1588 1592 1597-1599 1601-1603 1605 1607 1611-1612 1615-1616 1618 1622-1623 1625 1629-1630 1632-1634 1637-1641 1645-1646 1651 1654-1655 1657-1660 1662 1666-1668 1673-1674 1677-1679 1681 1683-1686 1691-1694 1699-1701 1704 1706 1709 1712-1714 1716-1720 1722 1724-1726 1733 1735-1736 1738 1740 1742-1748 1750-1753 1756-1757 1759 1761-1762 1765-1767 1769-1770 1772 1774-1775 1777-1781 1783 1786-1787 1789 1791 1793 1795-1797 1799-1800 1803

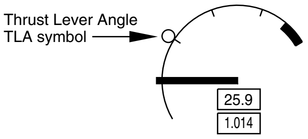
MSN 1805-1806 1808-1812 1815-1816 1819-1820 1824 1828 1833 1836 1838-1839 1841 1846 1851-1853 1859-1860 1863-1864 1866-1867 1870 1872-1876 1879 1881-1882 1884-1887 1889-1890 1894 1897 1900-1901 1905-1906 1908 1911 1913 1916 1920-1921 1923-1925 1929-1932 1936-1940 1942-1943 1949 1951 1954 1959-1961 1963-1966 1968 1972-1973 1975-1976 1978 1980-1983 1988-1991 1994 1997 1999 2001-2003 2005 2009-2013 2017-2019 2022 2024-2026 2028 2030 2033-2037 2039 2043 2046-2054 2056-2057 2059-2062 2064-2066 2068-2069 2071-2072 2074 2076 2078 2081-2083 2086-2087 2091-2093 2095 2100-2101 2103-2104 2106 2109 2113-2117 2119-2120 2122-2124 2126-2127 2129 2131 2133-2134 2140 2142-2146 2151 2154-2155 2158 2162-2163 2165-2166 2170-2171 2174-2176 2178-2184 2186-2187 2189 2191 2196 2198-2199 2206-2209 2212-2214 2217-2222 2224-2225 2227-2228 2230 2233 2235-2237 2239-2245 2248-2251 2253 2256 2258 2260 2262 2264-2266 2269-2272 2274 2276 2278-2279 2283 2285 2287 2289 2291 2293-2294 2298 2300 2306 2309 2311 2315 2317-2319 2325 2327-2328 2330 2332-2333 2337 2342 2344 2346-2347 2349-2350 2353-2354 2357-2358 2360-2361 2364-2365 2367 2369-2370 2373-2374 2377-2378 2380-2382 2385 2387-2388 2390-2392 2394 2398-2400 2402 2406-2407 2409 2411-2412 2416 2419-2420 2425 2427 2432 2436-2437 2439-2440 2442 2446 2448 2450-2451 2456 2460 2463-2465 2471-2472 2474 2477-2478 2481 2483-2484 2486-2488 2492-2495 2497-2499 2503 2506-2508 2511-2512 2514 2516 2518-2519 2523 2525 2527-2529 2532 2538-2552 2554-2558 2561-2563 2565 2569 2575 2578 2581-2584 2586 2588 2591-2593 2596 2599 2601 2605-2607 2611-2612 2616-2620 2623-2625 2627-2629 2632-2633 2635-2638 2641 2644 2646 2652 2654 2656 2658 2662 2665 2668 2672 2674-2675 2677-2678 2681 2683-2686 2691 2693 2695-2696 2699-2700 2702 2705-2709 2712 2715-2716 2719 2721 2726-2727 2729 2733 2735-2736 2740 2742-2746 2748-2751 2754 2756-2758 2760-2765 2768-2770 2773-2774 2776-2779 2782 2785-2786 2788-2790 2792 2794-2796 2798 2800-2801 2803 2805-2807 2810-2812 2816 2818-2822 2824-2827 2829-2831 2834-2837 2839 2841-2843 2846-2847 2849 2851-2855 2857 2860-2861 2865-2867 2869-2870 2873 2875-2879 2881-2882 2884-2885 2889-2891 2895 2897 2899 2902-2903 2905 2907 2909-2910 2912-2913 2915 2918 2920-2921 2923-2926 2930-2932 2935 2937-2939 2944 2946-2947 2949-2951 2954-2957 2959-2962 2964-2968 2972-2973 2975 2980 2985-2986 2988-2989 2991 2993-2996 2998 3000-3003 3006 3008-3009 3014 3016 3018-3019 3021 3023-3025 3027-3028 3030-3031 3035-3038 3040-3041 3043-3044 3046-3048 3051-3056 3058-3065 3068 3070 3073 3076 3078-3080 3082-3085 3087-3088 3090 3092-3102 3107-3111 3115 3117-3118 3121-3123 3129-3140 3145-3149 3151-3155 3157 3160-3161 3163-3164 3168-3171 3173-3174 3176 3178-3182 3184 3186-3189 3191 3194 3197 3199 3201-3206 3209 3212-3216 3220 3225-3226 3233 3238 3243-3260

The PF should announce "Take-off". The PF then applies power in as follows:

If cross wind is at or below 20 kts and there is no tail wind

. From idle to 1.05EPR / 50% N1 by reference to the TLA indicator on the EPR / N1 gauge.

. When the engine parameters have stabilized, to the FLX/MCT or TOGA detent as appropriate.

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In case of tailwind or if cross wind is greater than 20 kts:

. From idle to 1.05 EPR / 50% N1 by reference to the TLA indicator on the EPR / N1 gauge.

. Once stabilized, from 1.05 EPR / 50 % N1 to 1.15 EPR / 70% N1 by reference to the TLA indicator on the EPR / N1 gauge.

. Then, to FLX / TOGA, as required to reach take-off thrust by 40 kts groundspeed.

This procedure ensures that all engines will accelerate similarly. If not properly applied, this may lead to asymmetrical thrust increase, and, consequently, to severe directional control problem.

If the thrust levers are not set to the proper take-off detent, e.g. FLX instead of TOGA, a message comes up on the ECAM.

MSN 0035 0037-0038 0045-0058 0064-0067 0074-0077 0080-0082 0089-0091 0095-0099 0113-0114 0163-0166 0168-0169 0178-0180 0193-0194 0198 0225 0230 0243 0247 0249-0252 0256-0257 0259-0261 0275-0276 0280 0291-0292 0295-0296 0304 0308 0314-0317 0320-0322 0326-0327 0332 0334-0336 0338 0344 0347 0351 0353-0354 0357 0361-0364 0366 0368-0369 0373 0376 0385-0386 0393-0394 0396-0398 0405-0406 0411-0412 0414-0416 0423-0425 0428-0432 0435 0437 0439-0444 0447-0458 0460-0465 0467-0476 0478-0480 0483-0487 0489-0490 0492-0493 0496 0499-0500 0502-0506 0508 0510 0512 0518 0523 0527 0530 0538-0540 0542-0543 0550-0551 0555-0557 0560 0563-0565 0567-0568 0571 0573 0575 0580 0582 0584 0587 0589 0591-0592 0595 0597 0604 0606 0613-0614 0620 0631-0633 0638 0640 0652 0655 0659 0661 0663 0667-0668 0676 0678 0680 0683 0686-0687 0690 0692 0696 0698-0699 0702 0704-0705 0709-0710 0712 0715 0718 0720 0722 0725 0731 0733 0739 0741 0743 0746-0748 0751 0756 0758-0760 0762 0770-0771 0780 0783-0784 0787-0789 0791-0792 0798 0802-0806 0810-0812 0816 0820 0822 0824-0826 0834-0836 0839 0842-0843 0847 0849-0851 0855-0856 0858-0859 0862 0864-0867 0871-0874 0877-0878 0881-0882 0886-0887 0889 0892-0893 0895 0898-0902 0908 0910 0912-0913 0915-0916 0918-0919 0924 0927-0928 0930-0932 0934 0943-0944 0948 0950 0952-0955 0963 0965-0966 0968-0969 0974 0976-0977 0980 0983 0989-0990 0993 1001 1003-1004 1007-1008 1010 1013-1015 1022 1024 1031-1032 1035 1039 1042-1043 1045 1049-1050 1053 1056-1057 1060 1064 1066 1074-1076 1079-1080 1082-1083 1085 1088 1092 1096 1098 1103-1105 1110-1111 1113 1115-1118 1123 1128 1139-1140 1142-1143 1146 1153 1156 1158-1159 1161 1163 1166 1173-1174 1177-1178 1183 1188 1192-1197 1199 1204 1207 1211-1212 1214-1215 1218 1222-1223 1225 1227-1228 1232 1234-1236 1239-1240 1243 1246 1248 1251 1253 1256-1258 1260-1261 1266 1270 1272-1274 1276 1279-1282 1284 1290-1291 1293 1295 1300 1302 1304 1321 1323 1327 1329 1332-1335 1338-1339 1341 1343 1349-1351 1353 1355-1356 1359 1363 1366 1368 1373-1376 1380 1383-1384 1395 1397-1398 1400-1401 1406-1410 1418-1424 1426-1428 1432-1433 1435 1438 1440 1445-1446 1452 1459-1460 1463-1464 1466 1468-1469 1474-1475 1477 1482 1486-1487 1490-1491 1495 1497 1500 1506-1514 1518 1522-1523 1526-1529 1533-1534 1537-1538 1545-1548 1552 1555 1557-1559 1561 1563 1565-1566 1568-1569 1573-1576 1580-1581 1584-1587 1589-1591 1593-1596 1600 1604 1606 1608-1610 1613-1614 1617 1619-1621 1624 1626-1628 1631 1635-1636 1642-1644 1647-1650 1652-1653 1656 1661 1663-1665 1669-1672 1675-1676 1680 1682 1687-1690 1695-1698 1702-1703 1705 1707-1708 1710-1711 1715 1721 1723 1727-1732 1734 1737 1739 1741 1749 1754-1755 1758 1760 1763-1764 1768 1771 1773 1776 1782 1784-1785 1788 1790 1792 1794 1798 1801-1802 1804 1807 1814 1817-1818 1821-1823 1825-1827 1829-1832 1834-1835 1837 1840 1842-1845 1847-1850 1854-1858 1861-1862 1865 1868-1869 1871 1877-1878 1880 1883 1888 1891-1893 1895-1896 1898-1899 1902-1904 1907 1909-1910 1912 1914-1915 1917-1918 1922 1926-1928 1933-1935 1941

MSN 1944-1948 1950 1952-1953 1955-1958 1962 1967 1969-1971 1974 1977 1979 1984-1987 1993 1995-1996 1998 2000 2004 2006-2008 2014-2016 2020-2021 2023 2027 2029 2031-2032 2038 2040-2042 2044-2045 2055 2058 2063 2067 2070 2073 2075 2077 2079-2080 2084-2085 2088-2090 2094 2096-2099 2102 2105 2107-2108 2110-2112 2118 2121 2125 2128 2130 2132 2135-2139 2141 2147-2150 2152-2153 2156-2157 2159-2161 2164 2167-2169 2172-2173 2177 2185 2188 2190 2192-2195 2197 2200-2205 2210-2211 2215-2216 2223 2226 2229 2231-2232 2234 2238 2246-2247 2252 2254-2255 2257 2259 2261 2263 2267-2268 2273 2275 2277 2280-2282 2284 2286 2288 2290 2292 2295-2297 2299 2301-2305 2307-2308 2310 2312-2314 2316 2320-2324 2326 2329 2331 2334-2336 2338-2341 2343 2345 2348 2351-2352 2355-2356 2359 2362-2363 2366 2368 2371-2372 2375-2376 2379 2383-2384 2386 2389 2393 2395-2397 2401 2403-2405 2408 2410 2413-2415 2417-2418 2421-2424 2426 2428-2431 2433-2435 2438 2441 2443-2445 2447 2449 2452-2455 2457-2459 2461-2462 2466-2470 2473 2475-2476 2479-2480 2482 2485 2489-2491 2496 2500-2502 2504-2505 2509-2510 2513 2515 2517 2520-2522 2524 2526 2530-2531 2533-2537 2553 2559-2560 2564 2566-2568 2570-2574 2576-2577 2579-2580 2585 2587 2589-2590 2594-2595 2597-2598 2600 2602-2604 2608-2610 2613-2615 2621-2622 2626 2630-2631 2634 2639-2640 2642-2643 2645 2647-2651 2653 2655 2657 2659-2661 2663-2664 2666-2667 2669-2671 2673 2676 2679-2680 2682 2687-2690 2692 2694 2697-2698 2701 2703-2704 2710-2711 2713-2714 2717-2718 2720 2723-2725 2728 2730-2732 2734 2737-2739 2741 2747 2752-2753 2755 2759 2766-2767 2771-2772 2775 2780-2781 2783-2784 2787 2791 2793 2797 2799 2802 2804 2808-2809 2813-2815 2817 2823 2828 2832-2833 2838 2840 2844-2845 2848 2850 2856 2858-2859 2862-2864 2868 2871-2872 2874 2880 2883 2886-2888 2892-2894 2896 2898 2900-2901 2904 2906 2908 2911 2914 2916-2917 2919 2922 2927-2929 2933-2934 2936 2940-2943 2945 2948 2952-2953 2958 2963 2969-2971 2974 2976-2979 2981-2984 2987 2990 2992 2997 2999 3004-3005 3007 3010-3013 3015 3017 3020 3022 3026 3029 3032-3034 3039 3042 3045 3049-3050 3057 3066-3067 3069 3071-3072 3074-3075 3077 3081 3086 3089 3091 3103-3106 3112-3114 3116 3119-3120 3124-3128 3141-3144 3150 3156 3158-3159 3162 3165-3167 3172 3175 3177 3183 3185 3190 3192-3193 3195-3196 3198 3200 3207-3208 3210 3217 3222 3229-3231 3235 3241

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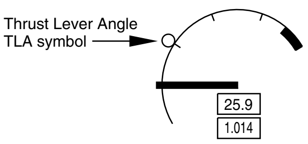
If cross wind is at or below 20 kts and there is no tail wind

. From idle to 1.05EPR / 50% N1 by reference to the TLA indicator on the EPR / N1 gauge.

. When the engine parameters have stabilized, to the FLX/MCT or TOGA detent as appropriate.

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In case of tailwind or if cross wind is greater than 20 kts:

. From idle to 1.05 EPR / 50% N1 by reference to the TLA indicator on the EPR / N1 gauge.

. Then, to FLX / TOGA, as required to reach take-off thrust by 40 kts groundspeed.

This procedure ensures that all engines will accelerate similarly. If not properly applied, this may lead to asymmetrical thrust increase, and, consequently, to severe directional control problem.

If the thrust levers are not set to the proper take-off detent, e.g. FLX instead of TOGA, a message comes up on the ECAM.

## TAKE-OFF ROLL

ALL

Once the thrust is set, the PF announces the indications on the FMA. The PNF must check that the thrust is set by 80 kts and must announce "Power Set".

The Captain must keep his hand on the thrust levers when the thrust levers are set to TOGA/FLX notch and until V1.

On a normal take-off, to counteract the pitch up moment during thrust application, the PF should apply half forward (full forward in cross wind case) sidestick at the start of the take-off roll until reaching 80 kts. At this point, the input should be gradually reduced to be zero by 100 kts.

The PF should use pedals to keep the aircraft straight. The nosewheel steering authority decreases at a pre-determined rate as the groundspeed increases (no more efficiency at 130 kts) and the rudder becomes more effective. The use the tiller is not recommended during takeoff roll, because of its high efficiency, which might lead to aircraft overreaction.

For crosswind take-offs, routine use of into wind aileron is not necessary. In strong crosswind conditions, small lateral stick input may be used, if deemed necessary due to into wind wing reaction, but avoid using large deflections, resulting in excessive spoiler deployment which increase the aircraft tendency to turn into the wind (due to high weight on wheels on the spoiler extended side), reduces lift and increases drag. Spoiler deflection becomes significant with more than a third sidestick deflection.

As the aircraft lifts off, any lateral stick input applied will result in a roll rate demand, making aircraft lateral control more difficult. Wings must be level.

In case of low visibility take-off, visual cues are primary means to track the runway centerline. The PFD yaw bar provides an assistance in case of expected fog patches if ILS available.

## TYPICAL AIRCRAFT ATTITUDE AT TAKEOFF AFTER LIFT-OFF

ALL

At take off, the typical all engine operating attitude after lift-off is about 15°.

## ROTATION

ALL

Rotation is conventional. During the takeoff roll and the rotation, the pilot flying scans rapidly the outside references and the PFD. Until airborne, or at least until visual cues are lost, this scanning depends on visibility conditions (the better the visibility, the higher the priority given to outside references). Once airborne, the PF must then controls the pitch attitude on the PFD using FD bars in SRS mode which is then valid.

Initiate the rotation with a smooth positive backward sidestick input (typically 1/3 to 1/2 backstick). Avoid aggressive and sharp inputs.

The initial rotation rate is about 3° /sec.

If the established pitch rate is not satisfactory, the pilot must make smooth corrections on the stick. He must avoid rapid and large corrections, which cause sharp reaction in pitch from the aircraft. If, to increase the rotation rate, a further and late aft sidestick input is made around the time of lift-off, the possibility of tailstrike increases significantly on A321.

During rotation, the crew must not chase the FD pitch bar, since it does not give any pitch rate order, and might lead to overreaction.

Once airborne only, the crew must refine the aircraft pitch attitude using the FD, which is then representative of the SRS orders. The fly-by-wire control laws change into flight normal law, with automatic pitch trim active.

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

## AIRCRAFT GEOMETRY

| Tail strike pitch attitude | |
|---|---|
| L/G compressed | L/G extended |
| 15.7° | 17.3° |

MSN 0546 0572 0578 0588 0598 0600 0608-0610 0612 0616 0618 0621 0623 0625 0627 0629 0634 0636-0637 0639 0641 0644 0646-0647 0649 0651 0654 0656 0660 0670 0672 0679 0682 0686 0688-0691 0693-0695 0697 0700 0711 0713 0717 0719 0721 0723 0727-0729 0732 0734 0736 0738 0740 0742 0744 0748 0750 0752 0755 0757 0759 0763 0767 0769 0773 0779 0783 0785 0788 0790 0794 0798 0800 0804 0813 0817 0821 0825 0829 0831 0833 0837 0840 0843 0845 0847 0850 0853 0858 0860 0862 0867 0869 0871 0873 0875 0880 0882 0885 0889-0890 0893 0896 0898 0904 0906 0910 0913 0917 0922 0924 0929 0931 0933 0938 0944 0946 0948-0949 0952 0965 0972 0976 0979-0980 0985 0989 0997-0998 1000 1002 1010 1016 1018-1020 1022 1025 1029 1031 1033-1034 1036 1038 1040 1043 1046 1048-1049 1051 1053 1055-1056 1058 1062 1064 1066 1068-1069 1071 1073-1074 1077-1078 1082 1084 1086 1088-1092 1095-1098 1100 1102-1103 1106-1107 1109 1111 1113 1115-1116 1118 1120 1122 1124 1126-1127 1129 1131 1135-1136 1139-1140 1142 1145 1147 1149 1151 1154-1155 1157 1159-1160 1164-1165 1167 1169-1170 1172 1176 1178 1180 1182 1184 1190-1191 1193 1197 1201 1203 1205 1209 1211-1212 1216 1222-1223 1225 1228 1230 1232 1236 1239 1243 1245 1247 1249 1252 1254 1256 1258 1261 1263 1265 1267 1269 1271 1275 1277-1279 1281 1283 1285 1287 1289 1291 1295 1297 1301 1303 1305 1309 1311 1313 1315 1317 1319 1321 1323-1326 1328-1329 1331 1335-1336 1338 1340 1342 1344 1346 1348 1350 1352 1354 1358 1360 1362 1364 1369 1371 1373 1375 1377-1378 1380 1382 1384 1386 1388-1389 1391-1393 1395 1397 1401 1404 1406 1410 1414-1415 1420 1423 1426 1429 1434 1440 1444-1445 1449 1453 1456 1460 1463 1466 1468 1471 1474 1477 1479 1483 1485 1488 1490 1494 1498 1501 1505 1507 1510 1513 1515 1520 1522 1524 1527 1529 1534 1537 1541 1543 1545 1547 1549 1551-1552 1556 1558 1560 1562-1563 1565 1567 1569-1570 1573-1577 1579 1581-1583 1585 1589-1590 1592 1594 1598 1600-1601 1603-1604 1606 1608 1612 1616 1618 1622 1625 1627 1630 1634 1640 1643 1645 1647 1649 1653-1654 1656 1659 1662 1664 1668 1671 1673 1677 1679 1683-1685 1688 1693 1698-1699 1703 1706 1709 1714 1718 1722 1727 1729 1731 1733 1737-1738 1740 1742-1743 1745-1746 1750 1752-1753 1756 1758-1759 1761 1765-1766 1768 1770 1774 1778-1779 1781 1786 1790-1791 1795-1796 1800-1801 1803 1805 1808 1810 1815 1819-1820 1824 1826 1828 1831 1833 1837 1839 1841 1844 1846 1851 1853 1855 1863 1866 1870 1872 1875-1876 1880 1882 1884 1886 1890 1893 1897 1901 1908 1912 1916 1923 1925 1934 1936 1938 1943 1947 1952 1955 1959 1962-1963 1971 1976 1980 1982 1986 1990 1997 1999-2000 2002 2004 2007-2008 2010 2012-2013 2015 2019 2023 2026 2028 2030 2032-2033 2037 2039 2043 2047 2050 2052-2053 2057 2062 2066 2069 2072 2074 2078 2083 2086-2087 2089 2091 2093 2095-2096 2098 2101 2103 2113 2119-2120 2122 2124 2126-2127 2129 2131 2170 2172 2174 2176 2179 2181 2184 2186 2188 2192 2194 2196 2198 2200 2202-2203 2205 2209 2213-2214 2222 2224 2228 2230 2232 2236-2237 2240-2241 2243 2245 2249 2251 2253 2258 2260 2262-2266 2268-2269 2271 2273 2277

MSN 2279 2281 2283 2285 2287 2289 2293 2295-2296 2298 2300 2302 2304 2306 2308 2311 2313 2318-2319 2321 2326 2332 2335 2339 2341 2346 2348 2353 2355 2360 2362 2365 2369-2371 2373 2375 2378-2380 2382-2383 2385 2387 2389 2392 2396 2398 2400 2402 2404 2406 2408 2412 2414 2416 2418 2420-2421 2424 2426-2427 2429 2431 2433 2435-2436 2438 2440 2442 2444 2446 2448 2450 2452 2454 2456 2458 2460 2463-2471 2473-2474 2477 2481 2483 2485 2487 2490 2492 2494-2495 2497 2499 2501 2503 2505 2507-2508 2510 2512 2514 2516 2518-2519 2525 2527-2528 2532 2534 2538 2541 2545-2548 2550-2551 2554-2561 2565 2567-2568 2570 2572 2574 2578-2579 2581 2585-2586 2588 2592-2593 2595 2597 2603 2605 2607 2611 2614-2615 2617-2618 2621-2622 2624-2625 2628-2629 2631-2632 2634 2636 2638-2639 2641 2643-2644 2646 2648 2650 2652 2655 2657 2659-2660 2662 2664 2666-2667 2669 2672-2673 2675 2677 2679 2681 2684 2690-2691 2693-2694 2697-2698 2700 2702 2704 2706 2709 2711 2715-2716 2718 2720 2723 2727 2729 2733 2735 2738-2739 2742 2744 2746 2748 2751 2754 2757 2762-2763 2765 2769 2771 2773-2774 2777 2779-2780 2782 2784 2786 2788 2790 2795 2797 2801 2803 2805-2806 2811-2813 2815 2818-2819 2821 2825 2827 2829 2831 2833 2836-2837 2839 2841 2843 2845 2847 2849-2850 2852 2854 2857-2858 2860 2864 2866 2870 2872-2873 2876 2878-2879 2884 2886-2894 2897-2898 2901 2905 2907 2913 2921 2923 2925 2929 2935 2938 2940 2942 2946 2948-2949 2954 2959 2961 2963 2969 2976 2978-2979 2981 2983 2985 2997 3003 3007 3011 3017 3019-3020 3024 3026 3028 3032 3036 3041 3043 3045-3046 3049 3053-3054 3057 3059 3061 3065 3069 3073 3077-3078 3082 3084-3085 3088 3090 3094 3096 3102 3104 3108 3114 3116 3118 3122 3124 3128 3133-3134 3137 3139 3144 3165 3168-3169 3171-3172 3175-3176 3179 3181 3184 3186 3188 3193 3195 3200 3202 3204 3209 3226 3231 3243-3260

## AIRCRAFT GEOMETRY

| Tail strike pitch attitude | |
|---|---|
| L/G compressed | L/G extended |
| 13.9° | 15.5° |

MSN 0002-0363 0365-0384 0386-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545 0548-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571 0573-0575 0577 0579-0580 0582 0584-0585 0587 0589-0590 0592 0594 0596 0601-0603 0605 0607 0611 0613 0615 0617 0619 0622 0624 0626 0628 0630 0635 0638 0640 0643 0645 0648 0650 0653 0655 0657-0659 0661-0662 0665 0667 0669 0671 0673 0676 0678 0681 0683 0685 0696 0698 0701-0710 0712 0714 0716 0718 0720 0722 0724 0726 0730 0733 0735 0737 0739 0741 0743 0745 0747 0749 0751 0753-0754 0756 0758 0760 0762 0764 0766 0768 0770 0772 0774 0776 0778 0780 0782 0784 0786 0789 0791 0793 0795 0797 0799 0801 0803 0805 0807 0809 0812 0814 0816 0818 0820 0822 0824 0826 0828 0830 0832 0834 0836 0838-0839 0842 0844 0846 0849 0851 0854 0856-0857 0859 0861 0863 0865-0866 0868 0870 0872 0874 0876-0877 0879 0881 0883-0884 0886 0888 0892 0894-0895 0897 0899-0900 0902-0903 0905 0907 0909 0911-0912 0914 0916 0918-0919 0921 0923 0925 0927-0928 0930 0932 0934 0936-0937 0939 0942-0943 0945 0947 0950-0951 0953 0955 0957-0958 0960 0962 0964 0966-0967 0969 0971 0973 0975 0977-0978 0981-0982 0984 0986 0988 0990 0992 0994 0996 0999 1001 1003 1005 1007 1009 1011 1013-1014 1026 1028 1030 1032 1035 1037 1039 1041 1044 1047 1050 1052 1054 1057 1059 1061 1063 1065 1067 1070 1072 1075-1076 1079 1081 1083 1085 1087 1093 1099 1101 1104-1105 1108 1110 1112 1114 1117 1119 1121 1123 1125 1128 1130 1132 1134 1137-1138 1141 1143 1146 1148 1150 1152 1156 1158 1162-1163 1166 1168 1171 1173 1175 1177 1179 1181 1183 1187 1189 1192 1194 1196 1198 1200 1206 1208 1210 1213 1215 1217 1221 1224 1226 1229 1231 1234-1235 1237 1240 1242 1244 1246 1248 1251 1253 1255 1257 1259 1262 1264 1266 1268 1270 1272 1274 1280 1282 1284 1286 1288 1290 1292 1294 1296 1298 1300 1302 1304 1306 1308 1310 1312 1314 1316 1318 1320 1322 1327 1330 1332 1334 1337 1339 1341 1343 1345 1347 1349 1351 1353 1355 1357 1359 1361 1363 1365 1367-1368 1370 1372 1374 1376 1379 1381 1383 1385 1387 1390 1394 1396 1398 1400 1402 1405 1407 1409 1411 1413 1416 1418-1419 1422 1424 1427 1430 1432 1435 1437 1439 1441 1443 1446 1448 1450 1452 1454 1457 1459 1461 1464 1467 1469-1470 1473 1475 1478 1480 1482 1484 1486 1489 1491 1493 1495 1497 1500 1502 1504 1506 1508-1509 1512 1514 1516 1518 1523 1526 1528 1530 1532-1533 1535 1538 1540 1542 1544 1546 1548 1550 1553 1555 1557 1559 1561 1564 1566 1568 1571 1578 1580 1584 1586 1588 1591 1593 1595 1597 1605 1609-1610 1613 1615 1617 1620-1621 1624 1626 1628 1631 1633 1635 1637 1639 1641 1644 1646 1648 1650 1652 1655 1657 1661 1663 1665 1667 1669 1672 1674 1676 1678 1680 1682 1686-1687 1689 1692 1694 1696-1697 1700 1702 1705 1708 1710 1712 1715 1717 1719 1721 1723 1725 1728 1730 1732 1735-1736 1739 1741 1744 1747 1749 1751 1754-1755 1757 1760 1762 1764 1767 1769 1771 1773 1775 1777 1780 1782 1784-1785

MSN 1787 1789 1792-1793 1797 1799 1802 1804 1806 1809 1812-1814 1816 1818 1821-1823 1825 1827 1829 1832 1834-1835 1838 1840 1842 1845 1847 1849 1852 1854 1856-1858 1860-1862 1864-1865 1867-1868 1871 1873-1874 1877 1879 1883 1885 1888-1889 1891-1892 1894-1896 1898-1900 1902-1904 1906-1907 1909-1911 1913-1915 1917-1920 1922 1924 1927 1929-1931 1933 1935 1937 1940 1942 1944-1945 1948-1949 1951 1954 1957-1958 1961 1964-1965 1968-1969 1973 1975 1979 1981 1983 1987 1989 1993 1996 1998 2001 2003 2006 2009 2011 2014 2016 2018 2020 2022 2024 2027 2029 2031 2034 2036 2038 2040 2042 2044 2046 2048-2049 2054 2056 2058 2061 2063 2065 2068 2070 2073 2075 2077 2079 2082 2084-2085 2088 2090 2092 2094 2097 2099 2102 2104 2106 2108 2112 2114 2116 2118 2121 2123 2125 2128 2130 2132-2169 2171 2173 2175 2177-2178 2180 2182-2183 2185 2187 2189 2191 2193 2195 2197 2199 2201 2204 2206-2207 2210 2212 2215 2217 2219 2221 2223 2225 2227 2229 2231 2233 2235 2238-2239 2242 2244 2246 2248 2250 2252 2254 2256-2257 2259 2272 2274-2275 2278 2280 2282 2284 2286 2288 2291-2292 2294 2297 2299 2301 2307 2310 2312 2314 2316 2322 2325 2327 2329 2331 2334 2336 2338 2340 2343 2345 2347 2349 2352 2354 2356 2359 2361 2364 2366 2368 2372 2374 2376 2384 2386 2388 2390-2391 2393 2395 2397 2399 2401 2403 2405 2407 2409 2411 2413 2415 2417 2419 2422-2423 2425 2428 2430 2432 2434 2437 2439 2441 2443 2445 2447 2449 2451 2453 2455 2457 2459 2461 2475 2478-2479 2482 2484 2486 2489 2491 2493 2496 2498 2500 2502 2504 2506 2509 2511 2513 2515 2517 2520 2522 2524 2526 2529 2531 2533 2535 2537 2539-2540 2542 2562 2564 2566 2569 2571 2573 2576-2577 2580 2583-2584 2587 2589 2591 2594 2596 2598 2600 2602 2604 2606 2608-2609 2612-2613 2616 2619-2620 2623 2626-2627 2630 2633 2635 2637 2640 2642 2645 2647 2649 2651 2654 2656 2658 2661 2663 2665 2668 2670-2671 2674 2676 2678 2680 2683 2685 2688-2689 2692 2695-2696 2699 2701 2703 2705 2708 2710 2712 2714 2717 2719 2721 2724-2725 2728 2731-2732 2734 2737 2740 2743 2745 2747 2749 2752-2753 2755 2758 2760-2761 2764 2766 2768 2770 2772 2775-2776 2778 2781 2783 2785 2787 2789 2791-2792 2794 2796 2798 2800 2802 2804 2807-2808 2810 2814 2816-2817 2820 2822 2824 2826 2828 2830 2832 2834-2835 2838 2840 2842 2844 2846 2848 2851 2853 2855-2856 2859 2861 2863 2865 2867 2869 2871 2874-2875 2877 2880-2881 2883 2885 2896 2899-2900 2902 2904 2906 2908-2909 2911 2914-2915 2917 2920 2922 2924 2926 2928 2930 2932 2934 2937 2939 2941 2943-2945 2947 2950 2952-2953 2956 2958 2960 2962 2964 2966 2968 2970 2973 2975 2977 2980 2982 2984 2986-2995 2998 3000 3002 3004 3006 3008 3010 3012 3014 3016 3018 3021 3023 3025 3027 3029 3031 3033 3035 3037 3039-3040 3042 3044 3047-3048 3050 3052 3055-3056 3058 3060 3063-3064 3066 3068 3071-3072 3074 3076 3079-3080 3083 3086-3087 3089 3091 3093 3095 3097 3099 3101 3103 3105 3107 3109 3111 3113 3115 3117 3119 3121 3123 3125 3127 3129 3131-3132 3135-3136 3138 3140-3143 3145 3147-3162 3164 3166-3167 3170 3173-3174 3177-3178 3180 3182-3183 3185 3187

MSN 3189-3190 3192 3194 3196-3197 3199 3201 3203 3205-3206 3208 3210 3213 3215

## AIRCRAFT GEOMETRY

| Tail strike pitch attitude | |
|---|---|
| L/G compressed | L/G extended |
| 11.7° | 13.5° |

MSN 0364 0385 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532 0535 0538 0541 0544 0550 0552 0555 0557 0560 0563-0564 0567 0570 0576 0581 0583 0586 0591 0593 0595 0597 0599 0604 0606 0614 0620 0631-0633 0642 0652 0663-0664 0666 0668 0674-0675 0677 0680 0684 0687 0692 0699 0715 0725 0731 0746 0761 0765 0771 0775 0777 0781 0787 0792 0796 0802 0806 0808 0810-0811 0815 0819 0823 0827 0835 0841 0848 0852 0855 0864 0878 0887 0891 0901 0908 0915 0920 0926 0935 0940-0941 0954 0956 0959 0961 0963 0968 0970 0974 0983 0987 0991 0993 0995 1004 1006 1008 1012 1015 1017 1021 1023-1024 1027 1042 1045 1060 1080 1094 1133 1144 1153 1161 1174 1185 1188 1195 1199 1202 1204 1207 1214 1218-1220 1227 1233 1238 1241 1250 1260 1273 1276 1293 1299 1307 1333 1356 1366 1399 1403 1408 1412 1417 1421 1425 1428 1431 1433 1436 1438 1442 1447 1451 1455 1458 1462 1465 1472 1476 1481 1487 1492 1496 1499 1503 1511 1517 1519 1521 1525 1531 1536 1539 1554 1572 1587 1596 1602 1607 1611 1614 1619 1623 1629 1632 1636 1638 1642 1651 1658 1666 1670 1675 1681 1690-1691 1695 1701 1704 1707 1711 1713 1716 1720 1724 1726 1734 1748 1763 1772 1776 1783 1788 1794 1798 1807 1811 1817 1836 1843 1848 1850 1859 1869 1878 1881 1887 1905 1921 1926 1928 1932 1941 1946 1950 1953 1956 1960 1966-1967 1970 1972 1974 1977-1978 1984 1988 1994-1995 2005 2021 2041 2045 2055 2060 2064 2067 2076 2080 2105 2107 2110 2115 2117 2190 2208 2211 2216 2220 2226 2234 2247 2255 2261 2267 2270 2290 2303 2305 2309 2315 2320 2323-2324 2330 2337 2342 2351 2357 2363 2381 2410 2462 2472 2476 2480 2488 2521 2530 2536 2543 2549 2553 2563 2590 2599 2610 2653 2682 2687 2707 2713 2726 2730 2736 2741 2756 2759 2767 2793 2799 2809 2823 2862 2868 2882 2895 2903 2912 2916 2919 2927 2933 2936 2957 2965 2971 2974 2996 2999 3005 3013 3015 3022 3034 3051 3067 3070 3075 3081 3098 3106 3112 3120 3126 3130 3146 3191 3198 3207 3212 3217 3222 3229 3233-3235 3241

## AIRCRAFT GEOMETRY

| Tail strike pitch attitude | |
|---|---|
| L/G compressed | L/G extended |
| 9.7° | 11.2° |

## TAIL STRIKE AVOIDANCE

ALL

### INTRODUCTION

If tailstrike it is not a concern for the A318, the importance of this subject increases as fuselage length increases. Therefore, it is particularly important for A321 operators.

Tail strikes can cause extensive structural damage, which can jeopardize the flight and lead to heavy maintenance action. They most often occur in such adverse conditions as crosswind, turbulence, windshear, etc.

## MAIN FACTORS

### EARLY ROTATION

Early rotation occurs when rotation is initiated below the scheduled VR. The potential reasons for this are:

. The calculated VR is incorrect for the aircraft weight or flap configuration.

. The PF commands rotation below VR due to gusts, windshear or an obstacle on the runway.

Whatever the cause of the early rotation, the result will be an increased pitch attitude at lift-off, and consequently a reduced tail clearance.

### ROTATION TECHNIQUE

The recommendation given in the ROTATION TECHNIQUE paragraph should be applied.

A fast rotation rate increases the risk of tailstrike, but a slow rate increases take-off distance. The recommended rate is about 3 degs/sec, which reflects the average rates achieved during flight test, and is also the reference rate for performance calculations.

### CONFIGURATION (NOT APPLICABLE TO A318)

When performance is limiting the takeoff weight, the flight crew uses TOGA thrust and selects the configuration that provides the highest takeoff weight.

When the actual takeoff weight is lower than the permissible one, the flight crew uses FLEX TO thrust. For a given aircraft weight, a variety of flap configurations are possible. Usually, the flight crew selects the configuration that provides the maximum FLEX temperature. This is done to prolong engine life. The first degrees of flexible thrust have an impact on maintenance costs about 5 times higher than the last one.

The configuration that provides the maximum FLEX temperature varies with the runway length.

On short runways, CONF 3 usually provides the highest FLEX temperature, and the tail clearance at lift off does not depends on the configuration.

On medium or long runways, the second segment limitation becomes the limiting factor, and CONF 2 or CONF 1+F becomes the optimum configuration, in term of FLEX temperature. In these cases, the tail clearance at lift off depends on the configuration. The highest flap configuration gives the highest tailstrike margin.

**TAKEOFF TRIM SETTING**

The main purpose of the pitch trim setting for take-off is to provide consistent rotation characteristics. Take-off pitch trim is set manually via the pitch trim wheel.

The aircraft performs a safe takeoff, provided the pitch trim setting is within the green band on the pitch trim wheel.

However, the pitch trim setting significantly affects the aircraft behaviour during rotation:

. With a forward CG and the pitch trim set to the nose-down limit the pilots will feel an aircraft "heavy to rotate" and aircraft rotation will be very slow in response to the normal take off stick displacement.

. With an aft CG and the pitch trim set to the nose-up limit the pilots will most probably have to counteract an early autorotation until VR is reached.

In either case the pilot may have to modify his normal control input in order to achieve the desired rotation rate, but should be cautious not to overreact.

**CROSSWIND TAKEOFF**

It is said in the TAKEOFF ROLL paragraph that care should be taken to avoid using large deflection, resulting in excessive spoiler deployment. A direct effect of the reduction in lift due to the extension of the spoilers on one wing will be a reduction in tail clearance and an increased risk of tailstrike.

**OLEO INFLATION**

The correct extension of the main landing gear shock absorber (and thus the nominal increase in tail clearance during the rotation) relies on the correct inflation of the oleos.

**ACTION IN CASE OF TAILSTRIKE**

If a tailstrike occurs at take-off, flight at attitude requiring a pressurized cabin must be avoided and a return to the originating airport should be performed for damage assessment.

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036-2050 2052-2058 2060-2070 2072-2080 2082-2099 2101-2108 2110-2217 2219-2275 2277-2316 2318-2327 2329-2332 2334-2343 2345-2349 2351-2357 2359-2366 2368-2376 2378-2393 2395-2522 2524-2543 2545-2551 2553-2574 2576-2581 2583-2600 2602-2685 2687-2749 2751-2909 2911-2917 2919-2930 2932-2950 2952-2954 2956-2966 2968-2971 2973-3000 3002-3008 3010-3029 3031-3037 3039-3061 3063-3091 3093-3099 3101-3109 3111-3162 3164-3213 3215 3217 3222 3226-3235 3241-3260

## MAXIMUM DEMONSTRATED CROSSWIND FOR TAKE-OFF

| Reported braking action | Reported runway friction coefficient | Maximum demonstrated crosswind for takeoff | Equivalent runway condition |
|---|---|---|---|
| Good | $\geq$0.4 | 29 kt | Dry, damp, wet |

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

## MAXIMUM DEMONSTRATED CROSSWIND FOR TAKE-OFF

| Reported braking action | Reported runway friction coefficient | Maximum demonstrated crosswind for takeoff | Equivalent runway condition |
|---|---|---|---|
| Good | $\geq$0.4 | 39 kt(Gust included) | Dry, damp, wet |

ALL

## AP ENGAGEMENT

The AP can be engaged 5 seconds after take-off and above 100ft RA.

## VERTICAL PROFILE

MSN 0022-0030 0035 0037-0038 0043 0052-0055 0059 0064-0065 0068 0073 0084 0091 0098-0099 0113-0114 0119 0122-0124 0126-0127 0140-0142 0149-0150 0154 0157 0159 0174-0175 0180 0183 0205 0210 0221-0222 0229 0231-0233 0242 0248 0252-0256 0259-0261 0265 0275-0277 0279 0283-0284 0290 0294-0296 0299 0301-0302 0305 0309-0311 0316 0320-0321 0324 0330 0333 0341-0342 0348-0350 0353 0359 0361-0363 0368-0371 0376 0378-0379 0384 0386 0389-0392 0398 0402-0405 0426 0511

SRS engages when the thrust levers are set to the applicable detent for take-off and will remain engaged until the acceleration altitude. The SRS pitch command is the minimum of the following pitches:

. Pitch required to fly V2 +10 in All Engine Operative case (AEO)

. Pitch required to fly IAS at the time of failure (with minimum of V2 and maximum of V2+15) in One Engine Inoperative case (OEI)

. Maximum pitch attitude of 18°

. Pitch required to climb a 120ft/mn minimum vertical speed.

This explains why, in many take-off, the IAS which is actually flown is neither V2+10 (AEO) nor V2 (OEI).

MSN 0002-0021 0031-0034 0036 0039-0042 0044-0051 0056-0058 0061-0063 0066-0067 0069-0072 0074-0083 0085-0090 0093-0097 0100-0112 0115-0118 0120-0121 0125 0128-0139 0143-0148 0151-0153 0155-0156 0158 0160-0173 0176-0179 0181-0182 0184-0204 0206-0209 0211-0220 0223-0228 0230 0234-0241 0243-0247 0249-0251 0257-0258 0262-0264 0266-0274 0278 0280-0282 0285-0289 0291-0293 0297-0298 0300 0303-0304 0306-0308 0312-0315 0317-0319 0322-0323 0325-0329 0331-0332 0334-0340 0343-0347 0351-0352 0354-0358 0360 0364-0367 0372-0375 0377 0380-0383 0385 0387-0388 0393-0396 0399-0401 0406-0425 0427-0510 0512-3260

SRS engages when the thrust levers are set to the applicable detent for take-off and will remain engaged until the acceleration altitude. The SRS pitch command is the minimum of the following pitches:

. Pitch required to fly V2 +10 in All Engine Operative case (AEO)

. Pitch required to fly IAS at the time of failure (with minimum of V2 and maximum of V2+15) in One Engine Inoperative case (OEI)

. Maximum pitch attitude of 18° (22.5° in case of windshear)

. Pitch required to climb a 120ft/mn minimum vertical speed.

This explains why, in many take-off, the IAS which is actually flown is neither V2+10 (AEO) nor V2 (OEI).

## LATERAL PROFILE

ALL

Under most circumstances, the crew can expect to follow the programmed SID. In this case, NAV is armed on selecting the thrust levers to the applicable detent for take-off and engages once above 30 ft RA.

## THRUST REDUCTION ALTITUDE

ALL

At the thrust reduction altitude, "LVR CLB" flashes on the FMA. When hand flying, lower slightly the nose, as applicable, to anticipate the pitch down FD order. Bring the thrust levers back to CLB detent. The A/THR is now active (A/THR on the FMA changes from blue to white).

The FD pitch down order depends upon the amount of thrust decrease between TOGA or FLX and CLB.

If take-off was performed packs OFF, the packs will be selected back to ON after thrust reduction because of the potential resulting EGT increase. They will be preferably selected sequentially to improve passenger's comfort.

## ACCELERATION ALTITUDE

ALL

At the acceleration altitude, the FD pitch mode changes from SRS to CLB or OP CLB mode. The speed target jumps:

. Either to the managed target speed e.g. speed constraint, speed limit or ECON climb speed

. Or to the preselected climb speed (entered by the pilot on the MCDU PERF CLB page before takeoff).

If green dot speed is higher than the managed target speed (e.g. speed constraint 220 kt) displayed by the magenta triangle on the PFD speed scale, the AP/FD will guide the aircraft to green dot (as per the general managed speed guidance rule). If required by ATC, the crew will select the adequate target speed (below green dot) on the FCU.

During takeoff phase, F and S speeds are the minimum speeds for retracting the surfaces:

. At F speed, the aircraft accelerating (positive speed trend): retract to 1.

. At S speed, the aircraft accelerating (positive speed trend): retract to 0.

If the engine start selector had been selected to IGN START for take-off, the PNF should confirm with the PF when it may be deselected.

## TAKE-OFF AT HEAVY WEIGHT

ALL

If take-off is carried out at heavy weight, two protections intervene:

. The Automatic Retraction System (ARS)

. The Alpha Lock function

### THE AUTOMATIC RETRACTION SYSTEM

While in Conf 1+F and IAS reaches 210 kts (VFE CONF1+F is 215 kts), the ARS is activated. The ARS automatically retracts flaps to 0°. The VFE displayed on the PFD change from VFE CONF1+F to VFECONF 1. As the aircraft accelerates above S speed, the flap lever can be selected to 0. If IAS decreases below VFE CONF1+F, the flaps will not extend back to 1+F.

### THE ALPHA LOCK FUNCTION

The slats alpha/speed lock function will prevent slat retraction at high AOA or low speed at the moment the flap lever is moved from Flaps 1 to Flaps 0. "A.

LOCK" pulses above the E/WD Slat indication. The inhibition is removed and the slats retract when both alpha and speed fall within normal values. This is a normal situation for take-off at heavy weight. If Alpha lock function is triggered, the crew will continue the scheduled acceleration, allowing further slats retraction.

## IMMEDIATE TURN AFTER TAKE-OFF

ALL

Obstacle clearance, noise abatement, or departure procedures may require an immediate turn after take-off. Provided FD commands are followed accurately, the flaps and slats may be retracted using the normal procedure as FD orders provide bank angle limits with respect to speed and configuration.

## LOW ALTITUDE LEVEL-OFF

ALL

If the aircraft is required to level off below the acceleration altitude, ALT* engages and target speed goes to initial climb speed. The "LVR CLB" message flashes on the FMA. In this case, the crew should expect a faster than normal acceleration, and be prepared to retract the flaps and slats promptly.

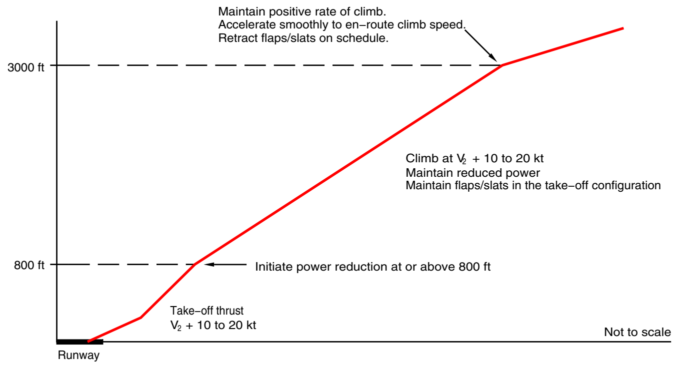
## NOISE ABATEMENT TAKE-OFF

ALL

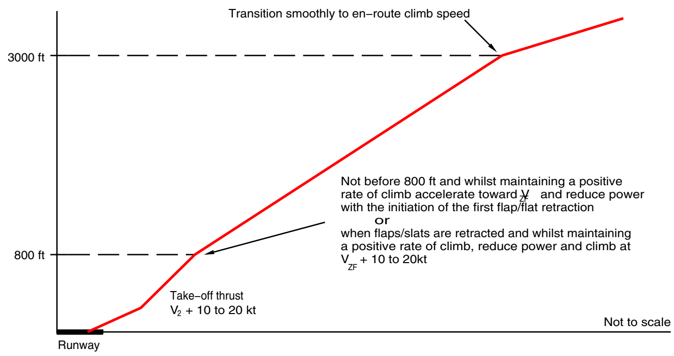
Noise Abatement Procedures will not be conducted in conditions of significant turbulence or windshear.

NOISE ABATEMENT PROCEDURE

Procedure NAPD 1 :
alleviating noise close to the aerodrome




Procedure NAPD 2 :
alleviating noise distant from the aerodrome




NOF 02050 00001 0001

## GENERAL

ALL

During the climb, the thrust levers are in the CL detent, the A/THR is active in thrust mode and the FADECs manage the thrust to a maximum value depending upon ambient conditions.

MSN 0002-0030 0033 0035-0039 0042-0068 0073-0077 0080-0082 0084-0085 0087-0091 0095-0103 0108-0109 0112-0115 0119-0120 0122-0124 0126-0134 0136 0138-0146 0148-0151 0154-0159 0163-0164 0167-0170 0173-0177 0179-0191 0193 0195-0196 0199 0203-0205 0207 0210-0212 0214-0215 0219-0257 0259-0261 0264-0266 0270 0274-0280 0283-0296 0299-0305 0308-0317 0320-0328 0330-0338 0341-0345 0347-0350 0352-0354 0356-0357 0359 0361-0365 0368-0371 0373-0379 0383-0386 0389-0398 0402-0407 0409 0411 0413-0416 0419-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0534 0537-0540 0542-0543 0546 0549-0552 0554-0558 0561 0565 0568-0573 0575 0579-0582 0584 0587 0589-0592 0594 0597 0601 0604-0607 0611 0613-0615 0617 0619-0620 0622 0624 0626 0628 0630-0634 0638-0639 0645-0646 0648-0650 0654-0656 0658-0659 0661-0662 0666-0667 0669-0672 0674-0675 0677-0678 0682-0685 0688 0691 0693 0695 0697 0702 0711 0714 0719 0721 0726 0728 0731-0732 0735-0736 0739-0740 0742-0743 0746 0751-0752 0756-0759 0762-0763 0769-0770 0772-0773 0775 0779-0781 0784-0785 0787 0791-0792 0794-0795 0799-0800 0802-0803 0805 0808 0811-0814 0816-0817 0820 0822-0824 0826 0828-0829 0831 0834 0836 0839-0840 0842 0845 0851-0852 0856-0857 0865-0866 0869 0877 0880 0888 0963 1008 1042 1204 1227

## AP/FD CLIMB MODES

The AP/FD climb modes may be either

. Managed

. Selected

### MANAGED

The managed AP/FD mode in climb is CLB. Its use is recommended as long as the aircraft is cleared along the F-PLN.

### SELECTED

The selected AP/FD modes in climb are OP CLB, V/S and EXPED (if installed).

OP CLB is to be used if ATC gives radar vector or clears the aircraft direct to a given FL without any climb constraints.

The use of low values of V/S, e.g. less than 1000 fpm, may be appropriate for small altitude changes as it makes the guidance smoother and needs less thrust variation.

In areas of high traffic density, low values of vertical speed will reduce the possibility of nuisance TCAS warnings.

If the crew selects a high V/S, it may happen that the aircraft is unable to climb with this high V/S and to maintain the target speed with Max Climb thrust, for performance reasons. In that case, the AP/FD will guide to the target V/S, and the A/THR will command up to Max Climb thrust, in order to try to keep the target speed; but the aircraft will decelerate and its speed might reach VLS. When VLS is reached the AP/FD reverts to OP CLB and the aircraft accelerate to initial target speed.

Whenever V/S is used, pilots should pay particular attention to the speed trend as V/S takes precedence over speed requirements.

The EXPED mode (if installed) is used to climb with maximum vertical gradient i.e. the target speed becomes green dot. Its use should be avoided above FL 250.

The crew should be aware that altitude constraints in the MCDU F-PLN page are observed only when the climb is managed, i.e. when CLB is displayed on the FMA. Any other vertical mode will disregard any altitude constraints.

A likely scenario would be, when the FCU altitude is set above an altitude constraint and the pilot selects V/S when below that constraint to avoid a potential TCAS TA. In this case, the aircraft will disregard the altitude constraint.

MSN 0031-0032 0034 0040-0041 0069-0072 0078 0083 0086 0093-0094 0104 0110-0111 0116-0118 0121 0125 0135 0137 0147 0152-0153 0160-0162 0165-0166 0171-0172 0178 0192 0194 0197-0198 0200-0202 0206 0208-0209 0213 0216-0218 0258 0262-0263 0267-0269 0272-0273 0281-0282 0297-0298 0306-0307 0318-0319 0329 0339-0340 0346 0351 0355 0358 0360 0366-0367 0372 0380-0382 0387-0388 0399-0401 0408 0410 0412 0417-0418 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0502 0505 0513-0520 0522 0524 0526 0532-0533 0535 0541 0545 0548 0553 0559-0560 0562-0564 0566-0567 0574 0576-0578 0583 0585-0586 0588 0593 0595-0596 0599 0603 0609-0610 0612 0616 0621 0623 0627 0629 0635-0636 0640-0643 0651-0653 0657 0663-0665 0668 0673 0676 0679-0681 0686-0687 0689-0690 0692 0694 0696 0698-0701 0703-0710 0712-0713 0715-0718 0720 0722-0725 0727 0729-0730 0733-0734 0737-0738 0741 0744-0745 0747-0750 0753-0755 0760-0761 0764-0768 0771 0774 0776 0778 0782-0783 0786 0788-0790 0793 0797-0798 0801 0804 0806-0807 0809-0810 0815 0818-0819 0821 0825 0827 0830 0832-0833 0835 0837-0838 0841 0843-0844 0846-0850 0853-0855 0858-0864 0867-0868 0870-0876 0878-0879 0881-0887 0889-0937 0939-0962 0964-0984 0986-0997 0999 1001-1007 1009-1019 1021-1024 1026-1035 1037-1041 1043-1132 1134-1136 1138-1149 1152-1188 1191-1200 1202-1203 1205-1215 1217-1226 1228-1266 1268-1270 1272-1298 1300-1343 1345-1386 1388-1403 1405-1414 1416-1443 1445-1448 1450-1457 1459-1470 1472-1475 1477 1479-1501 1503-1504 1506-1523 1525-1598 1600-1615 1617-1621 1623-1639 1641-1644 1646-1657 1659 1661-1676 1678-1690 1692-1698 1700-1732 1734-1793 1795-1858 1860-1872 1874-1877 1880-1884 1886-1893 1895-1899 1901-1923 1925-1927 1929-1937 1940-1948 1950-1951 1954-1955 1957-1966 1968-1976 1978-1990 1993-2014 2016 2018 2020 2022 2024 2027 2029 2031 2034 2036 2038 2040 2042 2044 2046 2048-2049 2054 2056 2058 2061 2063 2065 2068 2070 2073 2075 2104 2137 2143 2157 2225 2242 2248 2252 2311 2381 2391 2472 2488 2563 2599

## AP/FD CLIMB MODES

The AP/FD climb modes may be either

. Managed

. Selected

### MANAGED

The managed AP/FD mode in climb is CLB. Its use is recommended as long as the aircraft is cleared along the F-PLN.

### SELECTED

The selected AP/FD modes in climb are OP CLB, V/S and EXPED (if installed).

OP CLB is to be used if ATC gives radar vector or clears the aircraft direct to a given FL without any climb constraints.

The use of low values of V/S, e.g. less than 1000 fpm, may be appropriate for small altitude changes as it makes the guidance smoother and needs less thrust variation.

In areas of high traffic density, low values of vertical speed will reduce the possibility of nuisance TCAS warnings.

If the crew selects a high V/S, it may happen that the aircraft is unable to climb with this high V/S and to maintain the target speed with Max Climb thrust, for performance reasons. In that case, the AP/FD will guide to the target V/S, and the A/THR will command up to Max Climb thrust, in order to try to keep the target speed; but the aircraft will decelerate and its speed might reach VLS. When VLS is reached the AP will pitch the aircraft down so as to fly a V/S, which allows maintaining VLS.

Whenever V/S is used, pilots should pay particular attention to the speed trend as V/S takes precedence over speed requirements.

The EXPED mode (if installed) is used to climb with maximum vertical gradient i.e. the target speed becomes green dot. Its use should be avoided above FL 250.

The crew should be aware that altitude constraints in the MCDU F-PLN page are observed only when the climb is managed, i.e. when CLB is displayed on the FMA. Any other vertical mode will disregard any altitude constraints.

A likely scenario would be, when the FCU altitude is set above an altitude constraint and the pilot selects V/S when below that constraint to avoid a potential TCAS TA. In this case, the aircraft will disregard the altitude constraint.

MSN 0498 0509 0521 0529 0544 0598 0600 0608 0618 0625 0637 0644 0647 0660 0777 0796 0938 0985 0998 1000 1020 1025 1036 1133 1137 1150-1151 1189-1190 1201 1216 1267 1271 1299 1344 1387 1404 1415 1444 1449 1458 1471 1476 1478 1502 1505 1524 1599 1616 1622 1640 1645 1658 1660 1677 1691 1699 1733 1794 1859 1873 1878-1879 1885 1894 1900 1924 1928 1938-1939 1949 1952-1953 1956 1967 1977 1991 2015 2017 2019 2021 2023 2026 2028 2030 2032-2033 2035 2037 2039 2041 2043 2045 2047 2050-2053 2055 2057 2059-2060 2062 2064 2066-2067 2069 2071-2072 2074 2076-2103 2105-2136 2138-2142 2144-2156 2158-2224 2226-2241 2243-2247 2249-2251 2253-2310 2312-2380 2382-2390 2392-2471 2473-2487 2489-2562 2564-2598 2600-3260

## AP/FD CLIMB MODES

The AP/FD climb modes may be either

. Managed

. Selected

### MANAGED

The managed AP/FD mode in climb is CLB. Its use is recommended as long as the aircraft is cleared along the F-PLN.

## SELECTED

The selected AP/FD modes in climb are OP CLB, V/S and EXPED (if installed).

OP CLB is to be used if ATC gives radar vector or clears the aircraft direct to a given FL without any climb constraints.

The use of low values of V/S, e.g. less than 1000 fpm, may be appropriate for small altitude changes as it makes the guidance smoother and needs less thrust variation.

In areas of high traffic density, low values of vertical speed will reduce the possibility of nuisance TCAS warnings.

If the crew selects a high V/S, it may happen that the aircraft is unable to climb with this high V/S and to maintain the target speed with Max Climb thrust, for performance reasons. In that case, the AP/FD will guide to the target V/S, and the A/THR will command up to Max Climb thrust, in order to try to keep the target speed; but the aircraft will decelerate and its speed might reach VLS. When VLS is reached the AP will pitch the aircraft down so as to fly a V/S, which allows maintaining VLS. A triple click is generated.

Whenever V/S is used, pilots should pay particular attention to the speed trend as V/S takes precedence over speed requirements.

The EXPED mode (if installed) is used to climb with maximum vertical gradient i.e. the target speed becomes green dot. Its use should be avoided above FL 250.

The crew should be aware that altitude constraints in the MCDU F-PLN page are observed only when the climb is managed, i.e. when CLB is displayed on the FMA. Any other vertical mode will disregard any altitude constraints.

A likely scenario would be, when the FCU altitude is set above an altitude constraint and the pilot selects V/S when below that constraint to avoid a potential TCAS TA. In this case, the aircraft will disregard the altitude constraint.

## SPEED CONSIDERATIONS

ALL

The climb speed may be either:

. Managed

. Selected

**MANAGED**

The managed climb speed, computed by the FMGS, provides the most economical climb profile as it takes into account weight, actual and predicted winds, ISA deviation and Cost Index (CI). The managed climb speed also takes into account any speed constraints, e.g. the default speed limit which is 250 kts up to 10000 ft.

**SELECTED**

If necessary, the climb speed can be either pre-selected on ground prior to take-off on the MCDU PERF CLIMB page or selected on the FCU as required.

On ground, prior take-off, speed target at acceleration altitude can be pre-selected on the MCDU PERF CLIMB page. It is to be used when the F-PLN has a sharp turn after take-off, when high angle of climb is required or for ATC clearance compliance.

Once airborne, the speed can be selected on FCU to achieve the maximum rate of climb or the maximum gradient of climb.

The speed to achieve the maximum rate of climb, i.e. to reach a given altitude in the shortest time, lies between ECON climb speed and green dot. As there is no indication of this speed on the PFD, a good rule of thumb is to use turbulence speed to achieve maximum rate.

The speed to achieve the maximum gradient of climb, i.e. to reach a given altitude in a shortest distance, is green dot. The MCDU PERF CLB page displays the time and distance required to achieve the selected altitude by climbing at green dot speed. Avoid reducing to green dot at high altitude, particularly at heavy weight, as it can take a long time to accelerate to ECON mach.

Pilots should be aware that it is possible to select and fly a speed below green dot but there would be no operational benefit in doing this.

When selected speed is used, the predictions on the F-PLN page assume the selected speed is kept till the next planned speed modification, e.g. 250 kts /10.000 ft, where managed speed is supposed to be resumed. Consequently, the FM predictions remain meaningful.

When IAS is selected in lower altitude, there is an automatic change to Mach at a specific crossover altitude.

Finally, as selected speed does not provide the optimum climb profile, it should only be used when operationally required, e.g. ATC constraint or weather.

## VERTICAL PERFORMANCE PREDICTIONS

ALL

The MCDU PROG page provides the crew with the MAX REC ALT and with the OPT ALT information (See cruise section). This information is to be used to rapidly answer to ATC: "CAN YOU CLIMB TO FL XXX?"

The MCDU PERF CLB page provides predictions to a given FL in terms of time and distance assuming CLB mode. This FL is defaulted to the FCU target altitude or it may be manually inserted. The level arrow on the ND assumes the current AP engaged mode. This information is to be used to rapidly answer to ATC: "CAN YOU MAKE FL XXX by ZZZ waypoint?". The crew will use a PD, i.e. ZZZ,-10 waypoint if the question is "CAN YOU MAKE FL XXX , 10 NM before ZZZ point?"

## LATERAL NAVIGATION

ALL

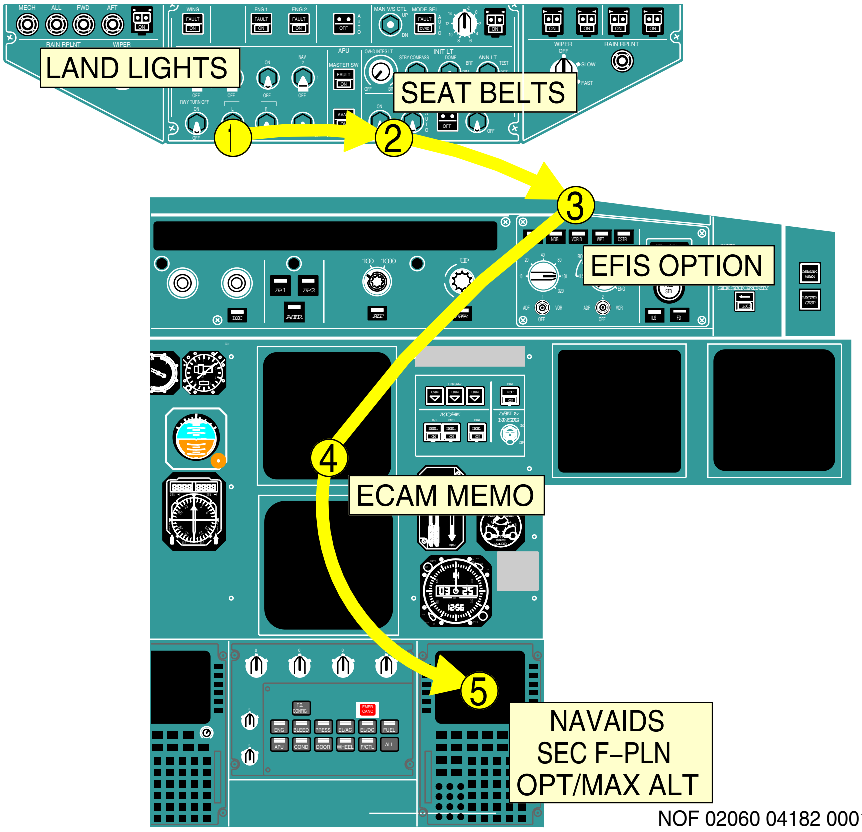
If the aircraft is following the programmed SID, the AP/FD should be in NAV. If ATC vectors the aircraft, HDG will be used until a time when clearance is given to either resume the SID or track direct to a specific waypoint. In either case, the crew must ensure that the waypoints are properly sequenced.

The crew should keep in mind that the use of HDG mode e.g. following ATC radar vectors, will revert CLB to OP CLB and any altitude constraints in the MCDU F-PLN page will not be observed unless they are selected on the FCU.

## 10.000 FT FLOW PATTERN

ALL

10.000 FT FLOW PATTERN




NOF 02060 04182 0001

EFIS Option:

The PF will select CSTR for grid MORA

The PNF will select ARPT

## PREFACE

MSN 0035 0037-0038 0043 0045-0058 0064-0067 0074-0077 0080-0082 0089-0091 0095-0099 0113-0114 0163-0166 0168-0169 0178-0182 0189-0190 0193-0195 0198 0221-0222 0225 0230 0232 0243 0247 0249-0252 0256-0257 0259-0261 0275-0276 0280 0289 0291-0292 0294-0296 0299 0301 0304 0308 0314 0316-0317 0320-0322 0326-0327 0332 0334-0336 0338 0343 0347 0349 0351 0353-0354 0357 0361-0363 0366 0368-0369 0371 0373 0376 0379 0386 0389 0391-0394 0396-0398 0405-0406 0411 0414-0416 0422-0425 0428-0432 0437 0440-0441 0443-0444 0446-0449 0451 0453 0455 0460-0461 0467 0469 0471 0476 0478 0480

Once the cruise flight level displayed on the MCDU PROG page is reached, the cruise Mach number is targeted and cruise fuel consumption is optimized.

MSN 0002-0034 0036 0039-0042 0044 0059-0063 0068-0073 0078 0083-0088 0093-0094 0100-0112 0115-0162 0167 0170-0177 0183-0188 0191-0192 0196-0197 0199-0220 0223-0224 0226-0229 0231 0233-0242 0244-0246 0248 0253-0255 0258 0262-0274 0277-0279 0281-0288 0290 0293 0297-0298 0300 0302-0303 0305-0307 0309-0313 0315 0318-0319 0323-0325 0328-0331 0333 0337 0339-0342 0344-0346 0348 0350 0352 0355-0356 0358-0360 0364-0365 0367 0370 0372 0375 0377-0378 0380-0385 0387-0388 0390 0395 0399-0404 0407-0410 0412-0413 0417-0421 0426-0427 0434-0436 0438-0439 0442 0445 0450 0452 0454 0456-0459 0462-0466 0468 0470 0472-0475 0477 0479 0482-3260

Once the cruise flight level is reached, "ALT CRZ" is displayed on the FMA. The cruise Mach number is targeted and cruise fuel consumption is optimized.

## FMS USE

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892 1902 1987 2058 2104 2115 2143 2252

## CRUISE FL

If the aircraft is cleared to a lower cruise flight level than the pre-planned cruise flight level displayed on MCDU PROG page, the cruise Mach number will not be targeted. The crew will update the MCDU PROG page accordingly.

When at cruise FL, the AP altitude control is soft. This means that the AP will allow small altitude variation around the cruise altitude (typically ± 50 ft) to keep cruise Mach before a readjustment of thrust occurs. This optimizes the fuel consumption in cruise.

## WIND AND TEMPERATURE

When reaching cruise FL, the crew will ensure that the wind and temperatures are correctly entered and the lateral and vertical F-PLN reflect the CFP. Wind entries should be made at waypoints when there is a difference of either 30° or

30 kt for the wind data and 5 °C for temperature deviation. This will ensure that the FMS fuel and time predictions are as accurate as possible.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-1901 1903-1986 1988-2057 2059-2103 2105-2114 2116-2142 2144-2251 2253-3260

## CRUISE FL

If the aircraft is cleared to a lower cruise flight level than the pre-planned cruise flight level displayed on MCDU PROG page, the cruise Mach number will not be targeted. The crew will update the MCDU PROG page accordingly.

When at cruise FL, the AP altitude control is soft. This means that the AP will allow small altitude variation around the cruise altitude (typically ± 50 ft) to keep cruise Mach before a readjustment of thrust occurs. This optimizes the fuel consumption in cruise.

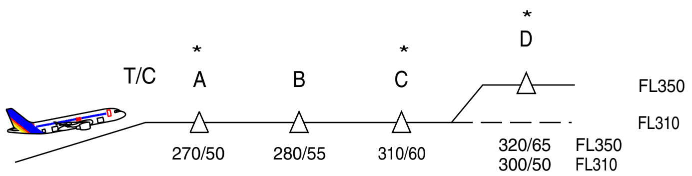
## WIND AND TEMPERATURE

When reaching cruise FL, the crew will ensure that the wind and temperatures are correctly entered and the lateral and vertical F-PLN reflect the CFP. Wind entries should be made at waypoints when there is a difference of either 30° or 30 kt for the wind data and 5°C for temperature deviation. These entries should be made for as many levels as possible to reflect the actual wind and temperature profile. This will ensure that the FMS fuel and time predictions are as accurate as possible and provide an accurate OPT FL computation.

**STEP CLIMB**

If there is a STEP in the F-PLN, the crew will ensure that the wind is properly set at the first waypoint beyond the step (D on the following example) at both initial FL and step FL.

GRAPHIC SOLUTION TITLE




* are the points where an entry shall be done.

NOF 02070 04189 0001

If at D waypoint, the CFP provides the wind at FL350 but not at FL310, it is recommended to insert the same wind at FL310 as the one at FL350. This is due to wind propagation rules, which might affect the optimum FL computation.

**ETP**

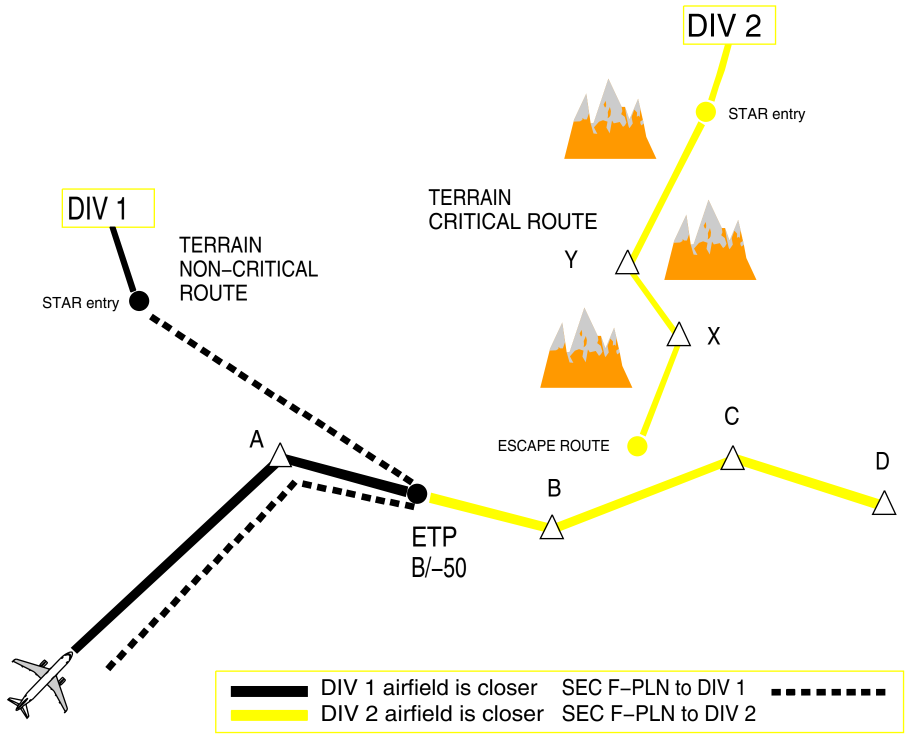
ETP function should be used to assist the crew in making a decision should an en-route diversion be required. Suitable airport pairs should be entered on the ETP page and the FMS will then calculate the ETP. Each time an ETP is sequenced, the crew should insert the next suitable diversion airfield.

The SEC F-PLN is a useful tool and should be used practically. The ETP should be inserted in the SEC F-PLN as a PD (Place/Distance) and the route to diversion airfield should be finalized. By programming a potential en-route diversion, the crew would reduce their workload should a failure occur. This is particularly true when terrain considerations apply to the intended diversion route. When an ETP is sequenced, the crew will

. Access to the ETP page

. Insert the next applicable diversion airfield with associated wind
. Read new ETP
. Insert new ETP as a PD
. Copy active on the SEC F-PLN
. Insert the new diversion as New Dest in the SEC F-PLN from new ETP

GRAPHIC SOLUTION TITLE




NOF 02070 04190 0001

The DATA/Stored Routes function in the MCDU can be used to store up to five possible diversion routes. These routes can be entered into the SEC F-PLN using the SEC INIT prompt. This prompt will only be available if the SEC F-PLN is deleted. See FCOM 4.04.30 for further information.

## CLOSEST AIRPORT

For diversion purpose, the crew can also use the CLOSEST AIRPORT page which provides valuable fuel/time estimates to the four closest airports from the aircraft position, as well as to an airport the crew may define. The fuel and time predictions are a function of the average wind between the aircraft and the airport.

## FMS USE: MISCELLANEOUS

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892

If ATC modifies the routing, the crew will revise the F-PLN. Once achieved and if printer is installed, the crew may perform a new F-PLN print.

If there is weather, the crew will use the OFFSET function which can be accessed from a lateral revision at PPOS. The crew will determine how many

NM are required to avoid the weather. Once cleared by ATC, the crew will insert the offset.

MSN 0143 0173 0240-0241 0264 0312 0323 0910 0913 0941 0961 0976 1002 1010 1021 1027 1047 1053 1059 1066-1067 1073 1080 1087 1092 1096 1099 1101 1103 1107 1113 1119 1123 1125 1130 1132 1137 1139-1140 1143 1150 1152 1156-1159 1161-1162 1173 1179 1184-1185 1188-1189 1195 1198 1200 1208 1212-1214 1219 1233 1235 1238 1240-1242 1244 1246 1250-1251 1253 1256-1257 1259-1260 1270 1273 1276 1280 1285 1300 1302-1304 1306 1308-1309 1318 1320 1322 1327 1332-1335 1337 1339 1349 1351-1353 1355 1364-1368 1374 1376-1377 1385-1387 1390 1394 1398 1400 1405 1408 1411 1429 1438 1441 1443 1446 1451-1452 1458 1464 1467-1468 1470 1478 1482 1485-1486 1491 1493 1497 1503-1504 1506 1509 1512 1516 1518 1523 1526 1528 1540-1541 1544 1546 1548 1551 1553 1556-1557 1562 1564 1568 1571 1575 1577-1578 1580 1587-1589 1591-1593 1595-1599 1601-1603 1605 1607-1608 1610-1615 1618-1619 1623-1626 1628-1632 1634 1637-1638 1642 1650 1652 1657 1663 1668 1672-1673 1675-1676 1678 1682 1686 1695 1703 1705-1707 1712 1717-1721 1725-1727 1730 1735 1739 1742 1747-1751 1753 1756-1757 1762-1763 1765 1767 1769 1771-1772 1775-1778 1780 1783-1788 1791 1794-1795 1797-1798 1801-1802 1804-1808 1811 1817-1818 1823 1825-1827 1831-1832 1835 1837-1838 1843 1846 1848-1849 1852-1858 1860-1862 1864 1866-1868 1872 1874 1877-1878 1880-1882 1884 1886-1889 1891 1896 1898 1901-1906 1908-1909 1911 1913-1917 1920-1921 1925 1927 1929-1934 1936-1937 1940-1942 1944-1948 1950-1956 1960-1961 1963-1968 1970-1975 1977-1979 1981 1983-1989 1994-1995 1998-2001 2003-2009 2011 2014-2015 2018 2020-2022 2024 2027 2031 2034 2036-2037 2042-2044 2046 2048-2050 2052-2056 2058 2060-2063 2065-2069 2072 2075 2078 2080 2084-2085 2089-2091 2093 2096 2099 2102 2104-2106 2108 2112 2114-2120 2123-2126 2128-2134 2136 2141 2143-2155 2159-2160 2162-2163 2165 2167-2185 2187 2191-2192 2196-2197 2199-2203 2205-2206 2208 2210 2212 2214-2215 2217 2219-2225 2227 2229-2235 2237-2239 2242-2246 2248-2252 2256-2257 2259 2262-2266 2268-2275 2280-2286 2289 2292-2295 2297-2301 2304 2307-2309 2311 2314-2316 2319 2321-2322 2325-2330 2333-2334 2336-2339 2342-2343 2345 2347 2352-2358 2360-2361 2364-2365 2367-2368 2370-2372 2374-2375 2377-2381 2384-2388 2391 2393-2395 2398-2399 2401-2403 2407-2409 2411-2413 2415-2416 2418-2421 2423-2424 2426-2428 2432-2440 2442-2447 2449-2451 2453-2455 2457 2460-2461 2463 2469-2473 2475-2479 2481 2484-2496 2498-2508 2511-2516 2519-2523 2525-2528 2530-2533 2535 2537-2538 2540-2556 2558-2560 2562-2563 2565 2567 2569 2571-2580 2583-2592 2594 2596 2598-2600 2602-2606 2608-2610 2614 2616 2620-2623 2625-2628 2634-2638 2640 2642-2643 2646-2647 2649-2652 2657-2659 2661 2663-2664 2666-2667 2670-2671 2673-2675 2677-2681 2687-2689 2691-2693 2695 2698 2701-2704 2706 2708-2711 2713-2715 2717-2719 2723-2725 2727-2730 2734-2737 2740-2745 2748 2752 2754-2759 2761 2765-2767 2769-2773 2776-2798 2800-2805 2807 2809-2812 2814-2815 2817-2819 2821-2825 2827 2829-2832 2834 2837-2839 2843 2845 2847-2848 2850-2852 2854-2856 2858-2862 2864 2866 2868
MSN 2870-2873 2875-2877 2880 2884 2886-2890 2892-2894 2896-2901 2903-2904 2906 2912 2915-2917 2919-2921 2923-2924 2927-2929 2933-2934 2936 2940-2942 2945-2950 2952-2953 2957 2959-2960 2962-2963 2965 2969-2971 2977-2979 2982-2984 2986-2988 2992-2994 2996 2998-2999 3002-3003 3007 3010 3015-3017 3020 3025-3026 3029 3031-3032 3034-3037 3039-3043 3045 3047-3048 3052-3054 3057-3061 3063 3067 3069 3072-3073 3075 3077-3078 3082-3085 3088-3091 3094-3095 3097 3099 3101-3103 3105 3109 3111-3113 3118-3120 3122-3123 3125-3127 3129 3133-3137 3141-3145 3147-3148 3150-3152 3155-3157 3165-3166 3168-3169 3174-3177 3179-3181 3184-3186 3189-3191 3195 3200 3203-3204 3207-3209 3215 3217 3222 3226-3231 3238-3260

If ATC requires for a position report, the crew will use the REPORT page which can be accessed from PROG page.

If ATC modifies the routing, the crew will revise the F-PLN. Once achieved and if printer is installed, the crew may perform a new F-PLN print.
ATC requires a report on a given radial, the crew will use the FIX INFO page which can be accessed from a lateral revision on F-PLN page at PPOS.

If ATC requires a report at a given time, the crew will insert a time marker pseudo waypoint.

If there is weather, the crew will use the OFFSET function which can be accessed from a lateral revision at PPOS. The crew will determine how many NM are required to avoid the weather. Once cleared by ATC, the crew will insert the offset.

If ATC gives a DIR TO clearance to a waypoint far from present position, the crew will use the ABEAM facility. This facility allows both a better crew orientation and the previously entered winds to be still considered.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0144-0145 0152-0153 0155-0156 0160 0165-0166 0171 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0239 0244 0262-0263 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0317-0319 0322 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0911 0923 0938 0958 0962 0964 0975 0981 0985 0988 0994 0996 0998 1000 1011 1020 1025 1036-1037 1048 1058 1062 1071 1078 1082 1090-1091 1102 1115 1118 1121 1126 1129 1131 1133-1134 1142 1148-1149 1151 1164 1167 1169 1172 1175-1176 1187 1190-1191 1193 1197 1201 1215-1216 1222 1225 1230 1232 1236 1239 1249 1258 1261 1265 1267 1271 1279 1283 1294-1295 1299 1305 1311 1314 1319 1324-1325 1329 1338 1344 1346 1360 1380 1382 1384 1391-1393 1404 1406 1410 1414-1415 1419 1423 1428 1433-1434 1436 1440 1444-1445 1449 1453 1456 1463 1466 1471 1476 1479 1481 1483 1488 1490 1494 1498 1500-1502 1505 1510 1513 1515 1519-1521 1524 1527 1529 1534-1535 1537 1543 1547 1549 1552 1558 1560 1563 1565-1567 1570 1574 1576 1579 1582-1583 1590 1594 1604 1606 1616 1621-1622 1633 1640-1641 1643-1646 1648 1656 1658-1662 1665 1677 1683-1685 1687 1689-1691 1693 1696 1699-1700 1708-1711 1714-1715 1722-1724 1733 1738 1740 1743-1746 1752 1754 1758-1761 1764 1766 1770 1773-1774 1779 1781-1782 1789-1790 1792 1796 1800 1803 1810 1812-1815 1819-1820 1824 1828-1829 1833 1839 1841 1844 1850-1851 1859 1863 1869-1871 1873 1875-1876 1879 1883 1885 1890 1893-1895 1897 1899-1900 1907 1910 1912 1918 1922-1924 1926 1928 1935 1938-1939 1943 1949 1957-1959 1962 1969 1976 1980 1982 1990-1993 1996-1997 2002 2010 2012-2013 2016-2017 2019 2023 2026 2028-2030 2032-2033 2035 2038-2041 2045 2047 2051 2057 2059 2064 2070-2071 2073-2074 2076-2077 2079 2081-2083 2086-2088 2092 2094-2095 2097-2098 2100-2101 2103 2107 2109-2110 2113 2121-2122 2127 2135 2137-2140 2142 2156-2158 2161 2164 2166 2186 2188-2190 2193-2195 2198 2204 2207 2209 2211 2213 2216 2218 2226 2228 2236 2240-2241 2247 2253-2255 2258 2260-2261 2267 2276-2279 2287-2288 2290-2291 2296 2302-2303 2305-2306 2310 2312-2313 2317-2318 2320 2323-2324 2331-2332 2335 2340-2341 2344 2346 2348-2351 2359 2362-2363 2366 2369 2373 2376 2382-2383 2389-2390 2392 2396-2397 2400 2404-2406 2410 2414 2417 2422 2425 2429-2431 2441 2448 2452 2456 2458-2459 2462 2464-2468 2474 2480 2482-2483 2497 2509-2510 2517-2518 2524 2529 2534 2536 2539 2557 2561 2564 2566 2568 2570 2581-2582 2593 2595 2597 2601 2607 2611-2613 2615 2617-2619 2624 2629-2633 2639 2641 2644-2645 2648 2653-2656 2660 2662 2665 2668-2669 2672 2676 2682-2686 2690 2694
MSN 2696-2697 2699-2700 2705 2707 2712 2716 2720-2721 2726 2731-2733 2738-2739 2746-2747 2749-2751 2753 2760 2762-2764 2768 2774-2775 2799 2806 2808 2813 2816 2820 2826 2828 2833 2835-2836 2840-2842 2844 2846 2849 2853 2857 2863 2865 2867 2869 2874 2878-2879 2881-2883 2885 2891 2895 2902 2905 2907-2911 2913-2914 2918 2922 2925-2926 2930-2932 2935 2937-2939 2943-2944 2951 2954-2956 2958 2961 2964 2966-2968 2972-2976 2980-2981 2985 2989-2991 2995 2997 3000-3001 3004-3006 3008-3009 3011-3014 3018-3019 3021-3024 3027-3028 3030 3033 3038 3044 3046 3049-3051 3055-3056 3062 3064-3066 3068 3070-3071 3074 3076 3079-3081 3086-3087 3092-3093 3096 3098 3100 3104 3106-3108 3110 3114-3117 3121 3124 3128 3130-3132 3138-3140 3146 3149 3153-3154 3158-3164 3167 3170-3173 3178 3182-3183 3187-3188 3192-3194 3196-3199 3201-3202 3205-3206 3210-3214 3216 3220 3225 3233-3235

If ATC modifies the routing, the crew will revise the F-PLN. Once achieved and if printer is installed, the crew may perform a new F-PLN print.

If there is weather, the crew will use the OFFSET function which can be accessed from a lateral revision at PPOS. The crew will determine how many NM are required to avoid the weather. Once cleared by ATC, the crew will insert the offset.

If ATC gives a DIR TO clearance to a waypoint far from present position, the crew will use the ABEAM facility. This facility allows both a better crew orientation and the previously entered winds to be still considered.

## COST INDEX

ALL

The Cost Index (CI) is used to take into account the relationship between fuel and time related costs in order to minimize the trip cost. The CI is calculated by the airline for each sector. From an operational point of view, the CI affects the speeds (ECON SPEED/MACH) and cruise altitude (OPT ALT). CI=0 corresponds to maximum range whereas the CI=999 corresponds to minimum time.

The CI is a strategic parameter which applies to the whole flight. However, the CI can be modified by the crew in flight for valid strategic operational reasons. For example, if the crew needs to reduce the speed for the entire flight to comply with curfew requirements or fuel management requirements (XTRA gets close to 0), then it is appropriate to reduce the CI.

The SEC F-PLN can be used to check the predictions associated with new CI. If they are satisfactory, the crew will then modify the CI in the primary The SEC F-PLN can be used to check the predictions associated with new CI. If they are satisfactory, the crew will then modify the CI in the primary F-PLN. However, the crew should be aware that any modification of the CI would affect trip cost. However, the crew should be aware that any modification of the CI would affect trip cost.

## SPEED CONSIDERATIONS

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0086 0089-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0564 0566-0568 0570-0574 0576-0579 0581-0583 0585-0597 0599 0601-0607 0609-0617 0619-0623 0627 0629 0631-0636 0638-0643 0645-0646 0648-0658 0662-0666 0668-0676 0678-0679 0681-0685 0688-0689 0691-0695 0697 0699-0703 0707 0711 0713-0714 0716-0717 0719 0721 0723-0724 0726-0744 0746-0747 0749-0752 0754-0758 0760-0765 0767-0770 0772-0776 0779-0780 0782 0784-0785 0789-0791 0793-0795 0797 0799-0800 0802-0803 0805 0808-0809 0811-0817 0819-0824 0826-0829 0831 0833-0834 0836-0842 0845 0848 0851 0853-0854 0856-0857 0860 0865-0866 0870 0872 0874-0879 0883-0884 0886-0889 0891-0892 0894 0897 0899 0901-0902 0905-0906 0909 0912 0914-0921 0924-0928 0930-0933 0935 0937 0939-0940 0943 0945 0951 0953 0955-0957 0959-0960 0963 0967 0969 0971 0973 0977-0979 0982-0984 0986-0987 0991-0993 0999 1001 1003 1005 1007-1009 1013 1015-1016 1018 1023-1024 1029 1032 1034 1041-1043 1049-1050 1056 1063-1064 1072 1074-1076 1079 1083 1085 1088 1093 1098 1100 1106 1108 1110-1111 1116-1117 1120 1127 1144 1154 1165-1166 1178 1180-1181 1194 1196 1200 1202 1204 1206 1208 1221 1223 1227-1229 1231 1234 1247 1255 1262 1274 1281 1284 1288 1292 1307 1316 1318 1323 1345 1347 1350 1362 1373 1375 1379 1395-1397 1399 1422 1430 1454 1461 1484 1516 1530 1540 1550 1554 1561 1572 1635 1655 1674 1681 1694 1698 1713 1716 1736 1793 1809 1834 1836 1892 1902 1987 2058 2104 2115 2143 2220 2225 2242 2248 2252 2270 2347 2357 2381 2391 2472 2488 2563 2599

The cruise speed may be either:

. Managed

. Selected

## MANAGED

When the cruise altitude is reached, the A/THR operates in SPEED/MACH mode. The optimum cruise Mach number is automatically targeted. Its value depends on:

. CI

. Cruise flight level

. Temperature deviation

. Weight

. Headwind component.

The crew should be aware that the optimum Mach number will vary according to the above mentioned parameters, e.g. it will increase with an increasing headwind, e.g. + 50kt head wind equates to + 0.01 Mach.

**SELECTED**

Should ATC require a specific cruise speed or turbulence penetration is required, the pilot must select the cruise speed on the FCU. FMS predictions are updated accordingly until reaching either the next step climb or top of descent, where the programmed speeds apply again. The FMS predictions are therefore realistic.

At high altitude, the speed should not be reduced below GREEN DOT as this may create a situation where it is impossible to maintain speed and/or altitude as the increased drag may exceed the available thrust.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0087-0088 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0565 0569 0575 0580 0584 0598 0600 0608 0618 0624-0626 0628 0630 0637 0644 0647 0659-0661 0667 0677 0680 0686-0687 0690 0696 0698 0704-0706 0709-0710 0712 0715 0718 0720 0722 0725 0745 0748 0753 0759 0766 0771 0777-0778 0781 0783 0786-0788 0792 0796 0798 0801 0804 0806-0807 0810 0818 0825 0830 0832 0835 0843-0844 0846-0847 0849-0850 0852 0855 0858-0859 0861-0864 0867-0869 0871 0873 0880-0882 0885 0890 0893 0895-0896 0898 0900 0903-0904 0907-0908 0910-0911 0913 0922-0923 0929 0934 0936 0938 0941-0942 0944 0946-0950 0952 0954 0958 0961-0962 0964-0966 0968 0970 0972 0974-0976 0980-0981 0985 0988-0990 0994-0998 1000 1002 1004 1006 1010-1012 1014 1017 1019-1022 1025-1028 1030-1031 1033 1035-1040 1044-1048 1051-1055 1057-1062 1065-1071 1073 1077-1078 1080-1082 1084 1086-1087 1089-1092 1094-1097 1099 1101-1105 1107 1109 1112-1115 1118-1119 1121-1126 1128-1143 1145-1153 1155-1164 1167-1177 1179 1182-1193 1195 1197-1199 1201 1203 1205 1207 1209-1220 1222 1224-1226 1230 1232-1233 1235-1246 1248-1254 1256-1261 1263-1273 1275-1280 1282-1283 1285-1287 1289-1291 1293-1306 1308-1315 1317 1319-1322 1324-1344 1346 1348-1349 1351-1361 1363-1372 1374 1376-1378 1380-1394 1398 1400-1421 1423-1429 1431-1453 1455-1460 1462-1483 1485-1515 1517-1529 1531-1539 1541-1549 1551-1553 1555-1560 1562-1571 1573-1634 1636-1654 1656-1673 1675-1680 1682-1693 1695-1697 1699-1712 1714-1715 1717-1735 1737-1792 1794-1808 1810-1833 1835 1837-1891 1893-1901 1903-1986 1988-2057 2059-2103 2105-2114 2116-2142 2144-2219 2221-2224 2226-2241 2243-2247 2249-2251 2253-2269 2271-2346 2348-2356 2358-2380 2382-2390 2392-2471 2473-2487 2489-2562 2564-2598 2600-3260

The cruise speed may be either:

. Managed

. Selected

## MANAGED

When the cruise altitude is reached, the A/THR operates in SPEED/MACH mode. The optimum cruise Mach number is automatically targeted. Its value depends on:

- CI
- Cruise flight level
- Temperature deviation
- Weight
- Headwind component.

The crew should be aware that the optimum Mach number will vary according to the above mentioned parameters, e.g. it will increase with an increasing headwind, e.g. + 50kt head wind equates to + 0.01 Mach.

Should ATC require a specific time over a waypoint, the crew can perform a vertical revision on that waypoint and enter a time constraint. The managed Mach number would be modified accordingly to achieve this constraint. If the constraint can be met within a tolerance, a magenta asterix will be displayed on the MCDU; if the constraint cannot be met, an amber asterix will be displayed. Once the constrained waypoint is sequenced, the ECON Mach is resumed.

## SELECTED

Should ATC require a specific cruise speed or turbulence penetration is required, the pilot must select the cruise speed on the FCU. FMS predictions are updated accordingly until reaching either the next step climb or top of descent, where the programmed speeds apply again. The FMS predictions are therefore realistic.

At high altitude, the speed should not be reduced below GREEN DOT as this may create a situation where it is impossible to maintain speed and/or altitude as the increased drag may exceed the available thrust.

# ALTITUDE CONSIDERATIONS

ALL

The MCDU PROG page displays:

- REC MAX FL

. OPT FL.

**REC MAX FL**

REC MAX FL reflects the present engine and wing performance and does not take into account the cost aspect. It provides a 0.3g buffet margin. If the crew inserts a FL higher than REC MAX into the MCDU, it will be accepted only if it provides a buffet margin greater than 0.2g. Otherwise, it will be rejected and the message "CRZ ABOVE MAX FL" will appear on the MCDU scratchpad. Unless there are overriding operational considerations, e.g. either to accept a cruise FL higher than REC MAX or to be held significantly lower for a long period, REC MAX should be considered as the upper cruise limit.

**OPT FL**

OPT FL displayed on the MCDU is the cruise altitude for minimum cost when ECON MACH is flown and should be followed whenever possible. It is important to note that the OPT FL displayed on the PROG page is meaningful only if the wind and temperature profile has been accurately entered. The crew should be aware that flying at a level other than the OPT FL would adversely affect the trip cost.

For each Mach number, there will be a different OPT FL. Should an FMGS failure occur, the crew should refer to the FCOM or QRH to determine the OPT FL. FCOM and QRH charts are only provided for two different Mach numbers.

## STEP CLIMB

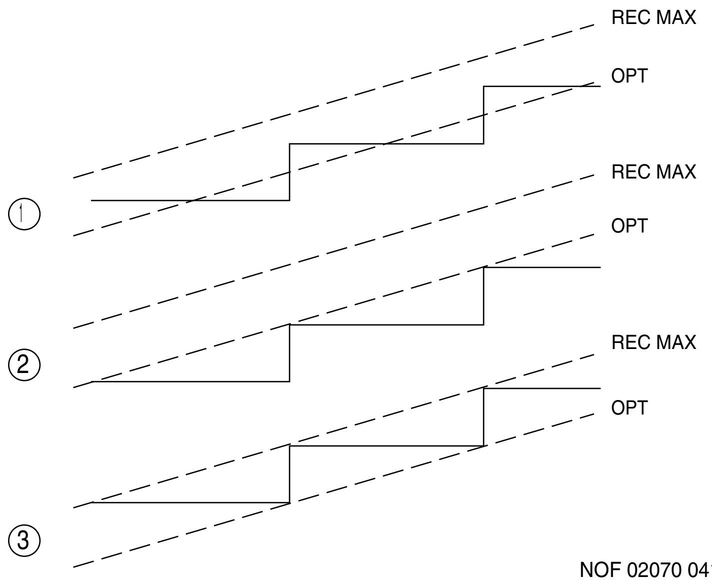
MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892

Since the optimum altitude increases as fuel is consumed during the flight, from a cost point of view, it is preferable to climb to a higher cruise altitude when the aircraft weight permits. This technique, referred to as a Step Climb, is typically accomplished by initially climbing approximately 2000 ft above the optimum altitude and then cruising at that flight level until approximately 4000 ft below optimum.

The MCDU STEP ALT page may be called a vertical revision from the MCDU F-PLN page or from the MCDU PERF CRZ page. Step climb can either be planned at waypoint (STEP AT) or be optimum step point calculated by the FMGS (ALT). If predictions are satisfactory in term of time and fuel saving, the crew will insert it in F-PLN provided it is compatible with ATC.

It may be advantageous to request an initial cruise altitude above optimum if altitude changes are difficult to obtain on specific routes. This minimizes the possibility of being held at a low altitude and high fuel consumption condition for long periods of time. The requested/cleared cruise altitude should be compared to the REC MAX altitude. Before accepting an altitude above optimum, the crew should determine that it will continue to be acceptable considering the projected flight conditions such as turbulence, standing waves or temperature change.

<u>OPT FL FOLLOW UP</u>




NOF 02070 04194 0001

The diagram above shows three step climb strategies with respect to OPT and REC MAX FL. Strategy 1 provides the best trip cost, followed by 2 then 3.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-3260

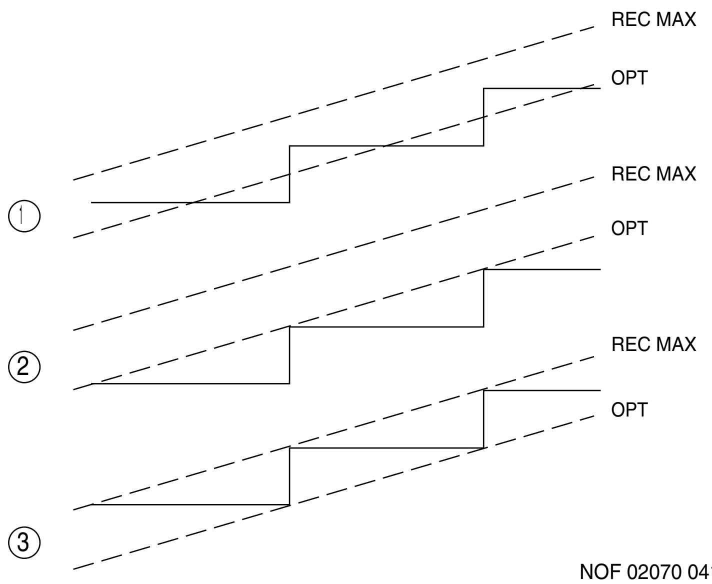
Since the optimum altitude increases as fuel is consumed during the flight, from a cost point of view, it is preferable to climb to a higher cruise altitude when the aircraft weight permits. This technique, referred to as a Step Climb, is typically accomplished by initially climbing approximately 2000 ft above the optimum altitude and then cruising at that flight level until approximately 4000 ft below optimum.

The MCDU STEP ALT page may be called a vertical revision from the MCDU F-PLN page or from the MCDU PERF CRZ page. Step climb can either be planned at waypoint (STEP AT) or be optimum step point calculated by the FMGS (ALT). If predictions are satisfactory in term of time and fuel saving, the crew will insert it in F-PLN provided it is compatible with ATC.

The OPT STEP computation will be accurate if vertical wind profile has been properly entered. Refer to FMS USE of this section. The FCOM 3.05.15 provides valuable tables to assess the effect of the vertical wind profile on the optimum cruise flight level.

It may be advantageous to request an initial cruise altitude above optimum if altitude changes are difficult to obtain on specific routes. This minimizes the possibility of being held at a low altitude and high fuel consumption condition for long periods of time. The requested/cleared cruise altitude should be compared to the REC MAX altitude. Before accepting an altitude above optimum, the crew should determine that it will continue to be acceptable considering the projected flight conditions such as turbulence, standing waves or temperature change.

OPT FL FOLLOW UP

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The diagram above shows three step climb strategies with respect to OPT and REC MAX FL. Strategy 1 provides the best trip cost, followed by 2 then 3.

## EFFECT OF ALTITUDE ON FUEL CONSUMPTION

ALL

The selected cruise altitude should normally be as close to optimum as possible. As deviation from optimum cruise altitude increases, performance economy decreases. The following table provide average specific range penalty when not flying at optimum altitude.

## FIGURES

MSN 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2918 2931 2951 2955 2967 2972 3009 3038 3092 3110 3163

| OPT + 2000ft | OPT 2000 ft | OPT 4000 ft | OPT 6000 ft |
|---|---|---|---|
| 0.7% | 1.6% | 5% | 10 % |

*Specific range penalty when not flying at optimum altitude*

MSN 0889 0913 0924 0931 0976 1010 1043 1049 1056 1064 1066 1074 1088 1092 1096 1098 1103 1111 1113 1116 1139-1140 1159 1178 1223 1228 1281 1323 1350 1373 1375 1395 1397 1406 1410 1463 1490 1527 1534 1547 1552 1563 1565 1575-1576 1608 1643 1698 1703 1727 1729 1758 1768 1790 1801 1826 1831 1837 1844 1855 1880 1893 1912 1934 1947 1952 1955 1962 1971 1986 2023 2032 2089 2096 2200 2203 2232 2273 2277 2295-2296 2302 2304 2321 2335 2339 2362 2371 2383 2396 2404 2408 2414 2424 2426 2431 2433 2435 2444 2452 2458 2467-2468 2470 2473 2485 2490 2505 2560 2567-2568 2570 2572 2574 2579 2585 2595 2603 2615 2622 2631 2648 2655 2657 2659-2660 2666-2667 2669 2673 2679 2690 2698 2704 2711 2718 2723 2738-2739 2784 2797 2813 2815 2833 2845 2850 2858 2864 2872 2886-2888 2892-2894 2898 2901 2929 2940 2942 2948 2963 2969 2976 2978 2983 2997 3007 3011 3017 3020 3026 3032 3057 3104 3128 3144 3165 3172 3193

| OPT + 2000ft | OPT 2000 ft | OPT 4000 ft | OPT 6000 ft |
|---|---|---|---|
| 1% | 3% | 7.2% | 12.2 % |

*Specific range penalty when not flying at optimum altitude*

MSN 0023-0034 0036 0039-0042 0044 0059-0063 0068-0073 0078 0083-0086 0093-0094 0100-0112 0115-0130 0133-0162 0167 0170-0177 0183-0185 0188 0191-0192 0196-0197 0199-0220 0222-0224 0226-0229 0231-0234 0236-0242 0244-0246 0248 0253-0255 0258 0262-0274 0277-0278 0281-0282 0284-0287 0290 0293 0297-0298 0300-0303 0306-0307 0309-0312 0318-0319 0323-0324 0328-0330 0333 0337 0341-0342 0346 0348 0350 0352 0356 0359 0365 0370-0371 0377-0378 0382-0384 0390 0395 0401-0404 0413 0426 0482 0491 0501 0507 0511 0531 0534 0549 0554 0615 0622 0658 0662 0669 0671 0685 0726 0958 0975 1187 1337 1365 1367 1700 1973 2054 2061 2082 2092

| OPT + 2000ft | OPT 2000 ft | OPT 4000 ft | OPT 6000 ft |
|---|---|---|---|
| - | 1.1% | 4.7% | 9.5 % |

*Specific range penalty when not flying at optimum altitude*

MSN 0425 0435 0439 0442 0448 0450 0452-0457 0462-0465 0470-0472 0475 0479 0483 0485 0487 0489 0496 0500 0503-0504 0506 0508 0510 0512 0523 0527 0530 0539-0540 0542-0543 0551 0565 0568 0571 0573 0575 0580 0582 0584 0587 0589 0592 0613 0638 0640 0655 0659 0661 0667 0676 0678 0683 0702 0709-0710 0720 0722 0751 0756 0758 0760 0762 0770 0780 0784 0791 0803 0805 0812 0816 0820 0822 0824 0826 0834 0836 0842 0849 0851 0856-0857 0859 0865-0866 0872 0877 0881 0886 0895 0899-0900 0918 0927-0928 0930 0932 0934 0943 0950 0953 0955 0966 0969 0977 0990 1001 1003 1014 1032 1035 1039 1050 1057 1075-1076 1079 1083 1085 1104-1105 1110 1117 1123 1128 1143 1146 1156 1158 1163 1166 1173 1177 1183 1192 1194 1196 1215 1234-1235 1240 1246 1248 1251 1253 1257 1266 1270 1272 1274 1280 1282 1284 1290 1302 1327 1341 1343 1349 1359 1363 1368 1376 1383 1398 1407 1409 1411 1418-1419 1422 1424 1427 1432 1435 1446 1452 1459 1464 1469 1475 1486 1495 1497 1506 1508 1514 1518 1528 1533 1538 1546 1555 1557 1559 1561 1566 1580 1584 1586 1591 1593 1595 1609-1610 1613 1617 1620-1621 1628 1631 1644 1648 1650 1652 1661 1663 1665 1669 1672 1680 1682 1687 1689 1696-1697 1702 1705 1708 1710 1715 1721 1723 1728 1732 1739 1741 1749 1754-1755 1760 1764 1771 1773 1782 1784-1785 1792 1802 1804 1814 1818 1821-1823 1825 1827 1829 1832 1835 1840 1842 1845 1847 1849 1856-1857 1861-1862 1865 1868 1871 1883 1888 1891 1895-1896 1898-1899 1904 1907 1909-1910 1914-1915 1917-1918 1922 1927 1933 1935 1944-1945 1948 1957-1958 1969 1979 1987 1993 1996 1998 2006 2016 2020 2027 2029 2031 2038 2040 2042 2058 2063 2070 2073 2075 2077 2079 2085 2088 2090 2094 2097 2099 2108 2112 2121 2125 2128 2130 2132 2135-2139 2141 2147-2150 2152-2153 2156-2157 2159-2161 2164 2167-2169 2173 2177 2185 2193 2195 2197 2201 2204 2210 2215 2223 2229 2231 2238 2246 2254 2257 2259 2275 2280 2284 2286 2288 2292 2297 2299 2307 2310 2312 2314 2316 2322 2329 2331 2334 2336 2338 2340 2343 2345 2352 2356 2359 2366 2368 2372 2376 2384 2386 2393 2395 2397 2401 2403 2405 2413 2415 2417 2422-2423 2428 2430 2441 2443 2445 2447 2449 2453 2455 2457 2459 2461 2475 2479 2482 2489 2491 2496 2500 2502 2504 2509 2513 2515 2520 2522 2524 2526 2531 2533 2535 2537 2564 2566 2571 2573 2576-2577 2580 2587 2589 2594 2598 2600 2602 2604 2608-2609 2613 2626 2630 2640 2642 2645 2647 2649 2651 2661 2663 2670-2671 2676 2680 2688-2689 2692 2701 2703 2710 2714 2717 2724-2725 2728 2731-2732 2734 2737 2747 2752-2753 2755 2766 2772 2781 2783 2787 2802 2804 2808 2814 2817 2828 2832 2838 2840 2844 2848 2856 2859 2863 2871 2874 2880 2883 2896 2900 2904 2906 2908 2911 2914 2922 2928 2934 2941 2943 2945 2952-2953 2958 2970 2977 2982 2984 2987 2990 2992 3004 3010 3012 3029 3033 3039 3050 3066 3071-3072 3074 3086 3089 3091 3105 3119 3125 3127 3141-3143 3150 3156 3158-3159 3162 3166-3167 3177 3183 3185 3190 3192 3196 3208 3210

| OPT + 2000ft | OPT 2000 ft | OPT 4000 ft | OPT 6000 ft |
|---|---|---|---|
| 1.4% | 2.1% | 6.2% | 12 % |

*Specific range penalty when not flying at optimum altitude*

MSN 0434 0477 0488 0494-0495 0513-0516 0524 0526 0532 0576 0583 0586 0593 0599 0765 0819 0848 0940 0959 1220

| OPT + 2000ft | OPT 2000 ft | OPT 4000 ft | OPT 6000 ft |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 2.3% | 1.4% | 4.6% | 15.2 % |

*Specific range penalty when not flying at optimum altitude*

MSN 0633 0663 0668 0680 0687 0715 0725 0771 0787 0792 0806 0810 0835 0855 0864 0878 0908 0915 0954 0963 0968 0974 0983 0993 1004 1008 1015 1024 1042 1045 1060 1080 1153 1161 1174 1188 1195 1199 1202 1204 1207 1214 1218 1260 1273 1276 1293 1333 1366 1408 1421 1428 1433 1438 1487 1596 1614 1636 1670 1690 1695 1707 1711 1734 1763 1776 1788 1794 1843 1850 1869 1878 1926 1928 1941 1946 1950 1953 1956 1967 1970 1974 1977 1984 1995 2021 2041 2045 2055 2067 2080 2105 2107 2110 2190 2211 2216 2226 2234 2247 2255 2261 2267 2290 2303 2305 2320 2323-2324 2351 2363 2410 2462 2476 2480 2521 2530 2536 2553 2590 2610 2653 2682 2687 2713 2730 2741 2759 2767 2793 2799 2809 2823 2862 2868 2936 2971 2974 2999 3005 3013 3015 3022 3067 3075 3081 3106 3112 3120 3126 3198 3207 3217 3222 3229 3235 3241

| OPT + 2000ft | OPT - 2000ft | OPT - 4000ft |
|---|---|---|
| 2.4% | 1.5% | 4.9% |

*Specific range penalty when not flying at optimum altitude*

## FUEL MONITORING

ALL

The flight plan fuel burn from departure to destination is based on certain assumed conditions. These include gross weight, cruise altitude, route of flight, temperature, cruise wind and cruise speed. Actual fuel consumption should be compared with the flight plan fuel consumption at least once every 30 minutes.

The crew should be aware that many factors influence fuel consumption, such as actual flight level, cruise speed and unexpected meteorological conditions. These parameters should normally be reflected in the FMS.

The crew must keep in mind that

. A significant deviation between planned and actual fuel figures without reason

. An excessive fuel flow leading to a potential imbalance

. An abnormal decrease in total fuel quantity (FOB+FU)

May indicate a fuel leak and the associated procedure should be applied.

## FUEL TEMPERATURE

ALL

Fuel freeze refers to the formation of wax crystals suspended in the fuel, which can accumulate when fuel temperature is below the freeze point (-47 °C for jet A1) and can prevent proper fuel feed to the engines.

During normal operations, fuel temperature rarely decreases to the point that it becomes limiting. However, extended cruise operations increase the potential for fuel temperatures to reach the freeze point. Fuel temperature will slowly reduce towards TAT. The rate of cooling of fuel can be expected to be in the order of 3 °C per hour with a maximum of 12 °C per hour in the most extreme conditions.

If fuel temperature approaches the minimum allowed, the ECAM outputs a caution. Consideration should be given to achieving a higher TAT:

- Descending or diverting to a warmer air mass may be considered. Below the tropopause, a 4000 ft descent gives a 7 °C increase in TAT. In severe cases, a descent to as low as 25,000 ft may be required.
- Increasing Mach number will also increase TAT. An increase of 0.01 Mach produces approximately 0.7 °C increase in TAT.

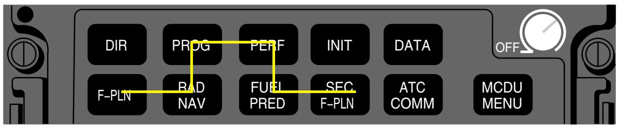
In either case, up to one hour may be required for fuel temperature to stabilise. The crew should consider the fuel penalty associated with either of these actions.

## APPROACH PREPARATION

ALL

The latest destination weather should be obtained approximately 15 minutes prior to descent and the FMGS programmed for the descent and arrival. During FMGS programming, the PF will be head down, so it is important that the PNF does not become involved in any tasks other than flying the aircraft. The fuel predictions will be accurate if the F-PLN is correctly entered in terms of arrival, go-around and alternate routing.

The FMGS will be programmed as follows:

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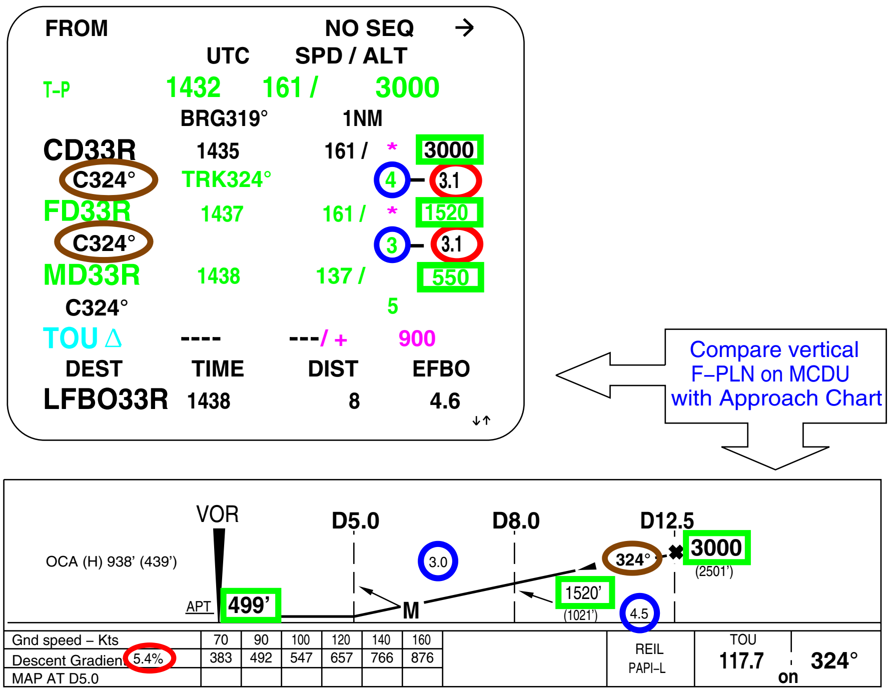
## FPLN

Lateral:
- Landing runway, STAR, Approach and Go-around procedure.
- F-PLN to alternate.

Vertical:
- Altitude and Speed constraints,
- Compare vertical F-PLN on MCDU with approach chart

MCDU F-PLN PAGE VS APPROACH CHART CROSSCHECK




NOF 02070 04196 0001

## RAD NAV

Manually tune the VOR/DME and/or NDB if required. Check ILS ident, frequency and associated course of destination airfield as required. It is not recommended manually forcing the ILS identifier as, in case of late runway change, the associated ILS would not be automatically tuned.

## PROG

Insert VOR/DME or landing runway threshold of destination airfield in the BRG/DIST field as required.

## PERF

PERF APPR:

. Descent winds,

. Destination airfield weather (QNH, Temperature and wind) The entered wind should be the average wind given by the ATC or ATIS. Do not enter gust values, for example, if the wind is 150/20-25, insert the lower speed 150/20 (With managed speed mode in approach, ground speed mini-function will cope with the gusts).

. Minima (DH for CATII or CATIII approach and MDA for others approaches)

. Landing configuration (wind shear anticipated or in case of failure).

PERF GO AROUND: Check thrust reduction and acceleration altitude.

**FUEL PRED**

Check estimated landing weight, EFOB and extra fuel.

**SEC F-PLN**

To cover contingencies e.g. runway change, circling or diversion.

Once the FMGS has been programmed, the PNF should then cross check the information prior to the Approach briefing.

## APPROACH BRIEFING

ALL

The main objective of the approach briefing is for the PF to inform the PNF of his intended course of action for the approach. The briefing should be practical and relevant to the actual weather conditions expected. It should be concise and conducted in a logical manner. It should be given at a time of low workload if possible, to enable the crew to concentrate on the content. It is very important that any misunderstandings are resolved at this time.

| PF briefing | Associated cross check |
|---|---|
| **Aircraft type and technical status** | |
| **NOTAM** | |
| **Weather** | |

| | |
|---|---|
| – Accessibility<br>– Runway in use | |
| **Fuel** | |
| – Extra fuel | FUEL PRED page |
| **Descent** | |
| – TOD (time, position)<br>– MORA, STAR, MSA<br>– Altitude and speed constraints | FPLN page<br>FPLN page |
| **Holding** (if expected) | |
| – Entry in holding pattern<br>– MHA and MAX speed | |
| **Approach** | |
| – Approach type<br>– Altitude and FAF identification<br>– Descend gradient<br>– MDA/DH<br>– Missed approach procedure<br>– Alternate considerations | – PERF APPR and ND<br>– FPLN<br>– PFD/FMA<br>– PERF APPR<br>– FPLN<br>– FPLN |
| **Landing** | |
| – Runway condition, length and width<br>– Tail strike awareness<br>– Use of Auto brake<br>– Expected taxi clearance | |
| **Radio aids** | RAD NAV |

## PREFACE

ALL

The PF will set preferably the MCDU PROG or PERF page as required (PROG page provides VDEV in NAV mode and BRG/DIST information, PERF DES page provides predictions down to any inserted altitude in DES/OP DES modes) whereas the PNF will set the MCDU F-PLN page.

If use of radar is required, consider selecting the radar display on the PF side and TERR on PNF side only.

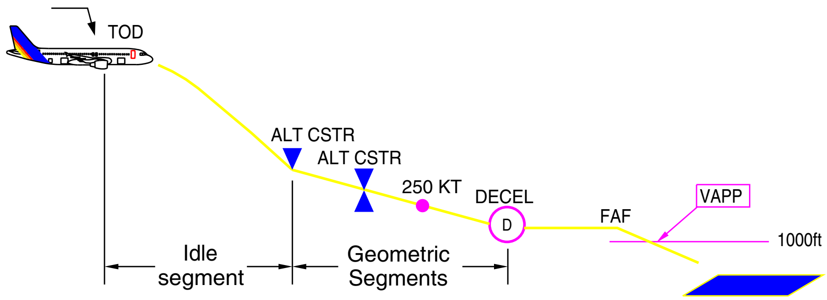
## COMPUTATION PRINCIPLES

ALL

### TOD AND PROFILE COMPUTATION

The FMGS calculates the Top Of Descent point (TOD) backwards from a position 1000 ft on the final approach with speed at Vapp. It takes into account any descent speed and altitude constraints and assumes managed speed is used. The first segment of the descent will always be idle segment until the first altitude constraint is reached. Subsequent segments will be "geometric", i.e. the descent will be flown at a specific angle, taking into account any subsequent constraints. If the STAR includes a holding pattern, it is not considered for TOD or fuel computation. The TOD is displayed on the ND track as a white symbol:

DESCENT PATH




Descent path

NOF 02080 04200 0001

The idle segment assumes a given managed speed flown with idle thrust plus a small amount of thrust. This gives some flexibility to keep the aircraft on the descent path if engine anti-ice is used or if winds vary. This explains THR DES on the FMA.

The TOD computed by the FMS is quite reliable provided the flight plan is properly documented down to the approach.

## MANAGED DESCENT SPEED PROFILE

The managed speed is equal to:

- The ECON speed (which may have been modified by the crew on the PERF DES page, before entering DESCENT phase), or
- The speed constraint or limit when applicable.

# GUIDANCE AND MONITORING

ALL

## INTRODUCTION

To carry out the descent, the crew can use either the managed descent mode (DES) or the selected descent modes (OP DES or V/S). Both descent modes can be flown either with selected speed or managed speed.

The modes and monitoring means are actually linked.

The managed DES mode guides the aircraft along the FMS pre-computed descent profile, as long as it flies along the lateral F-PLN: i.e. DES mode is available if NAV is engaged. As a general rule when DES mode is used, the descent is monitored using VDEV called "yoyo" on PFD, or its digital value on the PROG page, as well as the level arrow on the ND.

The selected OP DES or V/S modes are used when HDG is selected or when ALT CSTR may be disregarded or for various tactical purposes. As a general rule when OP DES or V/S modes are used, the descent is monitored using the Energy Circle, (displayed if HDG or TRK modes and indicating the required distance to descend, decelerate and land from present position) and the level arrow on the ND. When the aircraft is not far away from the lateral F-PLN (small XTK), the yoyo on PFD is also a good indicator.

## MANAGED DESCENT MODE

The managed descent profile from high altitude is approximately 2.5°.

As an estimation of the distance to touchdown is required to enable descent profile monitoring, it is important to ensure that the MCDU F-PLN plan page reflects the expected approach routing. Any gross errors noted in the descent profile are usually a result of incorrect routing entered in the MCDU or non-sequencing of F-PLN waypoints, giving a false distance to touchdown.

### DESCENT INITIATION

To initiate a managed descent, the pilot will set the ATC cleared altitude on the FCU and push the ALT selector. DES mode engages and is annunciated on the FMA. If an early descent were required by ATC, DES mode would give 1000 fpm rate of descent, until regaining the computed profile.

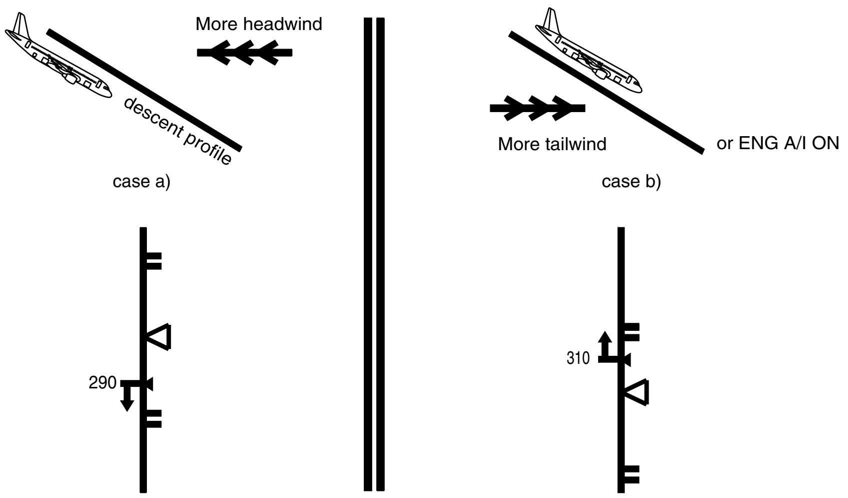
To avoid overshooting the computed descent path, it is preferable to push the FCU ALT selector a few miles prior to the calculated TOD. This method will ensure a controlled entry into the descent and is particularly useful in situations of high cruise Mach number or strong upper winds.

If the descent is delayed, a "DECELERATE" message appears in white on the PFD and in amber on the MCDU. Speed should be reduced towards green dot, and when cleared for descent, the pilot will push for DES and push for managed speed. The speed reduction prior to descent will enable the aircraft to recover the computed profile more quickly as it accelerates to the managed descent speed.

## DESCENT PROFILE

When DES with managed speed is engaged, the AP/FD guides the aircraft along the pre-computed descent path determined by a number of factors such as altitude constraints, wind and descent speed. However, as the actual conditions may differ from those planned, the DES mode operates within a 20 kts speed range around the managed target speed to maintain the descent path.

MANAGED DESCENT: SPEED TARGET RANGE PRINCIPLE

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**If the aircraft gets high on the computed descent path:**

. The speed will increase towards the upper limit of the speed range, to keep the aircraft on the path with IDLE thrust.

. If the speed reaches the upper limit, THR IDLE is maintained, but the autopilot does not allow the speed to increase any more, thus the VDEV will slowly increase.

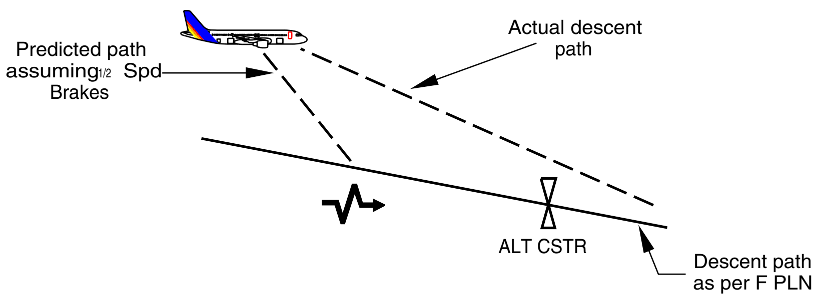
. A path intercept point, which assumes half speedbrake extension, will be displayed on the ND descent track.

. If speed brakes are not extended, the intercept point will move forward. If it gets close to an altitude-constrained waypoint, then a message "AIR BRAKES" or "MORE DRAG", depending of the FMGS standard, will be displayed on the PFD and MCDU.

This technique allows an altitude constraint to be matched with minimum use of speedbrakes.

When regaining the descent profile, the speedbrakes should be retracted to prevent the A/THR applying thrust against speedbrakes. If the speedbrakes are not retracted, the "SPD BRK" message on the ECAM memo becomes amber and "RETRACT SPEEBRAKES" is displayed in white on the PFD.

A/C ABOVE DESCENT PATH

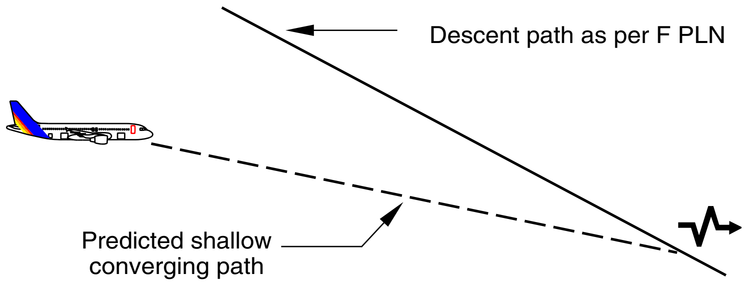



NOF 02080 04202 0001

**If the aircraft gets low on the computed descent path:**

The speed will decrease towards the lower limit of the speed range with idle thrust. When the lower speed limit is reached the A/THR will revert to SPEED/MACH mode and apply thrust to maintain the descent path at this lower speed. The path intercept point will be displayed on the ND, to indicate where the descent profile will be regained.

A/C BELOW DESCENT PATH

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**If selected speed is used:**

The descent profile remains unchanged. As the selected speed may differ from the speed taken into account for pre-computed descent profile and speed deviation range does not apply, the aircraft may deviate from the descent profile e.g. if the pilot selects 275 kts with a pre-computed descent profile assuming managed speed 300 kts, VDEV will increase.

## SELECTED DESCENT

There are 2 modes for flying a selected descent, namely OP DES and V/S. These modes will be used for pilot tactical interventions.

V/S mode is automatically selected when HDG or TRK mode is selected by the pilot, while in DES mode. Furthermore, in HDG or TRK mode, only V/S or OP DES modes are available for descent.

To initiate a selected descent, the pilot should set the ATC cleared altitude on the FCU and pull the ALT selector. OP DES mode engages and is annunciated on the FMA. In OP DES mode, the A/THR commands THR IDLE and the speed is controlled by the THS.

Speed may be either managed or selected. In managed speed, the descent speed is displayed only as a magenta target but there is no longer a speed target range since the pre-computed flight profile does not apply.

The AP/FD will not consider any MCDU descent altitude constraints and will fly an unrestricted descent down to the FCU selected altitude.

If the crew wishes to steep the descent down, OP DES mode can be used, selecting a higher speed. Speedbrake is very effective in increasing descent rate but should be used with caution at high altitude due to the associated increase in VLS.

If the pilot wishes to shallow the descent path, V/S can be used. A/THR reverts to SPEED mode. In this configuration, the use of speedbrakes is not recommended to reduce speed, since this would lead to thrust increase and the speed would be maintained.

## MODE REVERSION

MSN 0002-0030 0033 0035-0039 0042-0068 0073-0077 0080-0082 0084-0085 0087-0091 0095-0103 0108-0109 0112-0115 0119-0120 0122-0124 0126-0134 0136 0138-0146 0148-0151 0154-0159 0163-0164 0167-0170 0173-0177 0179-0191 0193 0195-0196 0199 0203-0205 0207 0210-0212 0214-0215 0219-0257 0259-0261 0264-0266 0270 0274-0280 0283-0296 0299-0305 0308-0317 0320-0328 0330-0338 0341-0345 0347-0350 0352-0354 0356-0357 0359 0361-0365 0368-0371 0373-0379 0383-0386 0389-0398 0402-0407 0409 0411 0413-0416 0419-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0534 0537-0540 0542-0543 0546 0549-0552 0554-0558 0561 0565 0568-0573 0575 0579-0582 0584 0587 0589-0592 0594 0597 0601 0604-0607 0611 0613-0615 0617 0619-0620 0622 0624 0626 0628 0630-0634 0638-0639 0645-0646 0648-0650 0654-0656 0658-0659 0661-0662 0666-0667 0669-0672 0674-0675 0677-0678 0682-0685 0688 0691 0693 0695 0697 0702 0711 0714 0719 0721 0726 0728 0731-0732 0735-0736 0739-0740 0742-0743 0746 0751-0752 0756-0759 0762-0763 0769-0770 0772-0773 0775 0779-0781 0784-0785 0787 0791-0792 0794-0795 0799-0800 0802-0803 0805 0808 0811-0814 0816-0817 0820 0822-0824 0826 0828-0829 0831 0834 0836 0839-0840 0842 0845 0851-0852 0856-0857 0865-0866 0869 0877 0880 0888 0963 1008 1042 1204 1227

If a high V/S target is selected, the autopilot will pitch the aircraft down to fly the target V/S. Thus the aircraft will tend to accelerate, while A/THR commands idle thrust to try to keep the speed. When IAS will reach a speed close to VMO or VFE, the descent mode will revert to OP DES to regain the initial target speed.

MSN 0031-0032 0034 0040-0041 0069-0072 0078 0083 0086 0093-0094 0104 0110-0111 0116-0118 0121 0125 0135 0137 0147 0152-0153 0160-0162 0165-0166 0171-0172 0178 0192 0194 0197-0198 0200-0202 0206 0208-0209 0213 0216-0218 0258 0262-0263 0267-0269 0272-0273 0281-0282 0297-0298 0306-0307 0318-0319 0329 0339-0340 0346 0351 0355 0358 0360 0366-0367 0372 0380-0382 0387-0388 0399-0401 0408 0410 0412 0417-0418 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0502 0505 0513-0520 0522 0524 0526 0532-0533 0535 0541 0545 0548 0553 0559-0560 0562-0564 0566-0567 0574 0576-0578 0583 0585-0586 0588 0593 0595-0596 0599 0603 0609-0610 0612 0616 0621 0623 0627 0629 0635-0636 0640-0643 0651-0653 0657 0663-0665 0668 0673 0676 0679-0681 0686-0687 0689-0690 0692 0694 0696 0698-0701 0703-0710 0712-0713 0715-0718 0720 0722-0725 0727 0729-0730 0733-0734 0737-0738 0741 0744-0745 0747-0750 0753-0755 0760-0761 0764-0768 0771 0774 0776 0778 0782-0783 0786 0788-0790 0793 0797-0798 0801 0804 0806-0807 0809-0810 0815 0818-0819 0821 0825 0827 0830 0832-0833 0835 0837-0838 0841 0843-0844 0846-0850 0853-0855 0858-0864 0867-0868 0870-0876 0878-0879 0881-0887 0889-0937 0939-0962 0964-0984 0986-0997 0999 1001-1007 1009-1019 1021-1024 1026-1035 1037-1041 1043-1132 1134-1136 1138-1149 1152-1188 1191-1200 1202-1203 1205-1215 1217-1226 1228-1266 1268-1270 1272-1298 1300-1343 1345-1386 1388-1403 1405-1414 1416-1443 1445-1448 1450-1457 1459-1470 1472-1475 1477 1479-1501 1503-1504 1506-1523 1525-1598 1600-1615 1617-1621 1623-1639 1641-1644 1646-1657 1659 1661-1676 1678-1690 1692-1698 1700-1732 1734-1793 1795-1858 1860-1872 1874-1877 1880-1884 1886-1893 1895-1899 1901-1923 1925-1927 1929-1937 1940-1948 1950-1951 1954-1955 1957-1966 1968-1976 1978-1990 1993-2014 2016 2018 2020 2022 2024 2027 2029 2031 2034 2036 2038 2040 2042 2044 2046 2048-2049 2054 2056 2058 2061 2063 2065 2068 2070 2073 2075 2104 2137 2143 2157 2225 2242 2248 2252 2311 2381 2391 2472 2488 2563 2599

If a high V/S target is selected (or typically after a DES to V/S reversion), the autopilot will pitch the aircraft down to fly the target V/S. Thus the aircraft will tend to accelerate, while A/THR commands idle thrust to try to keep the speed. When IAS will reach a speed close to VMO or VFE, the autopilot will pitch the aircraft up, so as to fly a V/S allowing VMO or VFE to be maintained with idle thrust.

MSN 0498 0509 0521 0529 0544 0598 0600 0608 0618 0625 0637 0644 0647 0660 0777 0796 0938 0985 0998 1000 1020 1025 1036 1133 1137 1150-1151 1189-1190 1201 1216 1267 1271 1299 1344 1387 1404 1415 1444 1449 1458 1471 1476 1478 1502 1505 1524 1599 1616 1622 1640 1645 1658 1660 1677 1691 1699 1733 1794 1859 1873 1878-1879 1885 1894 1900 1924 1928 1938-1939 1949 1952-1953 1956 1967 1977 1991 2015 2017 2019 2021 2023 2026 2028 2030 2032-2033 2035 2037 2039 2041 2043 2045 2047 2050-2053 2055 2057 2059-2060 2062 2064 2066-2067 2069 2071-2072 2074 2076-2103 2105-2136 2138-2142 2144-2156 2158-2224 2226-2241 2243-2247 2249-2251 2253-2310 2312-2380 2382-2390 2392-2471 2473-2487 2489-2562 2564-2598 2600-3260

If a high V/S target is selected (or typically after a DES to V/S reversion), the autopilot will pitch the aircraft down to fly the target V/S. Thus the aircraft will tend to accelerate, while A/THR commands idle thrust to try to keep the speed. When IAS will reach a speed close to VMO or VFE, the autopilot will pitch the aircraft up, so as to fly a V/S allowing VMO or VFE to be maintained with idle thrust.

Triple click will be triggered.

## DESCENT CONSTRAINTS

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892

Descent constraints may be automatically included in the route as part of an arrival procedure or they may be manually entered through the MCDU F-PLN page. The aircraft will attempt to meet these as long as DES mode is being used.

The crew should be aware that an ATC "DIR TO" clearance automatically removes the requirement to comply with the speed/altitude constraints assigned to the waypoints deleted from the F-PLN.

Following the selection of HDG, DES mode will switch automatically to V/S, and altitude constraints will no longer be taken into account.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-3260

Descent constraints may be automatically included in the route as part of an arrival procedure or they may be manually entered through the MCDU F-PLN page. The aircraft will attempt to meet these as long as DES mode is being used.

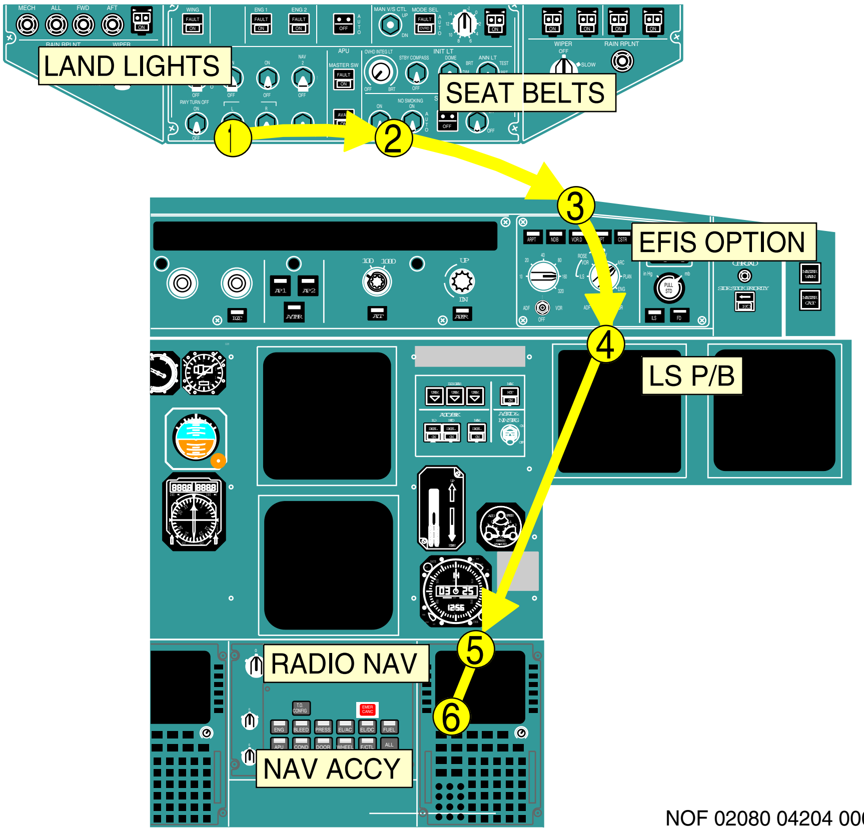
The crew should be aware that an ATC "DIR TO" clearance automatically removes the requirement to comply with the speed/altitude constraints assigned to the waypoints deleted from the F-PLN. However, if intermediate waypoints are relevant, e.g. for terrain awareness, then "DIR TO" with ABEAMS may be an appropriate selection as constraints can be re-entered into these waypoints if required.

Following the selection of HDG, DES mode will switch automatically to V/S, and altitude constraints will no longer be taken into account.

## 10.000 FT FLOW PATTERN

ALL

10.000 FT FLOW PATTERN




NOF 02080 04204 0001

## PREFACE

ALL

Whenever holding is anticipated, it is preferable to maintain cruise level and reduce speed to green dot, with ATC clearance, to minimize the holding requirement. As a rule of thumb, a 0.05 Mach decrease during one hour equates to 4 minutes hold. However, other operational constraints might make this option inappropriate.

A holding pattern can be inserted at any point in the flight plan or may be included as part of the STAR. In either case, the holding pattern can be modified by the crew.

## HOLDING SPEED AND CONFIGURATION

ALL

If a hold is to be flown, provided NAV mode is engaged and the speed is managed, an automatic speed reduction will occur to achieve green dot speed when entering the holding pattern. Green dot speed corresponds to an approximation of the best lift to drag ratio and provides the lowest hourly fuel consumption.

If green dot speed is greater than the ICAO or state maximum holding speed, the crew should select flap 1 below 20.000 ft and fly S speed. Fuel consumption will be increased when holding in anything other than clean configuration and green dot speed.

## IN THE HOLDING PATTERN

ALL

The holding pattern is not included in the descent path computation since the FMGS does not know how many patterns will be flown. When the holding fix is sequenced, the FMGS assumes that only one holding pattern will be flown and updates predictions accordingly. Once in the holding pattern, the VDEV indicates the vertical deviation between current aircraft altitude and the altitude at which the aircraft should cross the exit fix in order to be on the descent profile.

The DES mode guides the aircraft down at -1000 fpm whilst in the holding pattern until reaching the cleared altitude or altitude constraint.

When in the holding pattern, LAST EXIT UTC/FUEL information is displayed on the MCDU HOLD page. These predictions are based upon the fuel policy requirements specified on the MCDU FUEL PRED page with no extra fuel, assuming the aircraft will divert. The crew should be aware that this information is computed with defined assumptions e.g.:

. Aircraft weight being equal to landing weight at primary destination

. Flight at FL 220 if distance to ALTN is less than 200 NM, otherwise FL310 performed at maximum range speed.

. Constant wind (as entered in alternate field of the DES WIND page).

. Constant delta ISA (equal to delta ISA at primary destination)

. Airway distance for a company route, otherwise direct distance.

Alternate airport may be modified using the MCDU ALTN airport page which can be accessed by a lateral revision at destination.

To exit the holding pattern, the crew should select either:

. IMM EXIT (The aircraft will return immediately to the hold fix, exit the holding pattern and resume its navigation) or

. HDG if radar vectors or

. DIR TO if radar vectors or

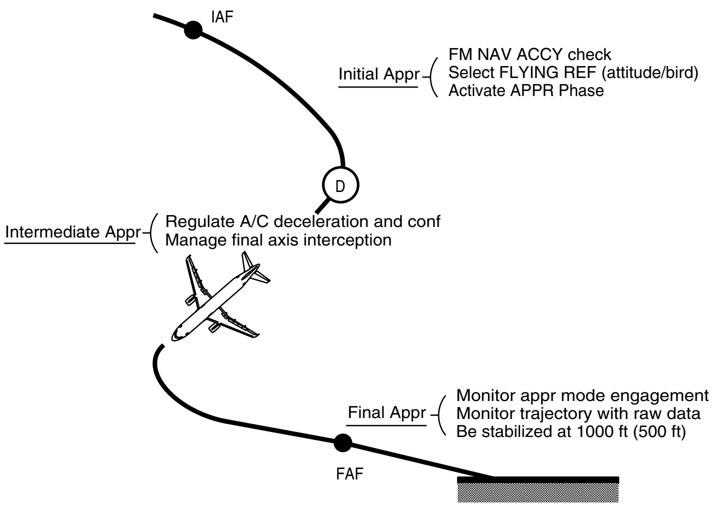
## PREFACE

ALL

This section covers general information applicable to all approach types. Techniques, which apply to specific approach types, will be covered in dedicated chapters.

All approaches are divided into three parts (initial, intermediate and final) where various drills have to be achieved regardless of the approach type.

THE APPROACH PARTS AND ASSOCIATED ACTIONS




NOF 02100 04206 0001

## INITIAL APPROACH

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892 1902 1987 2058 2104 2115 2143 2252

## NAVIGATION ACCURACY

Prior to any approach, a navigation accuracy check is to be carried out. On aircraft equipped with GPS however, no navigation accuracy check is required as long as GPS PRIMARY is available.

Without GPS PRIMARY or if no GPS is installed, navigation accuracy check has to be carried out. The navigation accuracy determines which AP modes the crew should use and the type of display to be shown on the ND.

## THE FLYING REFERENCE

It is recommended to use the FD bars for ILS approaches and the FPV called "bird" with FPD for non-precision or circling approach approaches.

## APPROACH PHASE ACTIVATION

Activation of the approach phase will initiate a deceleration towards VAPP or the speed constraint inserted at FAF, whichever applies.

When in NAV mode with managed speed, the approach phase activates automatically when sequencing the deceleration pseudo-waypoint . If an early deceleration is required, the approach phase can be activated on the MCDU PERF APPR page. When the approach phase is activated, the magenta target speed becomes VAPP.

When in HDG mode, e.g. for radar vectoring, the crew will activate the approach phase manually.

There are two approach techniques:

. The decelerated approach

. The stabilized approach

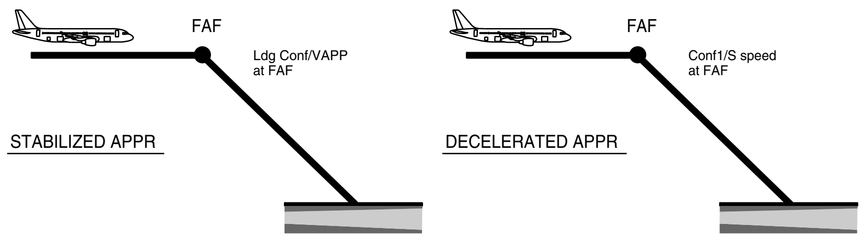
### THE DECELERATED APPROACH

This technique refers to an approach where the aircraft reaches 1000 ft in the landing configuration at VAPP. In most cases, this equates to the aircraft being in Conf 1 and at S speed at the FAF. This is the preferred technique for an ILS approach. The deceleration pseudo-waypoint assumes a decelerated approach technique.

### THE STABILIZED APPROACH

This technique refers to an approach where the aircraft reaches the FAF in the landing configuration at VAPP. This technique is recommended for non-precision approaches. To get a valuable deceleration pseudo waypoint and to ensure a timely deceleration, the pilot should enter VAPP as a speed constraint at the FAF.

STABILIZED VERSUS DECELERATED APPROACH




NOF 02100 04207 0001

## F-PLN SEQUENCING

When in NAV mode, the F-PLN will sequence automatically. In HDG/TRK mode, the F-PLN waypoints will sequence automatically only if the aircraft flies close to the programmed route. Correct F-PLN sequencing is important to ensure that the programmed missed approach route is available in case of go-around. A good cue to monitor the proper F-PLN sequencing is the TO waypoint on the upper right side of the ND, which should remain meaningful.

If under radar vectors and automatic waypoint sequencing does not occur, the F-PLN will be sequenced by deleting the FROM WPT on the F-PLN page until the next likely WPT to be over flown is displayed as the TO WPT on the ND.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-1901 1903-1986 1988-2057 2059-2103 2105-2114 2116-2142 2144-2251 2253-3260

## NAVIGATION ACCURACY

Prior to any approach, a navigation accuracy check is to be carried out. On aircraft equipped with GPS however, no navigation accuracy check is required as long as GPS PRIMARY is available.

Without GPS PRIMARY or if no GPS is installed, navigation accuracy check has to be carried out. The navigation accuracy determines which AP modes the crew should use and the type of display to be shown on the ND.

## THE FLYING REFERENCE

It is recommended to use the FD bars for ILS approaches and the FPV called "bird" with FPD for non-precision or circling approach approaches.

## APPROACH PHASE ACTIVATION

Activation of the approach phase will initiate a deceleration towards VAPP or the speed constraint inserted at FAF, whichever applies.

When in NAV mode with managed speed, the approach phase activates automatically when sequencing the deceleration pseudo-waypoint. If an early deceleration is required, the approach phase can be activated on the MCDU PERF APPR page. When the approach phase is activated, the magenta target speed becomes VAPP.

When in HDG mode, e.g. for radar vectoring, the crew will activate the approach phase manually.

There are two approach techniques:

. The decelerated approach

. The stabilized approach

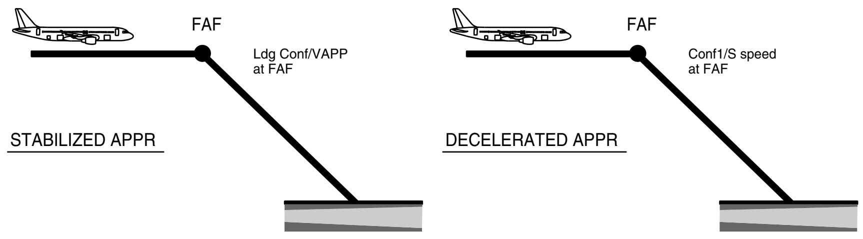
### THE DECELERATED APPROACH

This technique refers to an approach where the aircraft reaches 1000 ft in the landing configuration at VAPP. In most cases, this equates to the aircraft being in Conf 1 and at S speed at the FAF. This is the preferred technique for an ILS approach. The deceleration pseudo waypoint assumes a decelerated approach technique.

### THE STABILIZED APPROACH

This technique refers to an approach where the aircraft reaches the FAF in the landing configuration at VAPP. This technique is recommended for non-precision approaches. To get a valuable deceleration pseudo waypoint and to ensure a timely deceleration, the pilot should enter VAPP as a speed constraint at the FAF.

STABILIZED VERSUS DECELERATED APPROACH

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## F-PLN SEQUENCING

When in NAV mode, the F-PLN will sequence automatically. In HDG/TRK mode, the F-PLN waypoints will sequence automatically only if the aircraft flies close to the programmed route. Correct F-PLN sequencing is important to ensure that the programmed missed approach route is available in case of go-around. A good cue to monitor the proper F-PLN sequencing is the TO waypoint on the upper right side of the ND, which should remain meaningful.

If under radar vectors and automatic waypoint sequencing does not occur, the F-PLN will be sequenced by either using the DIR TO RADIAL IN function or by deleting the FROM WPT on the F-PLN page until the next likely WPT to be over flown is displayed as the TO WPT on the ND.

## INTERMEDIATE APPROACH

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892

The purpose of the intermediate approach is to bring the aircraft at the proper speed, altitude and configuration at FAF.

## DECELERATION AND CONFIGURATION CHANGE

Managed speed is recommended for the approach. Once the approach phase has been activated, the A/THR will guide aircraft speed towards the maneuvering speed of the current configuration, whenever higher than VAPP, e.g. green dot for Config 0, S speed for Config 1 etc.

To achieve a constant deceleration and to minimize thrust variation, the crew should extend the next configuration when reaching the next configuration maneuvering speed + 10 kts (IAS must be lower than VFE next), e.g. when the speed reaches green dot + 10 kts, the crew should select Config 1. Using this technique, the mean deceleration rate will be approximately 10 kts/NM in level flight. This deceleration rate will be twice i.e. 20 kts/NM, with the use of the speedbrakes.

If selected speed is to be used to comply with ATC, the requested speed should be selected on FCU. A speed below the manoeuvring speed of the present configuration may be selected provided it is above VLS. When the ATC speed constraint no longer applies, the pilot should push the FCU speed selector to resume managed speed.

When flying the intermediate approach in selected speed, the crew will activate the approach phase. This will ensure further proper speed deceleration when resuming managed speed; otherwise the aircraft will accelerate to the previous applicable descent phase speed.

In certain circumstances, e.g. tail wind or high weight, the deceleration rate may be insufficient. In this case, the landing gear may be lowered, preferably below 220 kts (to avoid gear doors overstress), and before selection of Flap 2. Speedbrakes can also be used to increase the deceleration rate but the crew should be aware of:

. The increase in VLS with the use of speedbrakes

. The limited effect at low speeds

. The speed brake auto-retraction when selecting Conf 3 (A321 only) or Conf full. (Not applicable for A318)

## INTERCEPTION OF FINAL APPROACH COURSE

To ensure a smooth interception of final approach course, the aircraft ground speed should be appropriate, depending upon interception angle and distance to runway threshold. The pilot should refer to applicable raw data (LOC, needles), XTK information on ND and wind component for the selection of an appropriate IAS.

If ATC provides radar vectors, the crew will sequence the F-PLN by checking that the TO WPT, on upper right hand corner of ND, is the most probable one and meaningful. This provides:

. A comprehensive ND display

. An assistance for lateral interception (XTK)

. A meaningful vertical deviation

. The go around route to be displayed.

When established on the LOC, a DIR TO should not be performed to sequence the F-PLN as this will result in the FMGS reverting to NAV mode. In this case, the LOC will have to be re-armed and re-captured, increasing workload unduly.

The final approach course interception in NAV mode is possible if GPS is PRIMARY or if the navigation accuracy check is positive.

If ATC gives a new wind for landing, the crew will update it on MCDU PERF APPR page.

Once cleared for the approach, the crew will press the APPR P/B to arm the approach modes when applicable.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-3260

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## DECELERATION AND CONFIGURATION CHANGE

Managed speed is recommended for the approach. Once the approach phase has been activated, the A/THR will guide aircraft speed towards the maneuvering speed of the current configuration, whenever higher than VAPP, e.g. green dot for Config 0, S speed for Config 1 etc.

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If selected speed is to be used to comply with ATC, the requested speed should be selected on FCU. A speed below the manoeuvring speed of the present configuration may be selected provided it is above VLS. When the ATC speed constraint no longer applies, the pilot should push the FCU speed selector to resume managed speed.

When flying the intermediate approach in selected speed, the crew will activate the approach phase. This will ensure further proper speed deceleration when resuming managed speed; otherwise the aircraft will accelerate to the previous applicable descent phase speed.

In certain circumstances, e.g. tail wind or high weight, the deceleration rate may be insufficient. In this case, the landing gear may be lowered, preferably below 220 kts (to avoid gear doors overstress), and before selection of Flap 2. Speedbrakes can also be used to increase the deceleration rate but the crew should be aware of:

. The increase in VLS with the use of speedbrakes

. The limited effect at low speeds

. The speed brake auto-retraction when selecting the landing configuration. (Not applicable for A318)

## INTERCEPTION OF FINAL APPROACH COURSE

To ensure a smooth interception of final approach course, the aircraft ground speed should be appropriate, depending upon interception angle and distance to runway threshold. The pilot should refer to applicable raw data (LOC, needles), XTK information on ND and wind component for the selection of an appropriate IAS.

If ATC provides radar vectors, the crew will use the DIR TO RADIAL INBND facility. This ensures:

. A proper F-PLN sequencing

. A comprehensive ND display

. An assistance for lateral interception

. The VDEV to be computed on reasonable distance assumptions.

However, considerations should be given the following:

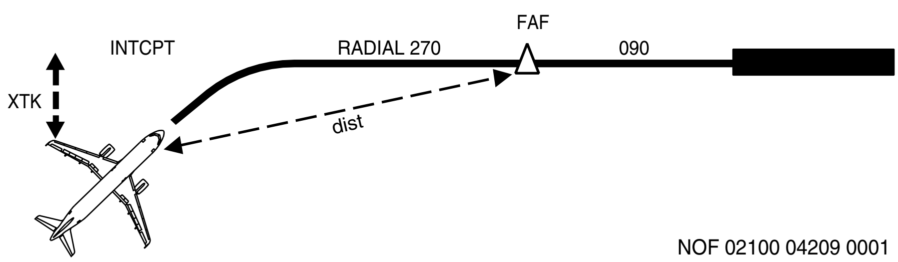
. A radial is to be inserted in the MCDU. In the following example, the final approach course is 090° corresponding to radial 270°.

. Deceleration will not occur automatically as long as lateral mode is HDG

When established on the LOC, a DIR TO should not be performed to sequence the F-PLN as this will result in the FMGS reverting to NAV mode. In this case, the LOC will have to be re-armed and re-captured, increasing workload unduly.

The final approach course interception in NAV mode is possible if GPS is PRIMARY or if the navigation accuracy check is positive.

USE OF DIR TO RADIAL IN FACILITY

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If ATC gives a new wind for landing, the crew will update it on MCDU PERF APPR page.

Once cleared for the approach, the crew will press the APPR P/B to arm the approach modes when applicable.

## FINAL APPROACH

ALL

### FINAL APPROACH MODE ENGAGEMENT MONITORING

The crew will monitor the engagement of G/S* for ILS approach, FINAL for fully managed NPA or will select the Final Path Angle (FPA) reaching FAF for selected NPA. If the capture or engagement is abnormal, the pilot will either use an appropriate selected mode or take over manually.

## FINAL APPROACH MONITORING

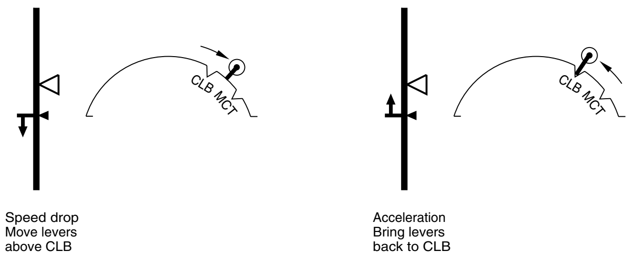
The final approach is to be monitored through available data. Those data depends on the approach type and the result of the navigation accuracy check.

| Approach type | Navigation accuracy check | Data to be monitored |
|---|---|---|
| ILS | - | LOC, GS deviation, DME and/or OM |
| Managed NPA | GPS primary | VDEV, XTK and F-PLN |
| Managed NPA | Non GPS PRIMARY | VDEV, XTK, Needles, DME and ALT |
| Selected NPA | Accuracy check negative | Needles, DME and ALT, Time |

## USE OF A/THR

The pilot should use the A/THR for approaches as it provides accurate speed control. The pilot will keep hand on the thrust levers so as to be prepared to react if needed. If for any reason, the speed drops below VAPP significantly, the pilot will push the thrust levers forward above CLB detent (but below MCT) till the speed trend arrow indicates an acceleration then bring back the thrust levers into CLB detent. This is enough to be quickly back on speed.

USE OF A/THR FOR FINAL APPROACH

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The pilot should keep in mind, however, that, when below 100 ft AGL, moving the thrust levers above the CLB detent would result in the A/THR disconnection.

During final approach, the managed target speed moves along the speed scale as a function of wind variation. The pilot should ideally check the reasonableness of the target speed by referring to GS on the top left on ND. If the A/THR performance is unsatisfactory, the pilot should disconnect it and control the thrust manually.

If the pilot is going to perform the landing using manual thrust, the A/THR should be disconnected by 1000 feet on the final approach.

## GO-AROUND ALTITUDE SETTING

When established on final approach, the go-around altitude must be set on FCU. This can be done at any time when G/S or FINAL mode engages. However, on a selected Non Precision Approach, i.e. when either FPA or V/S is used, the missed approach altitude must only be set when the current aircraft altitude is below the missed approach altitude, in order to avoid unwanted ALT*.

## TRAJECTORY STABILIZATION

The first prerequisite for safe final approach and landing is to stabilize the aircraft on the final approach flight path laterally and longitudinally, in landing configuration, at VAPP speed, i.e:

. Only small corrections are necessary to rectify minor deviations from stabilized conditions

. The thrust is stabilized, usually above idle, to maintain the target approach speed along the desired final approach path

Airbus policy requires that stabilized conditions be reached at 1000 feet above airfield elevation in IMC and 500 feet above airfield elevation in VMC.

If, for any reason, one flight parameter deviates from stabilized conditions, the PNF will make a callout as stated below:

<table>
<tr><th colspan="5">Exceedance and associated PNF callout</th></tr>
<tr><td colspan="2">Parameter</td><td colspan="2">Exceedance</td><td>Callout</td></tr>
<tr><td colspan="2">IAS</td><td colspan="2">VAPP + 10kts / -5kts</td><td>"SPEED"</td></tr>
<tr><td colspan="2">V/S</td><td colspan="2"><-1000 ft/mn</td><td>"SINK RATE"</td></tr>
<tr><td colspan="2">Pitch attitude</td><td colspan="2">+ 10° / -2.5° *</td><td>"PITCH"</td></tr>
<tr><td colspan="2">Bank angle</td><td colspan="2">7°</td><td>"BANK"</td></tr>
<tr><td rowspan="2">ILS only</td><td>Localizer</td><td rowspan="2">Excess Deviation</td><td>1/4 dot PFD</td><td>"LOCALIZER"</td></tr>
<tr><td>Glide slope</td><td>1 dot PFD</td><td>"GLIDE SLOPE"</td></tr>
</table>

| | | | |
|---|---|---|---|
| **NPA only** | Course | Excess deviation: 1/2 dot on PFD (or 2.5 deg. (VOR)/5 deg. (ADF)) | COURSE" |
| | Altitude at check points | Deviation | xFT HIGH (LOW)" |

* The pitch attitude upper threshold becomes +7.5° for A321.

Following a PNF flight parameter exceedance call out, the suitable PF response will be:

. Acknowledge the PNF callout, for proper crew coordination purposes

. Take immediate corrective action to control the exceeded parameter back into the defined stabilized conditions

. Assess whether stabilized conditions will be recovered early enough prior to landing, otherwise initiate a go-around.

## REACHING THE MINIMA

Decision to land or go-around must be made at MDA/DH at the latest. Reaching the MDA/DH, at MINIMUM call out:

. If suitable visual reference can be maintained and the aircraft is properly established, continue and land.

. If not, go-around.

The MDA/DH should not be set as target altitude on the FCU. If the MDA/DH were inserted on the FCU, this would cause a spurious ALT* when approaching MDA/DH, resulting in the approach becoming destabilised at a critical stage.

## AP DISCONNECTION

During the final approach with the AP engaged, the aircraft will be stabilised. Therefore, when disconnecting the AP for a manual landing, the pilot should avoid the temptation to make large inputs on the sidestick.

The pilot should disconnect the autopilot early enough to resume manual control of the aircraft and to evaluate the drift before flare. During crosswind conditions, the pilot should avoid any tendency to drift downwind.

Some common errors include:

- Descending below the final path, and/or
- reducing the drift too early.

## VAPP

MSN 0002-0068 0073-0077 0080-0082 0084-0085 0087-0091 0095-0103 0108-0109 0112-0115 0118-0134 0136 0138-0146 0148-0160 0163-0171 0173-0199 0203-0208 0210-0215 0219-0266 0270-0345 0347-0363 0365-0381 0383-0384 0386-0400 0402-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0534 0537 0539-0540 0542-0543 0549 0551 0554 0556 0558 0561 0565 0568-0569 0571 0573 0575 0579-0580 0582 0584 0587 0589-0590 0592 0594 0601 0605 0607 0611 0613 0615 0617 0619 0622 0624 0626 0628 0630 0638 0640 0645 0648 0650 0653 0655 0657-0659 0661-0662 0665 0667 0669 0671 0676 0678 0683 0685 0696 0698 0702 0704-0710 0712 0714 0716 0718 0720 0722 0724 0726 0730 0733 0735 0737 0739 0741 0743 0745 0747 0749 0751 0753-0754 0758 0760 0762 0764 0766 0770 0772 0778 0780 0786 0789 0791 0795 0799 0801 0803 0805 0807 0814 0818 0820 0822 0824 0826 0828 0830 0832 0834 0836 0838-0839 0842 0846 0849 0851 0854 0856-0857 0859 0865-0866 0872 0874 0876 0879 0881 0883 0886 0888 0892 0895 0897 0899-0900 0902-0903 0907 0909 0911-0912 0914 0916 0918-0919 0921 0923 0925 0927-0928 0932 0937 0939 0943 0950 0953 0955 0958 0962 0964 0966-0967 0969 0973 0975 0977-0978 0981 0984 0986 0988 0990 0992 0994 0996 1001 1003 1005 1007 1009 1011 1013 1037 1047 1059 1063 1067 1087 1099 1101 1119 1200 1208 1221 1229 1255 1262 1288 1292 1318 1347 1379 1396 1430 1454 1461 1484 1516 1530 1535 1540 1550 1633 1641 1646 1655 1674 1694 1736 1789 1793 1809 1812 1973 2054 2061 2082 2092 2225 2242 2248 2347 2391 2998 3099 3147-3148 3189

The approach speed (VAPP) is defined by the crew to perform the safest approach. It is function of gross weight, configuration, headwind, A/THR ON/OFF, icing and downburst.

VAPP=VLS + Δ

- Gross weight
- Configuration

Max
- 5 ks for severe icing
- 5 kts for A/THR ON
- 1/3 of steady headwind (limited to 15 kts)

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In most cases, the FMGC provides valuable VAPP on MCDU PERF APPR page, once tower wind and FLAP3 or FLAP FULL landing configuration has been inserted (VAPPfmgc = Vls + 5kt + 1/3 tower head wind component on landing RWY in the F-PLN}).

The crew can insert a lower VAPP on the MCDU APPR page, down to VLS, if landing is performed with A/THR OFF, with no wind, no downburst and no icing.

He can insert a higher VAPP in case of strong suspected downburst, but this increment is limited to 15 kts above VLS.

In case of strong or gusty crosswind greater than 20 knots, Vapp should be at least VLS +5 knots but this increment is limited to 15 knots above VLS.

The crew will bear in mind that the wind entered in MCDU PERF APPR page considers the wind direction to be in the same reference as the runway direction e. g. if airport is magnetic referenced, the crew will insert magnetic wind. The wind direction provided by ATIS and tower is given in the same reference as the runway direction whereas the wind provided by VOLMET, METAR or TAF is always true referenced.
VAPP is computed at predicted landing weight while the aircraft is in CRZ or DES phase. Once the approach phase is activated, VAPP is computed using current gross weight.

Managed speed should be used for final approach as it provides Ground Speed mini (GS mini) guidance, even when the VAPP has been manually inserted.

MSN 0069-0072 0078 0083 0086 0093-0094 0104 0110-0111 0116-0117 0135 0137 0147 0161-0162 0172 0200-0202 0209 0216-0218 0267-0269 0346 0364 0382 0385 0401 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532-0533 0535 0538 0541 0544-0548 0550 0552-0553 0555 0557 0559-0560 0562-0564 0566-0567 0570 0572 0574 0576-0578 0581 0583 0585-0586 0588 0591 0593 0595-0600 0603-0604 0606 0608-0610 0612 0614 0616 0618 0620-0621 0623 0625 0627 0629 0631-0637 0639 0641-0644 0646-0647 0649 0651-0652 0654 0656 0660 0663-0664 0666 0668 0670 0672-0675 0677 0679-0682 0684 0686-0695 0697 0699-0701 0703 0711 0713 0715 0717 0719 0721 0723 0725 0727-0729 0731-0732 0734 0736 0738 0740 0742 0744 0746 0748 0750 0752 0755-0757 0759 0761 0763 0765 0767-0769 0771 0773-0777 0779 0781-0785 0787-0788 0790 0792-0794 0796-0798 0800 0802 0804 0806 0808-0813 0815-0817 0819 0821 0823 0825 0827 0829 0831 0833 0835 0837 0840-0841 0843-0845 0847-0848 0850 0852-0853 0855 0858 0860-0864 0867-0871 0873 0875 0877-0878 0880 0882 0884-0885 0887 0889-0891 0893-0894 0896 0898 0901 0904-0906 0908 0910 0913 0915 0917 0920 0922 0924 0926 0929-0931 0933-0936 0938 0940-0942 0944-0949 0951-0952 0954 0956-0957 0959-0961 0963 0965 0968 0970-0972 0974 0976 0979-0980 0982-0983 0985 0987 0989 0991 0993 0995 0997-1000 1002 1004 1006 1008 1010 1012 1014-1036 1038-1046 1048-1058 1060-1062 1064-1066 1068-1086 1088-1098 1100 1102-1118 1120-1199 1201-1207 1209-1220 1222-1228 1230-1254 1256-1261 1263-1287 1289-1291 1293-1317 1319-1346 1348-1378 1380-1395 1397-1429 1431-1453 1455-1460 1462-1483 1485-1515 1517-1529 1531-1534 1536-1539 1541-1549 1551-1632 1634-1640 1642-1645 1647-1654 1656-1673 1675-1693 1695-1735 1737-1788 1790-1792 1794-1808 1810-1811 1814-1972 1974-2053 2055-2060 2062-2081 2083-2091 2093-2224 2226-2241 2243-2247 2249-2346 2348-2390 2392-2997 2999-3098 3100-3146 3149-3188 3190-3260

The approach speed (VAPP) is defined by the crew to perform the safest approach. It is function of gross weight, configuration, headwind, A/THR ON/OFF, icing and downburst.

VAPP=VLS + Δ

- Δ: Gross weight / Configuration
- Max:
  - 5 kts for severe icing
  - 5 kts for A/THR ON
  - 1/3 of steady headwind (limited to 15 kts)

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In most cases, the FMGC provides valuable VAPP on MCDU PERF APPR page, once tower wind and FLAP3 or FLAP FULL landing configuration has been inserted (VAPPfmgc = Vls + max of {5kt, 1/3 tower head wind component on landing RWY in the F-PLN}).

The crew can insert a lower VAPP on the MCDU APPR page, down to VLS, if landing is performed with A/THR OFF, with no wind, no downburst and no icing.

He can insert a higher VAPP in case of strong suspected downburst, but this increment is limited to 15 kts above VLS.

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VAPP is computed at predicted landing weight while the aircraft is in CRZ or DES phase. Once the approach phase is activated, VAPP is computed using current gross weight.

Managed speed should be used for final approach as it provides Ground Speed mini (GS mini) guidance, even when the VAPP has been manually inserted.

## GROUND SPEED MINI

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892 1902 1987 2058 2104 2115 2143 2252

## PURPOSE

The purpose of the ground speed mini function is to keep the aircraft energy level above a minimum value, whatever the wind variations or gusts.

This allows an efficient management of the thrust in gusts or longitudinal shears. Thrust varies in the right sense, but in a smaller range (± 15% N1) in gusty situations, which explains why it is recommended in such situations.

It provides additional but rational safety margins in shears.

It allows pilots "to understand what is going on" in perturbed approaches by monitoring the target speed magenta bugs: when target goes up = head wind gust.

## COMPUTATION

This minimum energy level is the energy the aircraft will have at landing with the expected tower wind; it is materialized by the ground speed of the aircraft at that time which is called GS mini:

GS mini = VAPP - Tower head wind component

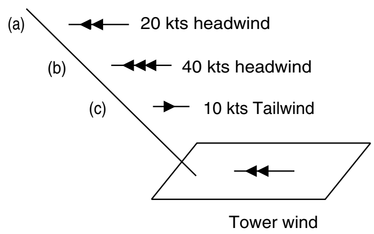
In order to achieve that goal, the aircraft ground speed should never drop below GS mini in the approach, while the winds are changing. Thus the aircraft IAS must vary while flying down, in order to cope with the gusts or wind changes. In order to make this possible for the pilot or for the ATHR, the FMGS continuously computes an IAS target speed, which ensures that the aircraft ground speed is at least equal to GS mini; the FMGS uses the instantaneous wind component experienced by the aircraft:

IAS Target Speed = GS mini + Current headwind component

This target speed is limited by VAPP in case of tailwind or if instantaneous wind is lower than the tower wind.

EXAMPLE

VLS=130 kts
Tower wind=20 kt Head wind
- Vapp=130 + 1/3 HW
  =137 kt
- GS mini=Vapp – HW
  =117 kt

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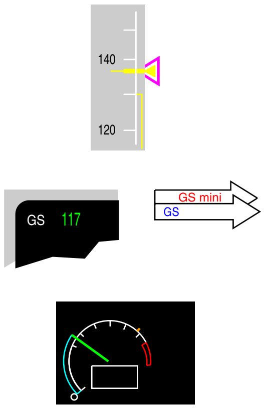
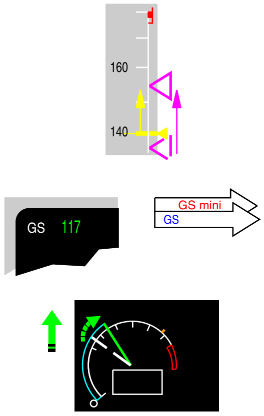
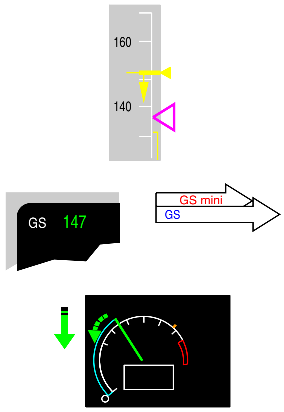
| (a) | (b) | (c) |
|---|---|---|
| Current wind<br>= tower wind | Head wind gust | Tailwind gust |
| Vapp is the IAS target | The IAS target increases | The IAS target decreases<br>(not below Vapp) |
| Ground speed = GS mini | The IAS increases<br>GS mini is maintained | The IAS decreases<br>GS increases |
| | Thrust slightly increases | Thrust slightly decreases |
|   |   |   |

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MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-1901 1903-1986 1988-2057 2059-2103 2105-2114 2116-2142 2144-2251 2253-3260

## PURPOSE

The purpose of the ground speed mini function is to keep the aircraft energy level above a minimum value, whatever the wind variations or gusts.

This allows an efficient management of the thrust in gusts or longitudinal shears. Thrust varies in the right sense, but in a smaller range (± 15% N1) in gusty situations, which explains why it is recommended in such situations.

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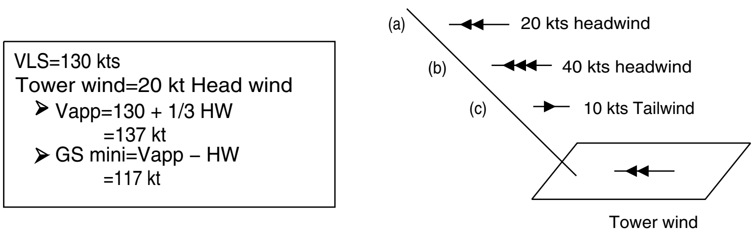
IAS Target Speed = GS mini + Current headwind component

This target speed is limited by VFE-5 in case of very strong gusts, by VAPP in case of tailwind or if instantaneous wind is lower than the tower wind.

EXAMPLE

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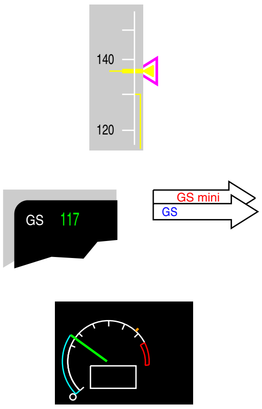
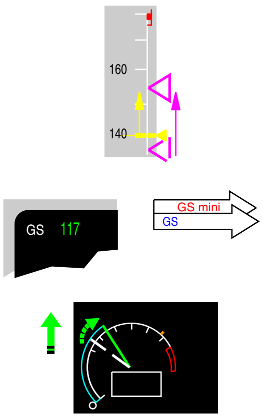
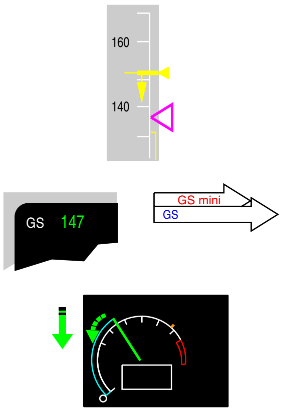
| (a) | (b) | (c) |
|---|---|---|
| Current wind = tower wind | Head wind gust | Tailwind gust |
| Vapp is the IAS target<br><br>Ground speed = GS mini | The IAS target increases<br><br>The IAS increases<br>GS mini is maintained<br><br>Thrust slightly increases | The IAS target decreases (not below Vapp)<br>The IAS decreases<br>GS increases<br><br>Thrust slightly decreases |
|  |  |  |

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## PREFACE

ALL

This chapter deals with some characteristics of the ILS approach. Recommendations mentioned in APPROACH GENERAL chapter apply.

For CAT1 ILS, the crew will insert DA/DH values into MDA (or MDH if QFE function is available) field on the MCDU PERF APPR page, since these values are baro referenced.

For CATII or CATIII ILS, the crew will insert DH into DH field on MCDU PERF APPR page, since this value is a radio altitude referenced.

## INITIAL APPROACH

MSN 0006 0008 0011 0017-0018 0022-0032 0034-0035 0037-0042 0045-0059 0064-0086 0089-0099 0103-0104 0109-0112 0116-0127 0132 0135 0137-0142 0147-0154 0157 0159-0172 0174-0175 0178-0183 0185 0189-0198 0200-0202 0205-0206 0208-0210 0212-0213 0216-0219 0221-0222 0225 0229-0234 0242-0243 0245 0247-0263 0265 0267-0269 0272-0273 0275-0277 0279-0284 0288-0302 0304-0311 0313-0322 0324-0336 0338-0351 0353-0355 0357-0376 0378-0399 0401-0411 0413-0432 0435-0457 0459-0465 0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0490 0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0531 0534 0537-0540 0542-0543 0546 0549 0551 0554-0556 0558 0561 0568 0571-0572 0579 0584 0587 0589-0592 0594 0597 0601 0604-0607 0611 0613-0615 0617 0619 0624 0626 0628 0630 0633-0634 0636 0638-0640 0645 0648-0650 0655-0656 0658 0669-0672 0676 0678 0682-0683 0685-0686 0688 0690-0691 0693 0695 0697 0702 0707 0711 0714 0716 0719 0721 0724 0726 0728 0730-0733 0735-0736 0740-0742 0746-0748 0751-0752 0756-0760 0762 0764 0766 0769-0770 0772-0773 0778-0780 0783-0786 0788-0789 0791 0795 0798-0801 0803-0804 0807 0813-0814 0817-0818 0820 0822 0824-0826 0828-0832 0834 0836 0840 0842-0843 0845-0847 0850-0851 0856-0858 0862 0865-0867 0871 0873-0874 0876 0879 0882-0883 0886 0888-0889 0893 0898 0902-0903 0907 0911-0912 0916 0918 0921 0923-0925 0931 0937 0944 0948 0952-0953 0955 0962 0964-0965 0978 0980-0981 0988-0989 0996 1001 1003 1011 1022 1032 1037 1043 1049-1050 1056 1058 1062 1064 1071 1075-1076 1078-1079 1083 1085 1088 1090-1091 1110-1111 1116-1117 1126 1129 1131 1149 1164 1166-1167 1178 1191 1223 1230 1234 1249 1274 1281 1284 1323-1325 1346 1350 1373 1375 1392 1395 1397 1414 1434 1453 1456 1483 1498 1501 1520 1535 1543 1549 1567 1570 1582 1633 1641 1646 1659 1662 1683 1685 1693 1709 1714 1738 1746 1752 1766 1774 1789 1796 1800 1810 1812 1815 1819-1820 1824 1828 1833 1839 1870 1875 1897 1923 1959 1976 1982 1990 2002 2013 2026 2028 2039 2047 2082 2087 2092 2095 2369 2373 2464 2474 2618 2641

### NAVIGATION ACCURACY

The navigation accuracy will be monitored throughout the approach and the crew will be prepared to modify the approach strategy if required. If NAV ACCURACY DOWNGRAD message is displayed on ND, the crew will use raw data to crosscheck navigation accuracy.

Navigation accuracy determines which autopilot modes the flight crew should use, and the type of displays to be shown on the ND.

<table>
<tr><th rowspan="2">NAVIGATION ACCURACY</th><th colspan="2">ND</th><th rowspan="2">AP/FD mode</th></tr>
<tr><th>PF</th><th>PNF</th></tr>
<tr><td>NAV ACCUR HIGH</td><td colspan="2" rowspan="3">ARC or ROSE NAV with navaid raw data</td><td rowspan="3">NAV</td></tr>
<tr><td>NAV ACCUR HIGH</td></tr>
<tr><td>NAV ACCUR LOW and NAV ACCURACY check $\leq$1 NM</td></tr>
<tr><td>GPS PRIMARY LOST and NAV ACCUR LOW and NAV ACCURACY check >1 NM</td><td rowspan="2">ROSE ILS</td><td rowspan="2">ARC or ROSE NAV or ROSE ILS with navaid raw data</td><td rowspan="2">HDG or TRK</td></tr>
<tr><td>Aircraft flying within unreliable radio navaid area</td></tr>
</table>

## FLYING REFERENCE

The crew will select HDG V/S on the FCU i.e. "bird" off.

## APPROACH PHASE ACTIVATION

For a standard ILS, the crew should plan a decelerated approach. However, if the G/S angle is greater than 3.5° or if forecast tail wind at landing exceeds 10 kt (if permitted by the AFM), a stabilized approach is recommended.

If FAF is at or below 2000 ft AGL and if deceleration is carried out using selected speed, the crew should plan a deceleration in order to be able to select config. 2 one dot below the G/S.

## MISCELLANEOUS

The ILS or LS PB is to be checked pressed in the first stage of the approach. The crew will check that

. LOC and GS scales and deviations are displayed on PFD

. IDENT is properly displayed on the PFD. If no or wrong ident displayed, the crew will check the audio ident.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0033 0036 0043-0044 0061-0063 0087-0088 0100-0102 0108 0113-0115 0128-0131 0133-0134 0136 0143-0146 0155-0156 0158 0173 0176-0177 0184 0186-0188 0199 0203-0204 0207 0211 0214-0215 0220 0223-0224 0226-0228 0235-0241 0244 0246 0264 0266 0270 0274 0278 0285-0287 0303 0312 0323 0337 0352 0356 0377 0400 0412 0434 0458 0466 0468 0473-0474 0477 0484 0488 0491 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529-0530 0532-0533 0535 0541 0544-0545 0548 0550 0552-0553 0557 0559-0560 0562-0567 0569-0570 0573-0578 0580-0583 0585-0586 0588 0593 0595-0596 0598-0600 0603 0608-0610 0612 0616 0618 0620-0623 0625 0627 0629 0631 0635 0637 0641-0644 0646-0647 0651-0654 0657 0659-0668 0673-0675 0677 0679-0681 0684 0687 0689 0692 0694 0696 0698-0701 0703-0706 0709-0710 0712-0713 0715 0717-0718 0720 0722-0723 0725 0727 0729 0734 0737-0739 0743-0745 0749-0750 0753-0755 0761 0763 0765 0767-0768 0771 0774-0777 0781-0782 0787 0790 0792-0794 0796-0797 0802 0805-0806 0808-0812 0815-0816 0819 0821 0823 0827 0833 0835 0837-0839 0841 0844 0848-0849 0852-0855 0859-0861 0863-0864 0868-0870 0872 0875 0877-0878 0880-0881 0884-0885 0887 0890-0892 0894-0897 0899-0901 0904-0906 0908-0910 0913-0915 0917 0919-0920 0922 0926-0930 0932-0936 0938-0943 0945-0947 0949-0951 0954 0956-0961 0963 0966-0977 0979 0982-0987 0990-0995 0997-1000 1002 1004-1010 1012-1021 1023-1031 1033-1036 1038-1042 1044-1048 1051-1055 1057 1059-1061 1063 1065-1070 1072-1074 1077 1080-1082 1084 1086-1087 1089 1092-1109 1112-1115 1118-1125 1127-1128 1130 1132-1148 1150-1163 1165 1168-1177 1179-1190 1192-1222 1224-1229 1231-1233 1235-1248 1250-1273 1275-1280 1282-1283 1285-1322 1326-1345 1347-1349 1351-1372 1374 1376-1391 1393-1394 1396 1398-1413 1415-1433 1435-1452 1454-1455 1457-1482 1484-1497 1499-1500 1502-1519 1521-1534 1536-1542 1544-1548 1550-1566 1568-1569 1571-1581 1583-1632 1634-1640 1642-1645 1647-1658 1660-1661 1663-1682 1684 1686-1692 1694-1708 1710-1713 1715-1737 1739-1745 1747-1751 1753-1765 1767-1773 1775-1788 1790-1795 1797-1799 1801-1809 1811 1814 1816-1818 1821-1823 1825-1827 1829-1832 1834-1838 1840-1869 1871-1874 1876-1896 1898-1922 1924-1958 1960-1975 1977-1981 1983-1989 1991-2001 2003-2012 2014-2024 2027 2029-2038 2040-2046 2048-2081 2083-2086 2088-2091 2093-2094 2096-2368 2370-2372 2374-2463 2465-2473 2475-2617 2619-2640 2642-3260

## NAVIGATION ACCURACY

When GPS PRIMARY is available, no NAV ACCURACY monitoring is required. When GPS PRIMARY is lost the crew will check on MCDU PROG page that the required navigation accuracy is appropriate. If NAV ACCURACY DOWNGRAD is displayed, the crew will use raw data for navigation accuracy check. The navigation accuracy determines which AP modes the crew should use and the type of display to be shown on the ND.

| NAVIGATION ACCURACY | ND | | AP/FD mode |
|---|---|---|---|
| | PF | PNF | |
| GPS PRIMARY | ARC or ROSE NAV with navaid raw data | | NAV |
| NAV ACCUR HIGH | | | |
| NAV ACCUR LOW and NAV ACCURACY check $\leq$1 NM | | | |

| | | | |
|---|---|---|---|
| GPS PRIMARY LOST and NAV ACCUR LOW and NAV ACCURACY check >1 NM | ROSE ILS | ARC or ROSE NAV or ROSE ILS with navaid raw data | HDG or TRK |
| GPS PRIMARY LOST and Aircraft flying within unreliable radio navaid area | | | |

## FLYING REFERENCE

The crew will select HDG V/S on the FCU i.e. "bird" off.

## APPROACH PHASE ACTIVATION

For a standard ILS, the crew should plan a decelerated approach. However, if the G/S angle is greater than 3.5° or if forecast tail wind at landing exceeds 10 kt (if permitted by the AFM), a stabilized approach is recommended.

If FAF is at or below 2000 ft AGL and if deceleration is carried out using selected speed, the crew should plan a deceleration in order to be able to select config. 2 one dot below the G/S.

## MISCELLANEOUS

The ILS or LS PB is to be checked pressed in the first stage of the approach. The crew will check that

. LOC and GS scales and deviations are displayed on PFD

. IDENT is properly displayed on the PFD. If no or wrong ident displayed, the crew will check the audio ident.

# INTERMEDIATE APPROACH

ALL

## INTERCEPTION OF FINAL APPROACH COURSE

When cleared for the ILS, the APPR pb should be pressed. This arms the approach mode and LOC and GS are displayed in blue on the FMA. At this stage the second AP, if available, should be selected.

If the ATC clears for a LOC capture only, the crew will press LOC p/b on the FCU.

If the ATC clears for approach at a significant distance, e.g. 30 NM, the crew should be aware that the G/S may be perturbed and CAT 1 will be displayed on FMA till a valid Radio Altimeter signal is received.

## FINAL APPROACH

ALL

### GLIDE SLOPE INTERCEPTION FROM ABOVE

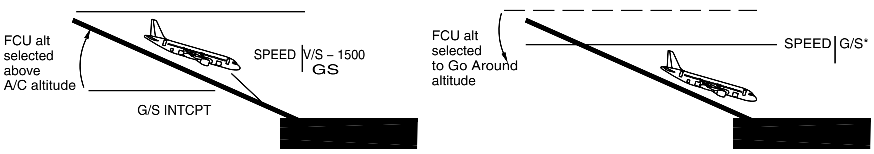
The following procedure should only be applied when established on the localizer. There are a number of factors which might lead to a glide slope interception from above. In such a case, the crew must react without delay to ensure the aircraft is configured for landing before 1000 ft AAL. In order to get the best rate of descent when cleared by ATC and below the limiting speeds, the crew should lower the landing gear and select Config 2. Speedbrakes may also be used, noting the considerations detailed in the sub-section "Deceleration and configuration change" earlier in this chapter. The recommended target speed for this procedure is VFE 2 - 5kts. When cleared to intercept the glide slope, the crew should:

. Press the APPR pb on FCU and confirm G/S is armed.

. Select the FCU altitude above aircraft altitude to avoid unwanted ALT*.

. Select V/S 1500 fpm initially. V/S in excess of 2000 fpm will result in the speed increasing towards VFE

A/C HIGH ABOVE G/S - RECOMMENDED G/S CAPTURE TECHNIQUE

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It is vital to use V/S rather than OP DES to ensure that the A/THR is in speed mode rather than IDLE mode. The rate of descent will be carefully monitored to avoid exceeding VFE . When approaching the G/S, G/S* will engage. The crew will monitor the capture with raw data (pitch and G/S deviation). The missed approach altitude will be set on the FCU and speed reduced so as to be configured for landing by 1000 ft.

In such a situation, taking into account the ground obstacles and if ATC permits, it may be appropriate to carry out a 360° turn before resuming the approach.

Close to the ground, avoid important down corrections. Give priority to attitude and sink rate. (See TAILSTRIKE AVOIDANCE in LANDING section).

## MISCELLANEOUS

In case of double receiver failure, the red LOC/GS flags are displayed, ILS scales are removed, THE AP trips off and the FDs revert to HDG/VS mode.

In case of the ILS ground transmitter failure, the AP/FD with LOC/GS modes will remain ON. This is because such a failure is commonly transient. In such a case, ILS scales and FD bars are flashing. If R/A height is below 200 ft, the red LAND warning is triggered. If this failure lasts more than several seconds or in case of AUTOLAND red warning, the crew will interrupt the approach.

# ILS RAW DATA

ALL

## INITIAL APPROACH

**FLYING REFERENCE**

The "bird" is to be used as the flying reference.

**APPROACH PHASE ACTIVATION**

The approach technique is the stabilized approach.

**INTERMEDIATE APPROACH**

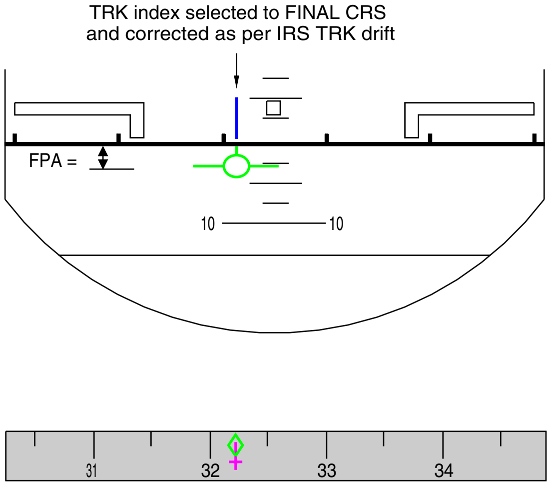
The TRK index will be set to the ILS course and, once established on the LOC, the tail of the bird should be coincident with the TRK index. This method allows accurate LOC tracking taking into account the drift.

Should the LOC deviate, the pilot will fly the bird in the direction of the LOC index, and when re-established on the LOC, set the tail of the bird on the TRK index again. If there is further LOC deviation, a slight IRS drift should be suspected. The bird is computed out of IRS data. Thus, it may be affected by IRS data drift amongst other TRK. A typical TRK error at the end of the flight is 1° to 2°.

The ILS course pointer and the TRK diamond are also displayed on PFD compass.

**FINAL APPROACH**

When 1/2 dot below the G/S, the pilot should initiate the interception of the G/S by smoothly flying the FPV down to the glide path angle. The bird almost sitting on the -5° pitch scale on PFD, provides a -3° flight path angle. Should the G/S deviate, the pilot will make small corrections in the direction of the deviation and when re-established on the G/S, reset the bird to the G/S angle.

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## PREFACE

ALL

This chapter deals with some characteristics of the Non Precision Approach (NPA). Recommendations mentioned in APPROACH GENERAL chapter apply. NPA are defined as:

. VOR approach

. NDB approach

. LOC, LOC-BC approach

. R-NAV approach.

## APPROACH STRATEGY

ALL

The overall strategy of NPA completion is to fly it "ILS alike" with the same mental image or representation and similar procedure. Instead of being referred to an ILS beam, the AP/FD guidance modes and associated monitoring data are referred to the FMS F-PLN consolidated by raw data. LOC only approach is the exception where LOC mode and localizer scale are to be used. This explains why the crew must ensure that the FMS data is correct, e.g. FMS accuracy, F-PLN (lateral and vertical) and proper leg sequencing.

The use of AP is recommended for all non-precision approaches as it reduces crew workload and facilitates monitoring the procedure and flight path.

## LIMITATIONS

ALL

Lateral and vertical managed guidance (FINAL APP) can be used provided the following conditions are met:

. The approach is defined in the navigation database

. The approach has been crosschecked by the crew with the published procedure

. The approach is approved by the operator for use of FINAL APP mode.

. The final approach is not modified by the crew.

. If one engine is inoperative, it is not permitted to use the autopilot to perform NPAs in the following modes: FINAL APP, NAV V/S, NAV/FPA. Only FD use is permitted (FCOM 3.01.22). In others words, if the use of the autopilot is preferred, its use will be limited to TRK/FPA or HDG/VS modes.

## INITIAL APPROACH

MSN 0006 0008 0011 0017-0018 0022-0032 0034-0035 0037-0042 0045-0059 0064-0086 0089-0099 0103-0104 0109-0112 0116-0127 0132 0135 0137-0142 0147-0154 0157 0159-0172 0174-0175 0178-0183 0185 0189-0198 0200-0202 0205-0206 0208-0210 0212-0213 0216-0219 0221-0222 0225 0229-0234 0242-0243 0245 0247-0263 0265 0267-0269 0272-0273 0275-0277 0279-0284 0288-0302 0304-0311 0313-0322 0324-0336 0338-0351 0353-0355 0357-0376 0378-0399 0401-0411 0413-0432 0435-0457 0459-0465 0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0490 0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0531 0534 0537-0540 0542-0543 0546 0549 0551 0554-0556 0558 0561 0568 0571-0572 0579 0584 0587 0589-0592 0594 0597 0601 0604-0607 0611 0613-0615 0617 0619 0624 0626 0628 0630 0633-0634 0636 0638-0640 0645 0648-0650 0655-0656 0658 0669-0672 0676 0678 0682-0683 0685-0686 0688 0690-0691 0693 0695 0697 0702 0707 0711 0714 0716 0719 0721 0724 0726 0728 0730-0733 0735-0736 0740-0742 0746-0748 0751-0752 0756-0760 0762 0764 0766 0769-0770 0772-0773 0778-0780 0783-0786 0788-0789 0791 0795 0798-0801 0803-0804 0807 0813-0814 0817-0818 0820 0822 0824-0826 0828-0832 0834 0836 0840 0842-0843 0845-0847 0850-0851 0856-0858 0862 0865-0867 0871 0873-0874 0876 0879 0882-0883 0886 0888-0889 0893 0898 0902-0903 0907 0911-0912 0916 0918 0921 0923-0925 0931 0937 0944 0948 0952-0953 0955 0962 0964-0965 0978 0980-0981 0988-0989 0996 1001 1003 1011 1022 1032 1037 1043 1049-1050 1056 1058 1062 1064 1071 1075-1076 1078-1079 1083 1085 1088 1090-1091 1110-1111 1116-1117 1126 1129 1131 1149 1164 1166-1167 1178 1191 1223 1230 1234 1249 1274 1281 1284 1323-1325 1346 1350 1373 1375 1392 1395 1397 1414 1434 1453 1456 1483 1498 1501 1520 1535 1543 1549 1567 1570 1582 1633 1641 1646 1659 1662 1683 1685 1693 1709 1714 1738 1746 1752 1766 1774 1789 1796 1800 1810 1812 1815 1819-1820 1824 1828 1833 1839 1870 1875 1897 1923 1959 1976 1982 1990 2002 2013 2026 2028 2039 2047 2082 2087 2092 2095 2369 2373 2464 2474 2618 2641

### NAVIGATION ACCURACY

The navigation accuracy check is most essential since it determines

. The AP/FD guidance mode to be used

. The ND display mode to be used

. Which raw data which are to be used.

| NAVIGATION ACCURACY | Approach guidance | ND PF | ND PNF | AP/FD mode |
|---|---|---|---|---|
| NAV ACCUR HIGH<br>NAV ACCUR LOW and NAV ACCURACY checK ≤1NM | Managed*** | ARC or ROSE NAV* with navaid raw data | | NAV-FPA or APP-NAV/FINAL*** |
| NAV ACCUR LOW and NAV ACCURACY check > 1NM<br>GPS PRIMARY LOST and aircraft flying within unreliable radio navaid area | Selected | ROSE VOR** | ARC or ROSE NAV or ROSE VOR** with navaid raw data | TRK-FPA |

(*) For VOR approach, one pilot may select ROSE VOR

(**) For LOC approach, select ROSE ILS

(***) The managed vertical guidance can be used provided the above limitations are observed.

Should a NAV ACCY DNGRADED message is displayed before a managed non-precision approach, the crew should proceed as follow:

. Cross-check the navigation accuracy with raw data

. If positive, continue managed approach. (*)

. If negative, revert to selected approach with raw data.

(*) If HIGH accuracy is lost on one FMGC, the approach can be continued with the AP/FD associated to the other FMGC.

## FLYING REFERENCE

The "bird" is to be used as the flying reference

## APPROACH PHASE ACTIVATION

The stabilized approach technique is recommended. The crew will set VAPP as a speed constraint at FAF in order to get a meaningful deceleration pseudo waypoint.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0033 0036 0043-0044 0061-0063 0087-0088 0100-0102 0108 0113-0115 0128-0131 0133-0134 0136 0143-0146 0155-0156 0158 0173 0176-0177 0184 0186-0188 0199 0203-0204 0207 0211 0214-0215 0220 0223-0224 0226-0228 0235-0241 0244 0246 0264 0266 0270 0274 0278 0285-0287 0303 0312 0323 0337 0352 0356 0377 0400 0412 0434 0458 0466 0468 0473-0474 0477 0484 0488 0491 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529-0530 0532-0533 0535 0541 0544-0545 0548 0550 0552-0553 0557 0559-0560 0562-0567 0569-0570 0573-0578 0580-0583 0585-0586 0588 0593 0595-0596 0598-0600 0603 0608-0610 0612 0616 0618 0620-0623 0625 0627 0629 0631 0635 0637 0641-0644 0646-0647 0651-0654 0657 0659-0668 0673-0675 0677 0679-0681 0684 0687 0689 0692 0694 0696 0698-0701 0703-0706 0709-0710 0712-0713 0715 0717-0718 0720 0722-0723 0725 0727 0729 0734 0737-0739 0743-0745 0749-0750 0753-0755 0761 0763 0765 0767-0768 0771 0774-0777 0781-0782 0787 0790 0792-0794 0796-0797 0802 0805-0806 0808-0812 0815-0816 0819 0821 0823 0827 0833 0835 0837-0839 0841 0844 0848-0849 0852-0855 0859-0861 0863-0864 0868-0870 0872 0875 0877-0878 0880-0881 0884-0885 0887 0890-0892 0894-0897 0899-0901 0904-0906 0908-0910 0913-0915 0917 0919-0920 0922 0926-0930 0932-0936 0938-0943 0945-0947 0949-0951 0954 0956-0961 0963 0966-0977 0979 0982-0987 0990-0995 0997-1000 1002 1004-1010 1012-1021 1023-1031 1033-1036 1038-1042 1044-1048 1051-1055 1057 1059-1061 1063 1065-1070 1072-1074 1077 1080-1082 1084 1086-1087 1089 1092-1109 1112-1115 1118-1125 1127-1128 1130 1132-1148 1150-1163 1165 1168-1177 1179-1190 1192-1222 1224-1229 1231-1233 1235-1248 1250-1273 1275-1280 1282-1283 1285-1322 1326-1345 1347-1349 1351-1372 1374 1376-1391 1393-1394 1396 1398-1413 1415-1433 1435-1452 1454-1455 1457-1482 1484-1497 1499-1500 1502-1519 1521-1534 1536-1542 1544-1548 1550-1566 1568-1569 1571-1581 1583-1632 1634-1640 1642-1645 1647-1658 1660-1661 1663-1682 1684 1686-1692 1694-1708 1710-1713 1715-1737 1739-1745 1747-1751 1753-1765 1767-1773 1775-1788 1790-1795 1797-1799 1801-1809 1811 1814 1816-1818 1821-1823 1825-1827 1829-1832 1834-1838 1840-1869 1871-1874 1876-1896 1898-1922 1924-1958 1960-1975 1977-1981 1983-1989 1991-2001 2003-2012 2014-2024 2027 2029-2038 2040-2046 2048-2081 2083-2086 2088-2091 2093-2094 2096-2368 2370-2372 2374-2463 2465-2473 2475-2617 2619-2640 2642-3260

## NAVIGATION ACCURACY

The navigation accuracy check is most essential since it determines

. The AP/FD guidance mode to be used

. The ND display mode to be used

. Which raw data which are to be used.

| NAVIGATION ACCURACY | Approach guidance | ND | | AP/FD mode |
|---|---|---|---|---|
| | | PF | PNF | |
| GPS PRIMARY | Managed*** | ARC or ROSE NAV* with navaid raw data | | NAV-FPA or APP-NAV/FINAL*** |
| NAV ACCUR HIGH | | | | |
| NAV ACCUR LOW and NAV ACCURACY checK ≤1NM | | | | |

<table>
<tr><td>GPS PRIMARY LOST and NAV ACCUR LOW and NAV ACCURACY check > 1NM</td><td rowspan="2">Selected</td><td rowspan="2">ROSE VOR**</td><td rowspan="2">ARC or ROSE NAV or ROSE VOR** with navaid raw data</td><td rowspan="2">TRK-FPA</td></tr>
<tr><td>GPS PRIMARY LOST and aircraft flying within unreliable radio navaid area</td></tr>
</table>

(*) For VOR approach, one pilot may select ROSE VOR

(**) For LOC approach, select ROSE ILS

(***) The managed vertical guidance can be used provided the approach coding in the navigation database has been validated.

Should a NAV ACCY DNGRADED or a GPS PRIMARY LOST message is displayed before a managed non-precision approach, the crew should proceed as follow:

<table>
<tr><th>Message</th><th>VOR, ADF, VOR/DME approach</th><th>GPS approach</th></tr>
<tr><td>GPS PRIMRAY LOST</td><td rowspan="2">Cross-check the navigation accuracy:<br>If positive, continue managed approach (*)<br>If negative, revert to selected approach with raw data.</td><td>Interrupt the approach</td></tr>
<tr><td>NAV ACCY DNGRADED</td><td>-</td></tr>
</table>

(*) If HIGH accuracy is lost on one FMGC, the approach can be continued with the AP/FD associated to the other FMGC.

## FLYING REFERENCE

The "bird" is to be used as the flying reference

## APPROACH PHASE ACTIVATION

The stabilized approach technique is recommended. The crew will set VAPP as a speed constraint at FAF in order to get a meaningful deceleration pseudo waypoint.

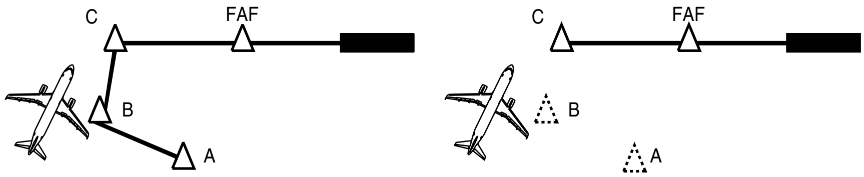
## INTERMEDIATE APPROACH

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892

## INTERCEPTION OF FINAL APPROACH COURSE

It is essential to have a correct F-PLN in order to ensure proper final approach guidance. Indeed the NAV and APPR NAV modes are always guiding the aircraft along the F-PLN active leg and the managed vertical mode ensures VDEV =0, VDEV, being computed along the remaining F-PLN to destination. Hence, the crew will monitor the proper sequencing of the F-PLN, more specifically if HDG mode is selected, by checking that the TO WPT, on upper right hand corner of ND, is the most probable one and meaningful.

### F-PLN SEQUENCE IN APPROACH




Radar vectors: pilot has not cleared A, B. A is still TO WPT – Hence no proper guidance available nor predictions.

Radar vectors: pilot has monitored the TO WPT and cleared successively A and B when no longer probable. Hence VDEV is meaningful and APPR NAV or NAV may be armed.

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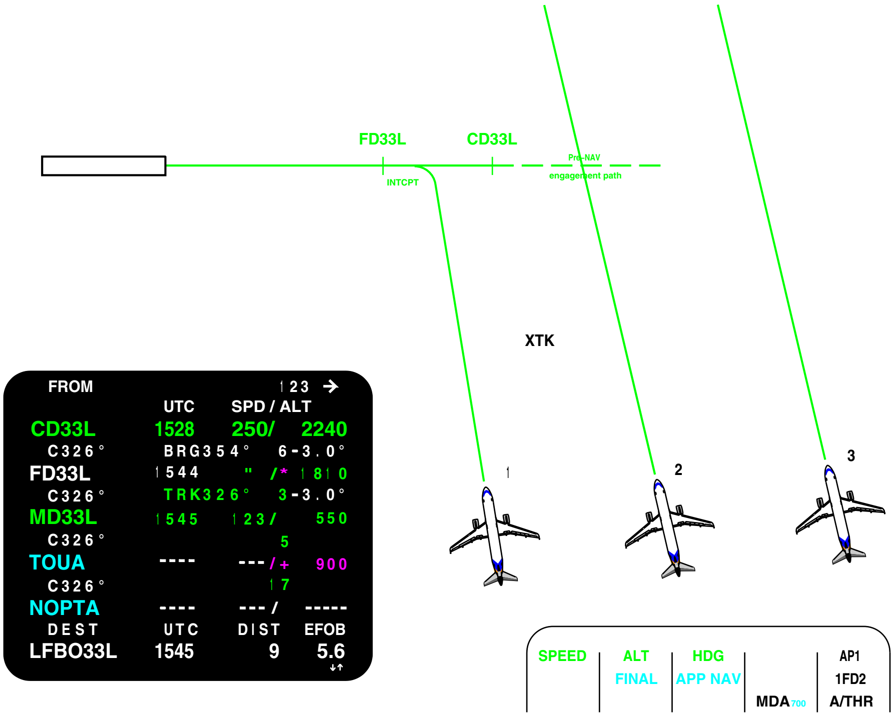
When ATC gives radar vector and clears for final approach course interception, the crew will:

⇒ For managed approach
. Select HDG according to ATC
. Select APPR p/b on FCU
. Check on FMA the final approach mode engagement

If the green solid line intercepts the F-PLN active leg (1), this creates an INTERCPT point with final approach axis. APP NAV will engage when intercepting the final approach course.
If the green solid line intercepts the PRE NAV engagement path (2), APP NAV engages when intercepting the final approach course. The PRE NAV engagement path is at least 1 NM and may be longer depending on aircraft speed.
HDG or TRK may be used to smooth the final approach course interception.
When close to the final approach course, DIR TO function may be used.
If the green solid line does not intercept the PRE NAV engagement path (3), APP NAV will not engage.
XTK is related to the beam and the ND gives a comprehensive display.
Additionally, the VDEV becomes active and represents the vertical deviation, which may include a level segment. The VDEV/brick scale will only be displayed if ILS or LS pb is not pressed. If the ILS or LS pb is pressed by mistake, the V/DEV will flash in amber on the PFD.




NOF 02120 04225 0001

⇒ For selected approach
- Select appropriate TRK on FCU in order to establish final course tracking with reference to raw data. When established on the final course, the selected track will compensate for drift.

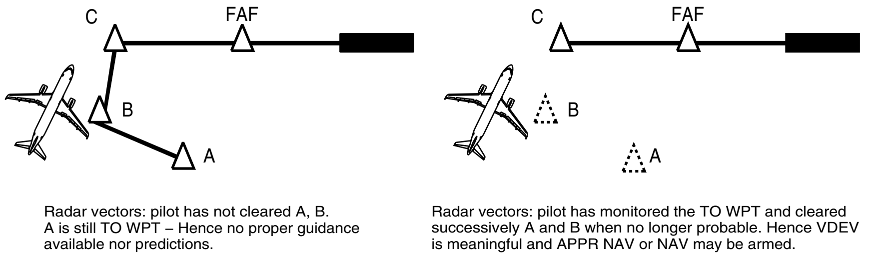
The final approach course interception will be monitored through applicable raw data.

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-1901 1903-1986 1988-2057 2059-2103 2105-2114 2116-2142 2144-2251 2253-3260

## INTERCEPTION OF FINAL APPROACH COURSE

It is essential to have a correct F-PLN in order to ensure proper final approach guidance. Indeed the NAV and APPR NAV modes are always guiding the aircraft along the F-PLN active leg and the managed vertical mode ensures VDEV =0, VDEV, being computed along the remaining F-PLN to destination. Hence, the crew will monitor the proper sequencing of the F-PLN, more specifically if HDG mode is selected, by checking that the TO WPT, on upper right hand corner of ND, is the most probable one and meaningful.

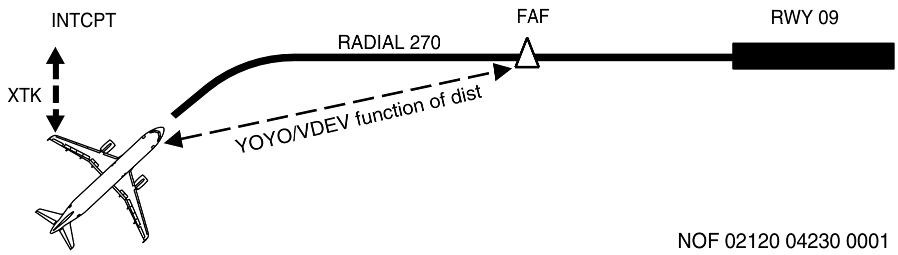
F-PLN SEQUENCE IN APPROACH




NOF 02120 04229 0001

If ATC gives radar vectors for final approach course interception, the crew will use DIR TO FAF with RADIAL INBND facility. This creates an ILS alike beam which will be intercepted by NAV and APPR NAV modes. Additionally, the VDEV is realistic, XTK is related to the beam and the ND gives a comprehensive display.

F-PLN IN APPROACH




NOF 02120 04230 0001

When cleared for final approach course interception, the pilot will either

⇒ For managed approach
Press APPR p/b on FCU. On the FMA, APP NAV becomes active and FINAL becomes armed. The VDEV or "brick" scale becomes active and represents the vertical deviation, which may include a level segment. The VDEV/brick scale will only be displayed if ILS or LS pb is not pressed. If the ILS or LS pb is pressed by mistake, the V/DEV will flash in amber on the PFD

⇒ For selected approach
Select adequate TRK on FCU in order to establish final course tracking with reference to raw data. When established on the final course, the selected track will compensate for drift.

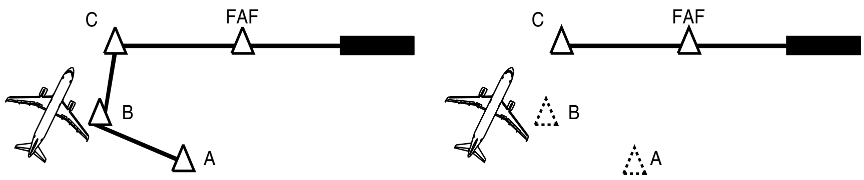
The final approach course interception will be monitored through applicable raw data.

MSN 1902 1987 2058 2104 2115 2143 2252

## INTERCEPTION OF FINAL APPROACH COURSE

It is essential to have a correct F-PLN in order to ensure proper final approach guidance. Indeed the NAV and APPR NAV modes are always guiding the aircraft along the F-PLN active leg and the managed vertical mode ensures VDEV =0, VDEV, being computed along the remaining F-PLN to destination. Hence, the crew will monitor the proper sequencing of the F-PLN, more specifically if HDG mode is selected, by checking that the TO WPT, on upper right hand corner of ND, is the most probable one and meaningful.

F-PLN SEQUENCE IN APPROACH




Radar vectors: pilot has not cleared A, B. A is still TO WPT – Hence no proper guidance available nor predictions.

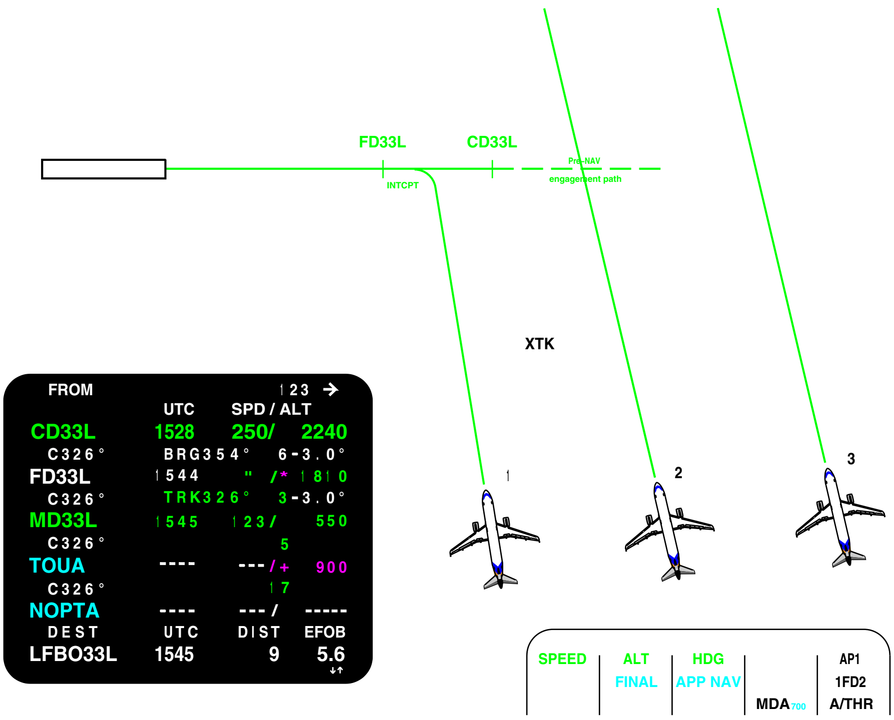
Radar vectors: pilot has monitored the TO WPT and cleared successively A and B when no longer probable. Hence VDEV is meaningful and APPR NAV or NAV may be armed.

NOF 02120 04224 0001

When ATC gives radar vector and clears for final approach course interception, the crew will:

⇒ For managed approach
. Select HDG according to ATC
. Select APPR p/b on FCU
. Check on FMA the final approach mode engagement
If the green solid line intercepts the F-PLN active leg (1), this creates an INTERCPT point with final approach axis. APP NAV will engage when intercepting the final approach course.
If the green solid line intercepts the PRE NAV engagement path (2), APP NAV engages when intercepting the final approach course. The PRE NAV engagement path is at least 1 NM and may be longer depending on aircraft speed.
HDG or TRK may be used to smooth the final approach course interception. When close to the final approach course, DIR TO function may be used.
If the green solid line does not intercept the PRE NAV engagement path (3), APP NAV will not engage.
XTK is related to the beam and the ND gives a comprehensive display. Additionally, the VDEV becomes active and represents the vertical deviation, which may include a level segment. The VDEV/brick scale will only be

displayed if ILS or LS pb is not pressed. If the ILS or LS pb is pressed by mistake, the V/DEV will flash in amber on the PFD.




NOF 02120 04225 0001

⇒ For selected approach
. Select appropriate TRK on FCU in order to establish final course tracking with reference to raw data. When established on the final course, the selected track will compensate for drift.

The final approach course interception will be monitored through applicable raw data.

## FINAL APPROACH

MSN 0035 0037-0038 0043 0045-0058 0064-0067 0074-0077 0080-0082 0089-0091 0095-0099 0113-0114 0163-0166 0168-0169 0178-0182 0189-0190 0193-0195 0198 0221-0222 0225 0230 0232 0243 0247 0249-0252 0256-0257 0259-0261 0275-0276 0280 0289 0291-0292 0294-0296 0299 0301 0304 0308 0314 0316-0317 0320-0322 0326-0327 0332 0334-0336 0338 0343 0347 0349 0351 0353-0354 0357 0361-0363 0366 0368-0369 0371 0373 0376 0379 0386 0389 0391-0394 0396-0398 0405-0406 0411 0414-0416 0422-0425 0428-0432 0437 0440-0441 0443-0444 0446-0449 0451 0453 0455 0460-0461 0467 0469 0471 0476 0478 0480

It is essential that the crew does not modify the final approach in the MCDU FPLN page.

The final approach will be flown either

. Managed or

. Selected

**MANAGED**

For a managed approach, APP NAV FINAL becomes active and the FM manages both lateral and vertical guidance. The crew will monitor the final approach using

. Start of descent blue symbol on ND

. FMA on PFD

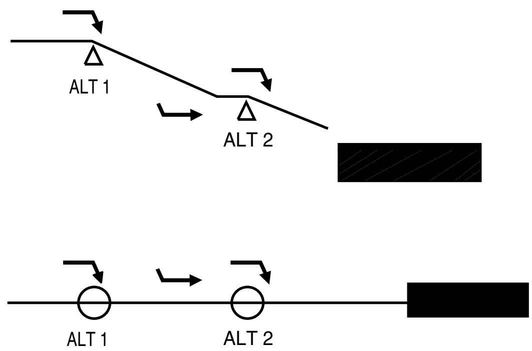
. VDEV, XTK, F-PLN on ND with GPS PRIMARY

. VDEV, XTK, F-PLN confirmed by needles, distance/altitude

If APP NAV FINAL does not engage at start of descent, the crew will select FPA convergent to the final path so as to fly with VDEV=0. Once VDEV=0, the crew may try to re-engage APPR.

In some NPAs, the final approach flies an "idle descent" segment from one altitude constraint to another, followed by a level segment. This is materialized by a magenta level off symbol on ND followed by a blue start of descent.

FINAL APPROACH TRAJECTORY WITH IDLE DESCENT SEGMENT




NOF 02120 04231 0001

## SELECTED

For a selected approach, the Final Path Angle (FPA) should be preset on the FCU 1 NM prior to the FAF at the latest. A smooth interception of the final approach path can be achieved by pulling the FPA selector 0.2 NM prior to the FAF.

If GPS is PRIMARY, the crew will monitor VDEV, XTK and F-PLN. Additionally, for VOR or ADF approaches, the crew will monitor raw data.

MSN 0002-0034 0036 0039-0042 0044 0059-0063 0068-0073 0078 0083-0088 0093-0094 0100-0112 0115-0162 0167 0170-0177 0183-0188 0191-0192 0196-0197 0199-0220 0223-0224 0226-0229 0231 0233-0242 0244-0246 0248 0253-0255 0258 0262-0274 0277-0279 0281-0288 0290 0293 0297-0298 0300 0302-0303 0305-0307 0309-0313 0315 0318-0319 0323-0325 0328-0331 0333 0337 0339-0342 0344-0346 0348 0350 0352 0355-0356 0358-0360 0364-0365 0367 0370 0372 0375 0377-0378 0380-0385 0387-0388 0390 0395 0399-0404 0407-0410 0412-0413 0417-0421 0426-0427 0434-0436 0438-0439 0442 0445 0450 0452 0454 0456-0459 0462-0466 0468 0470 0472-0475 0477 0479 0482-3260

It is essential that the crew does not modify the final approach in the MCDU FPLN page.

The final approach will be flown either

. Managed or

. Selected

## MANAGED

For a managed approach, FINAL APP becomes active and the FM manages both lateral and vertical guidance. The crew will monitor the final approach using

. Start of descent blue symbol on ND

. FMA on PFD

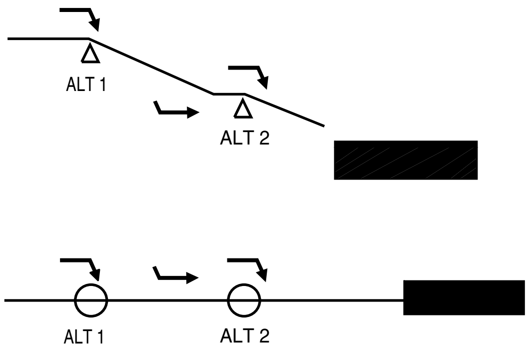
. VDEV, XTK, F-PLN on ND with GPS PRIMARY

. VDEV, XTK, F-PLN confirmed by needles, distance/altitude

If FINAL APPR does not engage at start of descent, the crew will select FPA convergent to the final path so as to fly with VDEV=0. Once VDEV=0, the crew may try to re-engage APPR.

In some NPAs, the final approach flies an "idle descent" segment from one altitude constraint to another, followed by a level segment. This is materialized by a magenta level off symbol on ND followed by a blue start of descent.

<u>FINAL APPROACH TRAJECTORY WITH IDLE DESCENT SEGMENT</u>




NOF 02120 04232 0001

## <u>SELECTED</u>

For a selected approach, the Final Path Angle (FPA) should be preset on the FCU 1 NM prior to the FAF at the latest. A smooth interception of the final approach path can be achieved by pulling the FPA selector 0.2 NM prior to the FAF. If GPS is PRIMARY, the crew will monitor VDEV, XTK and F-PLN. Additionally, for VOR or ADF approaches, the crew will monitor raw data.

## REACHING THE MINIMA

ALL

When approaching MDA, the pilot flying should expand the instrument scan to include outside visual cues.

Reaching MDA, "MINIMUM" is either monitored or called by the crew. The current altitude value becomes amber.

If the required conditions are not met by MDA, a missed approach must be initiated.

When the required visual conditions are met to continue the approach, the AP must be disconnected, the FDs selected off, Bird ON and continue for visual approach.

## LOC ONLY APPROACH

ALL

LOC ONLY approaches may be flown using the LOC signal for lateral navigation and FPA for vertical guidance. General recommendations mentioned above still apply i.e. stabilized approach technique, use of the bird. Some additional recommendations need to be highlighted.

### INITIAL APPROACH

The crew will select LS p/b on the EIS control panel.

### INTERMEDIATE APPROACH

The crew will press LOC p/b on the FCU when cleared to intercept. He will monitor the LOC armed mode and then LOC capture.

### FINAL APPROACH

Approaching FAF, the crew will select FPA. When established on the final path, the crew will monitor:

. Lateral displacement with LOC deviation

. Vertical displacement with DME and ALT, "yoyo", chrono

## LOC BACK COURSE APPROACH

MSN 0002-2611 2613-2632 2634-2655 2657-2682 2684-2698 2700-2718 2720-2757 2759 2761-2788 2790-2800 2802-2815 2817-2825 2827-2841 2843-2880 2882-2884 2886-2925 2927-2943 2945-2955 2957-2988 2990-2999 3001-3017 3019-3030 3032-3042 3044-3059 3061-3063 3065-3084 3086-3093 3095-3096 3098-3116 3118-3139 3141-3153 3155-3172 3174-3181 3183-3193 3195-3200 3202-3260

LOC-BC approaches may be flown using the Bird with reference to the LOC-BC signal for lateral guidance and FPA for vertical guidance. General recommendations mentioned above still apply i.e. stabilized approach technique and use of the bird. Some additional recommendations need to be highlighted.

### GENERAL

The LOC BC approach consists in using the LOC signal of the opposite runway for lateral approach management.

The ILS will be manually entered in the MCDU RAD NAV page using:

. Either the ident (ILS stored in the FMS database). RWY/ILS MISMATCH message may be triggered and will be disregarded.

. Or the frequency (ILS not stored in the FMS database).

In both cases, the front course will be entered in the CRS field.

### INITIAL APPROACH

The crew will select ROSE ILS and TRK/FPA. The crew will not select ILS or L/S p/b on the EIS control panel and ISIS (if installed), as it would provide reverse deviation.

### INTERMEDIATE APPROACH

When clear for approach, the crew will intercept manually LOC/BC using the blue TRK index with reference with LOC/BC lateral deviation on ND. The crew will not arm LOC or APPR modes.

### FINAL APPROACH

Approaching the FAF, the crew will select the FPA corresponding to the final approach path, LOC deviation (proper directional guidance), DME/ALT, time, yoyo.

MSN 2612 2633 2656 2683 2699 2719 2758 2760 2789 2801 2816 2826 2842 2881 2885 2926 2944 2956 2989 3000 3018 3031 3043 3060 3064 3085 3094 3097 3117 3140 3154 3173 3182 3194 3201

LOC-BC approaches may be flown using the Bird with reference to the LOC-BC signal for lateral guidance and FPA for vertical guidance. General recommendations mentioned above still apply i.e. stabilized approach technique and use of the bird. Some additional recommendations need to be highlighted.

## GENERAL

The LOC BC approach consists in using the LOC signal of the opposite runway for lateral approach management.

If the LOC BC approach is stored in the FMS database, it will be inserted into the F-PLN. The ILS frequency and associated back course are automatically tuned and displayed on the MCDU RAD NAV page. The CRS digit will be preceded by a "B".

If LOC BC is not stored in the FMS database, the crew will enter the ILS frequency and the final approach CRS the aircraft will actually fly preceded by a "B" in MCDU RAD NAV page. B/C in magenta will be displayed both on PFD and ND. This provides a proper directional deviation on PFD and a proper directional guidance from the FG.

## INITIAL APPROACH

The crew will select L/S p/b on the EIS control panel.

## INTERMEDIATE APPROACH

The crew will press LOC p/b on the FCU to arm LOC/BC and will monitor LOC/BC capture.

## FINAL APPROACH

Approaching the FAF, the crew will select the FPA corresponding to the final approach path, LOC deviation (proper directional guidance), DME/ALT, time, yoyo.

## PREFACE

ALL

The circling approach is flown when the tower wind is such that the landing runway is different from the runway fitted with an instrument approach, which is used for the descent and approach in order to get visual of the airfield.

## APPROACH PREPARATION

ALL

The approach preparation follows the same schema as described in APPROACH PREPARATION section in CRUISE chapter. However, some characteristics need to be highlighted:

### FPLN

Lateral: STAR, instrument approach procedure.

Vertical: Insert F speed as constraint at FAF since the approach will be flown flaps 3, landing gear down and F speed (stabilized approach). Check altitude constraints.

### RAD NAV

Manually tune the VOR/DME of destination airfield as required.

### PROG

Insert VOR/DME of destination airfield in the BRG/DIST field as required. Check NAV ACCY if required by comparing BRG/DIST data to raw data.

### PERF

PERF APPR: Descent winds, destination airfield weather, minima and landing flap selection (wind shear anticipated or in case of failure).

PERF GO AROUND: Check thrust reduction and acceleration altitude.

**FUEL PRED**

Check estimated landing weight and extra fuel.

**SEC F-PLN**

When planning for a circling approach, the landing runway will be inserted into the SEC F-PLN. The crew will update the SEC F-PLN as follows:

. SEC F-PLN then COPY ACTIVE

. Lateral revision on destination and insert landing runway

. Keep the F-PLN discontinuity

## FINAL INSTRUMENT APPROACH

ALL

The crew will fly a stabilized approach at F speed, configuration 3 and landing gear down.

## CIRCLING APPROACH

ALL

When reaching circling minima and with sufficient visual reference for circling,

. Level OFF

. Select TRK/FPA

. Select a TRK of 45° away from the final approach course (or as required by the published procedure)

. When wings level, start the chrono.

. Once established downwind, activate the SEC F-PLN to take credit of the "GS mini" protection in final approach when managed speed is used.

Additionally, the landing runway will be shown on the ND and the 10 NM range should be selected to assist in positioning onto final approach.

. By the end of the downwind leg, disconnect the AP, select both FDs off and keep the A/THR

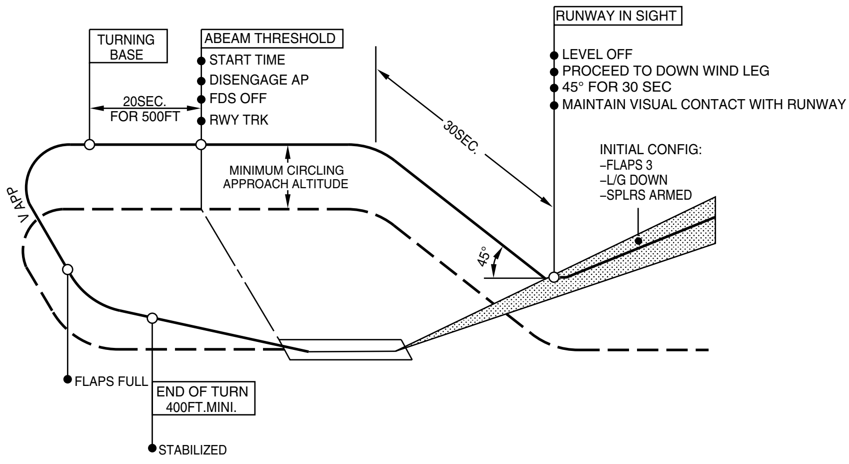
. When leaving the circling altitude, select the landing configuration

. Once fully configured, complete the Landing Checklist.

Once the SEC F-PLN is activated, the go-around procedure in the MCDU will be that for the landing runway rather than the one associated with the instrument approach just carried out. Therefore, if visual references were lost during the circling approach, the go-around would have to be flown using selected guidance, following the pre-briefed missed approach procedure.

For circling approach with one engine inoperative, refer to FCTM 03.020.

LOW VISIBILITY CIRCLING APPROACH




NOF 02130 04237 0001

## INITIAL APPROACH

MSN 0006 0008 0011 0017-0018 0022-0030 0035 0037-0039 0042-0043 0045-0051 0056-0059 0068-0075 0078-0080 0083-0090 0093-0097 0103-0104 0109-0114 0116-0117 0120 0122 0126-0127 0132 0134-0142 0146-0151 0154 0157-0159 0161-0164 0167-0170 0172 0174-0177 0179-0183 0185 0189-0191 0193 0195-0196 0199-0202 0207 0209-0210 0212 0216-0219 0221-0225 0229-0234 0242-0243 0245-0261 0265-0269 0274-0277 0279-0280 0283-0284 0288-0296 0299-0305 0308-0311 0313-0316 0320-0321 0324-0328 0330-0336 0338 0341-0350 0353-0354 0356-0357 0359 0361-0365 0368-0369 0371 0373-0376 0378-0379 0382-0386 0389 0391-0398 0401 0403-0407 0409 0411-0416 0419-0447 0449-0454 0456-0470 0472-0490 0492-0497 0499-0508 0510 0512-0520 0522-0526 0528 0530-0543 0545-0583 0585-0597 0599 0601-0607 0609-0617 0619-0624 0626-0636 0638-0643 0645-0646 0648-0659 0661-0679 0681-0686 0688-0714 0716-0724 0726-0765 0767-0776 0779-0785 0787-0795 0797-0800 0802-0806 0808-0817 0819-0829 0831 0833-0845 0847-0862 0864-0867 0870-0879 0881-0902 0904-0906 0908-0909 0912 0914-0922 0924-0937 0939-0940 0942-0957 0959-0960 0963 0965-0974 0977-0980 0982-0984 0986-0987 0989-0993 0995 0997 0999 1001 1003-1009 1012-1019 1022-1024 1026 1028-1035 1038-1046 1049-1052 1054-1057 1060-1061 1063-1065 1068-1070 1072 1074-1077 1079 1081 1083-1086 1088-1089 1093-1095 1097-1098 1100 1104-1106 1108-1112 1114 1116-1117 1120 1122 1124 1127-1128 1135-1136 1138 1141 1144-1147 1153-1155 1160 1163 1165-1166 1168 1170-1171 1174 1177-1178 1180-1183 1192 1194 1196 1199 1202-1207 1209-1211 1217-1218 1220-1221 1223-1224 1226-1229 1231 1234 1237 1243 1245 1247-1248 1252 1254-1255 1262-1264 1266 1268-1269 1272 1274-1275 1277 1281-1282 1284 1286-1293 1296-1298 1301 1307 1310 1312-1313 1315-1317 1321 1323 1326 1328 1330-1331 1336 1340-1343 1345 1347-1348 1350 1354 1356-1359 1361-1363 1369-1373 1375 1378-1379 1381 1383 1388-1389 1395-1397 1399 1401-1403 1407 1409 1412-1413 1416-1418 1420-1422 1424-1427 1430-1432 1435 1437 1439 1442 1447-1448 1450 1454-1455 1457 1459-1462 1465 1469 1472-1475 1477 1480 1484 1487 1489 1492 1495-1496 1499 1507-1508 1511 1514 1517 1522 1525 1530-1533 1536 1538-1539 1542 1545 1550 1554-1555 1559 1561 1569 1572-1573 1581 1584-1586 1600 1609 1617 1620 1627 1635-1636 1639 1647 1649 1651 1653-1655 1664 1666-1667 1669-1671 1674 1679-1681 1688 1692 1694 1697-1698 1701-1702 1704 1713 1716 1728-1729 1731-1732 1734 1736-1737 1741 1755 1768 1793 1799 1809 1816 1821 1834 1836 1840 1842 1845 1847 1865 1892 1902 1987 2058 2104 2115 2143 2252

The crew must keep in mind that the pattern is flown visually. However, the XTK is a good cue of the aircraft lateral position versus the runway centreline. This is obtained when sequencing the FPLN until the TO WPT (displayed on the ND top right hand corner) is on the final approach course.

The crew will aim to get the following configuration on commencement of the downwind leg:

. Both AP and FDs will be selected off

. BIRD ON

. A/THR confirmed active in speed mode, i.e. SPEED on the FMA.

. Managed speed will be used to enable the "GS mini" function

. The downwind track will be selected on the FCU to assist in downwind tracking.

. The down wind track altitude will be set on FCU

MSN 0002-0005 0007 0010 0012-0016 0019-0021 0031-0034 0036 0040-0041 0044 0052-0055 0061-0067 0076-0077 0081-0082 0091 0098-0102 0108 0115 0118-0119 0121 0123-0125 0128-0131 0133 0143-0145 0152-0153 0155-0156 0160 0165-0166 0171 0173 0178 0184 0186-0188 0192 0194 0197-0198 0203-0206 0208 0211 0213-0215 0220 0226-0228 0235-0241 0244 0262-0264 0270-0273 0278 0281-0282 0285-0287 0297-0298 0306-0307 0312 0317-0319 0322-0323 0329 0337 0339-0340 0351-0352 0355 0358 0360 0366-0367 0370 0372 0377 0380-0381 0387-0388 0390 0399-0400 0402 0408 0410 0417-0418 0448 0455 0471 0491 0498 0509 0511 0521 0527 0529 0544 0584 0598 0600 0608 0618 0625 0637 0644 0647 0660 0680 0687 0715 0725 0766 0777-0778 0786 0796 0801 0807 0818 0830 0832 0846 0863 0868-0869 0880 0903 0907 0910-0911 0913 0923 0938 0941 0958 0961-0962 0964 0975-0976 0981 0985 0988 0994 0996 0998 1000 1002 1010-1011 1020-1021 1025 1027 1036-1037 1047-1048 1053 1058-1059 1062 1066-1067 1071 1073 1078 1080 1082 1087 1090-1092 1096 1099 1101-1103 1107 1113 1115 1118-1119 1121 1123 1125-1126 1129-1134 1137 1139-1140 1142-1143 1148-1152 1156-1159 1161-1162 1164 1167 1169 1172-1173 1175-1176 1179 1184-1191 1193 1195 1197-1198 1200-1201 1208 1212-1216 1219 1222 1225 1230 1232-1233 1235-1236 1238-1242 1244 1246 1249-1251 1253 1256-1261 1265 1267 1270-1271 1273 1276 1279-1280 1283 1285 1294-1295 1299-1300 1302-1306 1308-1309 1311 1314 1318-1320 1322 1324-1325 1327 1329 1332-1335 1337-1339 1344 1346 1349 1351-1353 1355 1360 1364-1368 1374 1376-1377 1380 1382 1384-1387 1390-1394 1398 1400 1404-1406 1408 1410-1411 1414-1415 1419 1423 1428-1429 1433-1434 1436 1438 1440-1441 1443-1446 1449 1451-1453 1456 1458 1463-1464 1466-1468 1470-1471 1476 1478-1479 1481-1483 1485-1486 1488 1490-1491 1493-1494 1497-1498 1500-1506 1509-1510 1512-1513 1515-1516 1518-1521 1523-1524 1526-1529 1534-1535 1537 1540-1541 1543-1544 1546-1549 1551-1553 1556-1558 1560 1562-1568 1570-1571 1574-1580 1582-1583 1587-1599 1601-1608 1610-1616 1618-1619 1621-1626 1628-1634 1637-1638 1640-1646 1648 1650 1652 1656-1663 1665 1668 1672-1673 1675-1678 1682-1687 1689-1691 1693 1695-1696 1699-1700 1703 1705-1712 1714-1715 1717-1727 1730 1733 1735 1738-1740 1742-1754 1756-1767 1769-1792 1794-1798 1800-1808 1810-1815 1817-1820 1823-1833 1835 1837-1839 1841 1843-1844 1846 1848-1864 1866-1891 1893-1901 1903-1986 1988-2057 2059-2103 2105-2114 2116-2142 2144-2251 2253-3260

The crew must keep in mind that the pattern is flown visually. However, the XTK is a good cue of the aircraft lateral position versus the runway centreline. This is obtained when pressing DIR TO CI RADIAL IN.

The crew will aim to get the following configuration on commencement of the downwind leg:

. Both AP and FDs will be selected off

. BIRD ON

. A/THR confirmed active in speed mode, i.e. SPEED on the FMA.

. Managed speed will be used to enable the "GS mini" function

. The downwind track will be selected on the FCU to assist in downwind tracking.

. The down wind track altitude will be set on FCU

## INTERMEDIATE/FINAL APPROACH

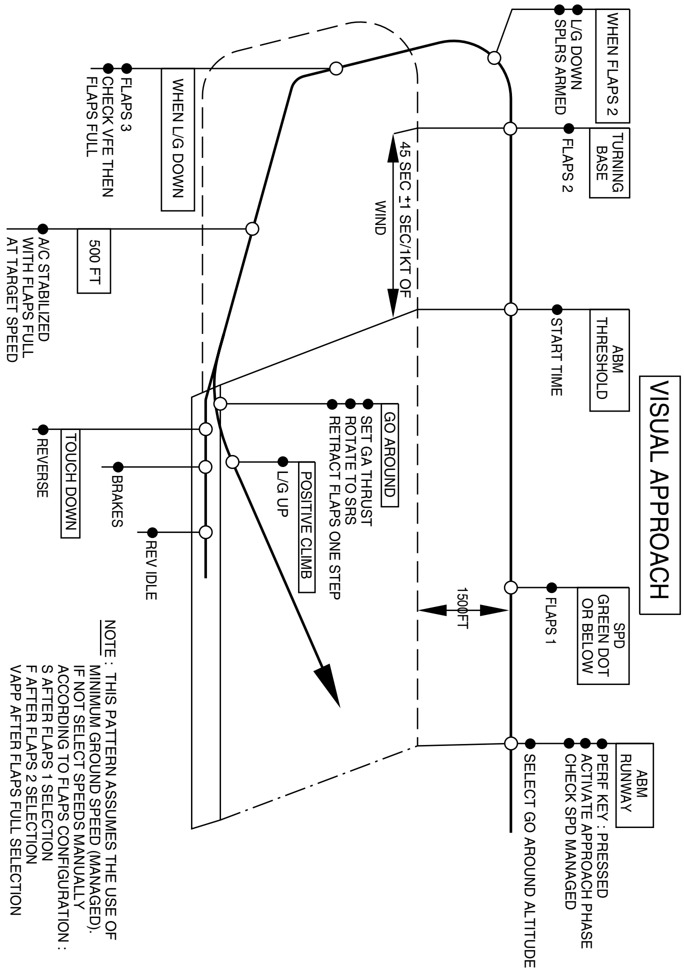
ALL

Assuming a 1500 ft AAL circuit, the base turn should be commenced 45 seconds after passing abeam the downwind threshold (± 1 second/kt of head/tailwind).

The final turn onto the runway centreline will be commenced with 20° angle of bank. Initially the rate of descent should be 400 fpm, increasing to 700 fpm when established on the correct descent path

The pilot will aim to be configured for landing at VAPP by 500 ft AAL, at the latest. If not stabilised, a go-around must be carried out.

<u>VISUAL APPROACH</u>

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NOF 02140 00001 0001

## GENERAL

ALL

CATII and CAT III approaches are flown to very low DH (or without DH) with very low RVR. The guidance of the aircraft on the ILS beam and the guidance of the aircraft speed must be consistently of high performance and accurate so that an automatic landing and roll out can be performed in good conditions and, the acquisition of visual cues is achieved the aircraft properly stabilized. Hence,

. The automatic landing is required in CATIII operations including roll out in CAT IIIB.

. The automatic landing is the preferred landing technique in CATII conditions

. Any failures of the automated systems shall not significantly affect the aircraft automatic landing system performance

. The crew procedures and task sharing allow to rapidly detect any anomaly and thus lead to the right decision

## DEFINITION

ALL

### DECISION HEIGHT

The Decision Height (DH) is the wheel height above the runway elevation by which a go around must be initiated unless adequate visual reference has been established and the aircraft position and the approach path have been assessed as satisfactory to continue the automatic approach and landing in safety. The DH is based on RA.

### ALERT HEIGHT

The Alert Height (AH) is the height above the runway, based on the characteristics of the aeroplane and its fail-operational automatic landing system, above which a CATIII approach would be discontinued and a missed approach initiated if a failure occurred in one of the redundant part of the automatic landing system, or in the relevant ground equipment.

In others AH definition, it is generally stated that if a failure affecting the fail-operational criteria occurs below the AH, it would be ignored and the approach continued (except if AUTOLAND warning is triggered). The AH concept is relevant when CAT3 DUAL is displayed on FMA.

On single aisle Airbus family, the AH =100 ft.

## CAT 3 SINGLE

CAT 3 SINGLE is announced when the airborne systems are fail passive which means that a single failure will lead to the AP disconnection without any significant out of trim condition or deviation of the flight path or attitude. Manual flight is then required. This minimum DH is 50ft.

## CAT 3 DUAL

CAT 3 DUAL is announced when the airborne systems are fail-operational. In case of a single failure, the AP will continue to guide the aircraft on the flight path and the automatic landing system will operate as a fail-passive system. In the event of a failure below the AH, the approach, flare and landing can be completed by the remaining part of the automatic system. In that case, no capability degradation is indicated. Such a redundancy allows CAT III operations with or without DH.

## CAT II OR CAT III APPROACHES

| | | ICAO | FAA | JAA |
|---|---|---|---|---|
| CAT II | DH | 100ft≤DH<200ft | 100ft≤DH<200ft | 100ft≤DH<200ft |
| | RVR | RVR ≥350 m RVR≥1200ft | 350m≤RVR<800mt 1200ft≤RVR<2400f | RVR>≥300m RVR≥1000 ft |
| CAT IIIA | DH | No DH or DH< 100ft | No DH or DH<100ft | DH<100 ft |
| | RVR | RVR ≥200 m RVR≥ 700ft | RVR ≥200 m RVR≥ 700ft | RVR ≥200 m RVR≥ 700ft |
| CAT IIIB | DH | No DH or DH<50 ft | No DH or DH<50 ft | No DH or DH<50 ft |
| | RVR | 50m≤RVR<200m 150ft≤RVR<700ft | 50m≤RVR<200m 150ft≤RVR<700ft | 75m≤RVR<200m 250ft≤RVR<700ft |

(1) DH≥50 ft if fail passive

## FLIGHT PREPARATION

ALL

In addition to the normal flight preparation, the following preparation must be performed when CATII or CATIII approach is planned:

. Ensure that destination airport meets CATII or CATIII requirements
. Check aircraft required equipment for CATII or CATIII in QRH
. Check that crew qualification is current
. Consider extra fuel for possible approach delay
. Consider weather at alternate

## APPROACH PREPARATION

ALL

**LIMITATIONS**

. The crew will check that tower wind remains within the limit for CATII or CATIII approaches (See limitations chapter in FCOM 3)
. The autoland maximum altitude must be observed.

**AIRCRAFT CAPABILITY**

The failures that may affect the aircraft's CATII or CATIII capability are listed in the QRH. Most of these failures are monitored by the FMGS and the landing capability will be displayed on the FMA once the APPR pb is pressed, i.e. CAT II, CAT III SINGLE, CAT III DUAL. However, there are a number of failures which affect the aircraft's landing capability which are not monitored by the FMGS and, consequently, not reflected on the FMA. It is very important, therefore, that the crew refer to the QRH to establish the actual landing capability if some equipment are listed inoperative.

**AIRPORT FACILITIES**

The airport authorities are responsible for establishing and maintaining the equipment required for CAT II/III approach and landing. The airport authorities will activate the LVP procedures as the need arises based on RVR. Prior to planning a CAT II/III approach, the crew must ensure that LVP are in force.

## CREW QUALIFICATION

The captain must ensure that both crew members are qualified and that their qualification is current for the planned approach.

## SEATING POSITION

The crew must realise the importance of eye position during low visibility approaches and landing. A too low seat position may greatly reduce the visual segment. When the eye reference position is lower than intended, the visual segment is further reduced by the cut-off angle of the glareshield or nose. As a rule of thumb, an incorrect seating position which reduces the cut-off angle by 1° reduces the visual segment by approximately 10m (30 ft).

## USE OF LANDING LIGHTS

The use of landing lights at night in low visibility can be detrimental to the acquisition of visual reference. Reflected lights from water droplets or snow may actually reduce visibility. The landing lights would, therefore, not normally be used in CAT II/III weather conditions.

## APPROACH STRATEGY

Irrespective of the actual weather conditions, the crew should plan the approach using the best approach capability. This would normally be CAT III DUAL with autoland, depending upon aircraft status. The crew should then assess the weather with respect to possible downgrade capability.

<table>
<tr><td rowspan="2">Conditions</td><td rowspan="2">CATI</td><td rowspan="2">CATII</td><td colspan="2">CATIII</td></tr>
<tr><td>WITH DH</td><td>NO DH</td></tr>
<tr><td>Flying technique</td><td>Hand flying or AP/FD, A/THR</td><td>AP/FD, A/THR down to DH</td><td colspan="2">AP/FD/ATHR and Autoland</td></tr>
<tr><td>Minima & weather</td><td>DA (DH) Baro re fVisibility</td><td colspan="3">DH with RA RVR</td></tr>
<tr><td>Autoland</td><td>Possible with precautions</td><td>Recom-mended</td><td colspan="2">Mandatory</td></tr>
</table>

## GO AROUND STRATEGY

The crew must be ready mentally for go-around at any stage of the approach. Should a failure occur above 1000 ft RA, all ECAM actions (and DH amendment if required) should be completed before reaching 1000 ft RA, otherwise a go-around should be initiated. This ensures proper task sharing for the remainder of the approach. Any alert generated below 1000 ft should lead to a go-around.

## APPROACH BRIEFING

Before commencing a CAT II/III approach a number of factors must be considered by the crew. In addition to the standard approach briefing, the following points should be emphasised during an approach briefing for a low visibility approach:

. Aircraft capability

. Airport facilities

. Crew qualification

. Weather minima

. Task sharing

. Call-outs

. Go-around strategy

# APPROACH PROCEDURE

ALL

## TASK SHARING

The workload is distributed in such a way that the PF primary tasks are supervising and decision making and the PNF primary task is monitoring the operation of the automatic system.

The PF supervises the approach (trajectory, attitude, speed) and takes appropriate decision in case of failure and at DH. Since the approach is flown with AP/FD/A-THR, the PF must be continuously ready to take-over

. If any AP hard over is experienced

. If a major failure occurs

. If any doubt arises

The PF announces "LAND", when displayed on FMA.

The PNF is head down throughout the approach and landing. The PNF monitors:

. The FMA and calls mode change as required (except "LAND")

. The Auto call out

. The aircraft trajectory or attitude exceedance

. Any failures

The PNF should be go-around minded.

## SOME SYSTEM PARTICULARS

. Below 700 ft RA, data coming from the FMS are frozen e.g. ILS tune inhibit.

. Below 400 ft RA, the FCU is frozen.

. At 350 ft, LAND must be displayed on FMA. This ensures correct final approach guidance.

. Below 200 ft, the AUTOLAND red light illuminates if
  - Both APs trip off
  - Excessive beam deviation is sensed
  - Localizer or glide slope transmitter or receiver fails
  - A RA discrepancy of at least 15 feet is sensed.

. Flare comes at or below 40ft

. THR IDLE comes at or below 30ft

. RETARD auto call out comes at 10ft for autoland as an order. (Instead of 20 ft for manual landing as an indication)

## VISUAL REFERENCE

Approaching the DH, the PF starts to look for visual references, progressively increasing external scanning. It should be stressed that the DH is the lower limit of the decision zone. The captain should come to this zone prepared for a go-around but with no pre-established judgement.

Required conditions to continue

. With DH
  In CATII operations, the conditions required at DH to continue the approach are that the visual references should be adequate to monitor the continued approach and landing and that the flight path should be acceptable. If both these conditions are not satisfied, it is mandatory to initiate a go-around. A 3 lights segment and a lateral light element is the minimum visual cue for JAR OPS.

In CATIII operations, the condition required at DH is that there should be visual references which confirm that the aircraft is over the touch down zone. Go-around is mandatory if the visual references do not confirm this. A 3 lights segment is required by JAR OPS for fail passive system and 1 centerline light segment for fail operational system.

. Without DH
The decision to continue does not depend on visual references, even though a minimum RVR is specified. The decision depends only on the operational status of the aircraft and ground equipment. If a failure occurs prior to reaching the AH, a go-around will be initiated. A go-around must nevertheless be performed if AUTOLAND warning is triggered below AH. However, it is good airmanship for the PF to acquire visual cues during flare and to monitor the roll out.

Loss of visual reference

. With DH before touch down
If decision to continue has been made by DH and the visual references subsequently become insufficient a go-around must be initiated.
A late go-around may result in ground contact. If touch down occurs after TOGA is engaged, the AP remains engaged in that mode and A/THR remains in TOGA. The ground spoilers and auto-brake are inhibited.

. With DH or without DH after touch down
If visual references are lost after touch down, a go-around should not be attempted. The roll-out should be continued with AP in ROLL OUT mode down to taxi speed.

## FLARE/LANDING/ROLL OUT

During the flare, decrab and roll-out, the PF will watch outside to assess that the autoland is properly carried out, considering the available visual references.

For CATII approaches, autoland is recommended. If manual landing is preferred, the PF will take-over at 80 ft at the latest. This ensures a smooth transition for the manual landing.

Select maximum reverse at main landing gear touch down.

The use of auto-brake is recommended as it ensures a symmetrical brake pressure application. However, the crew should be aware of possible dissymmetry in case of crosswind and wet runways.

The PNF will use standard call out. Additionally, he will advise ATC when aircraft is properly controlled (speed and lateral trajectory).

## FAILURE AND ASSOCIATED ACTIONS

ALL

As a general rule, if a failure occurs above 1000 ft AGL, the approach may be continued, ECAM actions completed, approach briefing update performed and a higher DH set if required.

Below 1000ft (and down to AH in CAT3 DUAL), the occurrence of any failure implies a go-around and a reassessment of the system capability. Another approach may be under taken according to the new system capability. It has been considered that below 1000 ft, not enough time is available for the crew to perform the necessary switching, to check system configuration and limitation and brief for minima.

In CAT3 DUAL and below AH, as a general rule, a single failure does not necessitate a go-around. A go-around is required if the AUTOLAND warning is triggered.

## AUTOLAND IN CAT 1 OR BETTER WEATHER CONDITIONS

ALL

The crew may wish to practice automatic landings in CATI or better weather conditions for training purposes. This type of approach should be carried out only with the airline authorization. The crew should be aware that fluctuations of the LOC and/or GS might occur due to the fact that protection of ILS sensitive areas, which applies during LVP, will not necessarily be in force. It is essential, therefore, that the PF is prepared to take over manually at any time during a practice approach and rollout, should the performance of the AP become unsatisfactory.

## PREFACE

ALL

When Transitioning from IMC to VMC, the crew will watch the bird versus the aircraft attitude symbol in the center of the PFD. This provides a good assessment of the drift, thus in which direction to look for the runway.

But, then

. Do not turn towards the runway

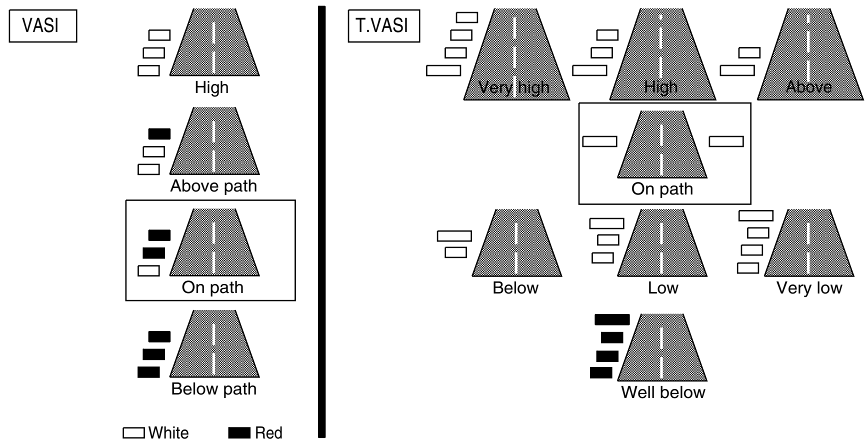
. Do not duck under

## MAIN GEAR CLEARANCE

ALL

The boxed images below are the one to retain to ensure about 20 ft wheel clearance at threshold.

USE OF VASI/TVASI/PAPI

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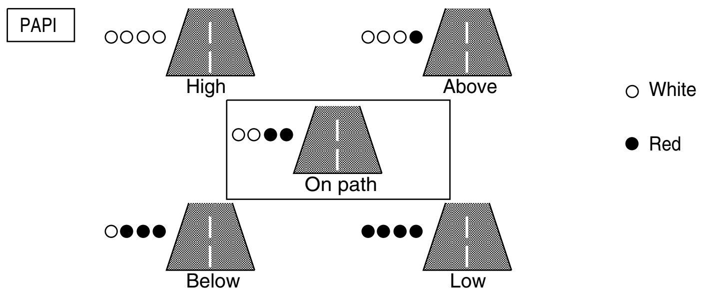
USE OF VASI/TVASI/PAPI

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This technique will ensure that performance margins are not compromised and provide adequate main gear clearance.

## FLARE

ALL

### PITCH CONTROL

When reaching 50 ft, auto-trim ceases and the pitch law is modified to flare law. Indeed, the normal pitch law, which provides trajectory stability, is not the best adapted to the flare manoeuvre. The system memorizes the attitude at 50 ft, and that attitude becomes the initial reference for pitch attitude control. As the aircraft descends through 30 ft, the system begins to reduce the pitch attitude at a predetermined rate of 2° down in 8 second. Consequently, as the speed reduces, the pilot will have to move the stick rearwards to maintain a constant path. The flare technique is thus very conventional.

From stabilized conditions, the flare height is about 30 ft. This height varies with different parameters, such as weight, rate of descent, wind variations...

Avoid under flaring.

- The rate of descent must be controlled prior to the initiation of the flare (rate not increasing)
- Start the flare with positive backpressure on the sidestick and holding as necessary
- Avoid forward stick movement once Flare initiated (releasing back-pressure is acceptable)

At 20 ft, the "RETARD" auto call-out reminds the pilot to retard thrust levers. It is a reminder rather than an order. The pilot will retard the thrust levers when best adapted e.g. if high and fast on the final path the pilot will retard earlier. In order to assess the rate of descent in the flare, and the aircraft position relative to the ground, look well ahead of the aircraft. The typical pitch increment in the flare is approximately 4°, which leads to -1° flight path angle associated with a 10 kt speed decay in the manoeuvre. A prolonged float will increase both the landing distance and the risk of tail strike.

### LATERAL AND DIRECTIONAL CONTROL

#### FINAL APPROACH

In crosswind conditions, a crabbed-approach should be flown.

**FLARE**

The objectives of the lateral and directional control of the aircraft during the flare are:

- To land on the centerline
- And, to minimize the loads on the main landing gear.

During the flare, rudder should be applied as required to align the aircraft with the runway heading. Any tendency to drift downwind should be counteracted by an appropriate input on the sidestick.

In the case of a very strong cross wind, the aircraft may be landed with a residual drift (maximum 5°) to prevent an excessive bank (maximum 5°).

Consequently, combination of the partial de-crab and wing down techniques may be required.

## MAXIMUM DEMONSTRATED CROSSWIND FOR LANDING

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036-2050 2052-2058 2060-2070 2072-2080 2082-2099 2101-2108 2110-2217 2219-2275 2277-2316 2318-2327 2329-2332 2334-2343 2345-2349 2351-2357 2359-2366 2368-2376 2378-2393 2395-2522 2524-2543 2545-2551 2553-2574 2576-2581 2583-2600 2602-2685 2687-2749 2751-2909 2911-2917 2919-2930 2932-2950 2952-2954 2956-2966 2968-2971 2973-3000 3002-3008 3010-3029 3031-3037 3039-3061 3063-3091 3093-3099 3101-3109 3111-3162 3164-3213 3215 3217 3222 3226-3235 3241-3260

| Reported braking action | Reported runway friction coefficient | Maximum demonstrated crosswind for landing (kt) | Equivalent runway condition |
|---|---|---|---|
| Good | $\geq$0.4 | 33 | Dry, damp, wet |

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

| Reported braking action | Reported runway friction coefficient | Maximum demonstrated crosswind for landing (kt) | Equivalent runway condition |
|---|---|---|---|
| Good | ≥0.4 | 38.5<br>(Gust included) | Dry, damp, wet |

**CALL OUT**

MSN 0002-0363 0365-0384 0386-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571-0575 0577-0580 0582 0584-0585 0587-0590 0592 0594 0596 0598 0600-0603 0605 0607-0613 0615-0619 0621-0630 0634-0641 0643-0651 0653-0662 0665 0667 0669-0673 0676 0678-0679 0681-0683 0685-0686 0688-0691 0693-0698 0700-0714 0716-0724 0726-0730 0732-0745 0747-0760 0762-0764 0766-0770 0772-0774 0776 0778-0780 0782-0786 0788-0791 0793-0795 0797-0801 0803-0805 0807 0809 0812-0814 0816-0818 0820-0822 0824-0826 0828-0834 0836-0840 0842-0847 0849-0851 0853-0854 0856-0863 0865-0877 0879-0886 0888-0890 0892-0900 0902-0907 0909-0914 0916-0919 0921-0925 0927-0934 0936-0939 0942-0953 0955 0957-0958 0960 0962 0964-0967 0969 0971-0973 0975-0982 0984-0986 0988-0990 0992 0994 0996-1003 1005 1007 1009-1011 1013-1014 1016 1018-1020 1022 1025-1026 1028-1041 1043-1044 1046-1059 1061-1079 1081-1093 1095-1132 1134-1143 1145-1152 1154-1160 1162-1173 1175-1184 1187 1189-1194 1196-1198 1200-1201 1203 1205-1206 1208-1213 1215-1217 1221-1226 1228-1232 1234-1237 1239-1240 1242-1249 1251-1259 1261-1272 1274-1275 1277-1292 1294-1298 1300-1306 1308-1332 1334-1355 1357-1365 1367-1398 1400-1402 1404-1407 1409-1411 1413-1416 1418-1420 1422-1424 1426-1427 1429-1430 1432 1434-1435 1437 1439-1441 1443-1446 1448-1450 1452-1454 1456-1457 1459-1461 1463-1464 1466-1471 1473-1475 1477-1480 1482-1486 1488-1491 1493-1495 1497-1498 1500-1502 1504-1510 1512-1516 1518 1520 1522-1524 1526-1530 1532-1535 1537-1538 1540-1553 1555-1571 1573-1586 1588-1595 1597-1601 1603-1606 1608-1610 1612-1613 1615-1618 1620-1622 1624-1628 1630-1631 1633-1635 1637 1639-1641 1643-1650 1652-1657 1659-1665 1667-1669 1671-1674 1676-1680 1682-1689 1692-1694 1696-1700 1702-1703 1705-1706 1708-1710 1712 1714-1715 1717-1719 1721-1723 1725 1727-1733 1735-1747 1749-1762 1764-1771 1773-1775 1777-1782 1784-1787 1789-1793 1795-1797 1799-1806 1808-1810 1812-1816 1818-1835 1837-1842 1844-1847 1849 1851-1858 1860-1868 1870-1877 1879-1880 1882-1886 1888-1904 1906-1920 1922-1925 1927 1929-1931 1933-1940 1942-1945 1947-1949 1951-1952 1954-1955 1957-1959 1961-1965 1968-1969 1971 1973 1975-1976 1979-1983 1986-1987 1989-1993 1996-2004 2006-2020 2022-2040 2042-2044 2046-2054 2056-2059 2061-2063 2065-2066 2068-2075 2077-2079 2081-2104 2106 2108-2109 2112-2114 2116 2118-2189 2191-2207 2209-2210 2212-2215 2217-2219 2221-2225 2227-2233 2235-2246 2248-2254 2256-2260 2262-2266 2268-2269 2271-2289 2291-2302 2304 2306-2308 2310-2314 2316-2319 2321-2322 2325-2329 2331-2336 2338-2341 2343-2350 2352-2356 2358-2362 2364-2380 2382-2409 2411-2461 2463-2471 2473-2475 2477-2479 2481-2487 2489-2520 2522-2529 2531-2535 2537-2542 2544-2548 2550-2552 2554-2562 2564-2589 2591-2598 2600-2609 2611-2652 2654-2681 2683-2686 2688-2706 2708-2712 2714-2725 2727-2729

MSN 2731-2735 2737-2740 2742-2755 2757-2758 2760-2766 2768-2792 2794-2798 2800-2808 2810-2822 2824-2861 2863-2867 2869-2881 2883-2894 2896-2902 2904-2911 2913-2915 2917-2918 2920-2926 2928-2932 2934-2935 2937-2956 2958-2964 2966-2970 2972-2973 2975-2995 2997-2998 3000-3004 3006-3012 3014 3016-3021 3023-3033 3035-3050 3052-3066 3068-3069 3071-3074 3076-3080 3082-3097 3099-3105 3107-3111 3113-3119 3121-3125 3127-3129 3131-3145 3147-3190 3192-3197 3199-3206 3208-3210 3213-3216 3220 3225-3226 3231 3238 3243-3260

If pitch attitude exceeds 10°, the PNF will announce "PITCH".

MSN 0364 0385 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532 0535 0538 0541 0544 0550 0552 0555 0557 0560 0563-0564 0567 0570 0576 0581 0583 0586 0591 0593 0595 0597 0599 0604 0606 0614 0620 0631-0633 0642 0652 0663-0664 0666 0668 0674-0675 0677 0680 0684 0687 0692 0699 0715 0725 0731 0746 0761 0765 0771 0775 0777 0781 0787 0792 0796 0802 0806 0808 0810-0811 0815 0819 0823 0827 0835 0841 0848 0852 0855 0864 0878 0887 0891 0901 0908 0915 0920 0926 0935 0940-0941 0954 0956 0959 0961 0963 0968 0970 0974 0983 0987 0991 0993 0995 1004 1006 1008 1012 1015 1017 1021 1023-1024 1027 1042 1045 1060 1080 1094 1133 1144 1153 1161 1174 1185 1188 1195 1199 1202 1204 1207 1214 1218-1220 1227 1233 1238 1241 1250 1260 1273 1276 1293 1299 1307 1333 1356 1366 1399 1403 1408 1412 1417 1421 1425 1428 1431 1433 1436 1438 1442 1447 1451 1455 1458 1462 1465 1472 1476 1481 1487 1492 1496 1499 1503 1511 1517 1519 1521 1525 1531 1536 1539 1554 1572 1587 1596 1602 1607 1611 1614 1619 1623 1629 1632 1636 1638 1642 1651 1658 1666 1670 1675 1681 1690-1691 1695 1701 1704 1707 1711 1713 1716 1720 1724 1726 1734 1748 1763 1772 1776 1783 1788 1794 1798 1807 1811 1817 1836 1843 1848 1850 1859 1869 1878 1881 1887 1905 1921 1926 1928 1932 1941 1946 1950 1953 1956 1960 1966-1967 1970 1972 1974 1977-1978 1984 1988 1994-1995 2005 2021 2041 2045 2055 2060 2064 2067 2076 2080 2105 2107 2110 2115 2117 2190 2208 2211 2216 2220 2226 2234 2247 2255 2261 2267 2270 2290 2303 2305 2309 2315 2320 2323-2324 2330 2337 2342 2351 2357 2363 2381 2410 2462 2472 2476 2480 2488 2521 2530 2536 2543 2549 2553 2563 2590 2599 2610 2653 2682 2687 2707 2713 2726 2730 2736 2741 2756 2759 2767 2793 2799 2809 2823 2862 2868 2882 2895 2903 2912 2916 2919 2927 2933 2936 2957 2965 2971 2974 2996 2999 3005 3013 3015 3022 3034 3051 3067 3070 3075 3081 3098 3106 3112 3120 3126 3130 3146 3191 3198 3207 3212 3217 3222 3229 3233-3235 3241

If pitch attitude exceeds 7.5°, the PNF will announce "PITCH".

## DEROTATION

ALL

When the aircraft is on the ground, pitch and roll control operates in Direct Law. Consequently, when the aircraft touches down, the pilot flies the nose down conventionally, varying sidestick input as required, to control the derotation rate.

After touch down, when reverse thrust is selected (on at least one engine) and one main landing gear strut is compressed, the ground spoilers partially extend to establish ground contact. The ground spoilers fully extend when both main landing gears are compressed. A small nose down term on the elevators is introduced by the control law, which compensates the pitch up tendency with ground spoiler extension.

It is not recommended to keep the nose high in order to increase aircraft drag during the initial part of the roll-out, as this technique is inefficient and increases the risk of tail strike. Furthermore, if auto brake MED is used, it may lead to a hard nose gear touch down.

## ROLL OUT

ALL

### NORMAL CONDITIONS

During the roll out, the rudder pedals will be used to steer the aircraft on the runway centreline. At high speed, directional control is achieved with rudder. As the speed reduces, the Nose Wheel Steering (NWS) becomes active. However, the NWS tiller will not be used until taxi speed is reached.

### CROSSWIND CONDITIONS

The above-mentioned technique applies. Additionally, the pilot will avoid setting stick into the wind as it increases the weathercock effect. Indeed, it creates a differential down force on the wheels into the wind side and differential drag due to spoiler retraction.

The reversers have a destabilizing effect on the airflow around the rudder and thus decrease the efficiency of the rudder. Furthermore they create a side force, in case of a remaining crab angle, which increases the lateral skidding tendency of the aircraft. This adverse effect is quite noticeable on contaminated runways with crosswind. In case a lateral control problem occurs in high crosswind landing, the pilot will consider to set reversers back to Idle.

At lower speeds, the directional control of the aircraft is more problematic, more specifically on wet and contaminated runways. Differential braking is to be used if necessary. On wet and contaminated runways, the same braking effect may be reached with full or half deflection of the pedals; additionally the anti skid system releases the brake pressure on both sides very early when the pilot presses on the pedals. Thus if differential braking is to be used, the crew will totally release the pedal on the opposite side to the expected turn direction.

ALL

## BRAKING

Once on the ground, the importance of the timely use of all means of stopping the aircraft cannot be overemphasised. Three systems are involved in braking once the aircraft is on the ground:

. The ground spoilers

. The thrust reversers

. The wheel brakes

### THE GROUND SPOILERS

When the aircraft touches down with at least one main landing gear and when at least one thrust lever is in the reverse sector, the ground spoilers partially automatically deploy to ensure that the aircraft is properly sit down on ground. Then, the ground spoilers automatically fully deploy. This is the partial lift dumping function.

The ground spoilers contribute to aircraft deceleration by increasing aerodynamic drag at high speed. Wheel braking efficiency is improved due to the increased load on the wheels. Additionally, the ground spoiler extension signal is used for auto-brake activation.

### THRUST REVERSERS

Thrust reverser efficiency is proportional to the square of the speed. So, it is recommended to use reverse thrust at high speeds.

Select maximum reverse at main landing gear touch down.

The maximum reverse thrust is obtained at N1 between 70% and 85% and is controlled by the FADEC.

A slight pitch-up, easily controlled by the crew, may appear when the thrust reversers are deployed before the nose landing gear touches down.

Below 70 kts, reversers efficiency decreases rapidly. Additionally, the use of high levels of reverse thrust at low speed can cause engine stalls.

Therefore, it is recommended to smoothly reduce the reverse thrust to idle at 70 kts. However, the use of maximum reverse is allowed down to aircraft stop in case of emergency.

If airport regulations restrict the use of reverse, select and maintain reverse idle until taxi speed is reached.

Stow the reversers before leaving the runway to avoid foreign object ingestion.

## WHEEL BRAKES

Wheel brakes contribute the most to aircraft deceleration on the ground. Many factors may affect efficient braking such as load on the wheels, tire pressure, runway pavement characteristics and runway contamination and braking technique. The only factor over which the pilot has any control is the use of the correct braking technique, as discussed below.

### ANTI-SKID

The anti-skid system adapts pilot applied brake pressure to runway conditions by sensing an impending skid condition and adjusting the brake pressure to each individual wheel as required. The anti-skid system maintains the skidding factor (slip ratio) close to the maximum friction force point. This will provide the optimum deceleration with respect to the pilot input. Full pedal braking with anti-skid provides a deceleration rate of 10 kts/sec.

### BRAKES

The use of auto brake versus pedal braking should observe the following guidelines:

. The use of A/BRAKE is usually preferable because it minimizes the number of application of brake and thus reduces brake wear. Additionally, the A/BRAKE provides a symmetrical brake pressure application which ensures an equal braking effect on both main landing gear wheels on wet or evenly contaminated runway. More particularly, the A/BRAKE is recommended on short, wet, contaminated runway, in poor visibility conditions and in Auto land.

. The use of LO auto brake should be preferred on long and dry runways whereas the use of MED auto brake should be preferred for short or contaminated runways. The use of MAX auto brake is not recommended.

. On very short runways, the use of pedal braking is to be envisaged since the pilot may apply full pedal braking with no delay after touch down.

. On very long runways, the use of pedal braking may be envisaged if the pilot anticipates that braking will not be needed. To reduce brake wear, the number of brake application should be limited.

. In case of pedal braking, do not ride the brakes but apply pedal braking when required and modulate the pressure without releasing. This minimizes brake wear.

The DECEL light indicates that the selected deceleration rate is or is not achieved, irrespective of the functioning of the autobrake. For example DECEL might not come up when the autobrake is selected on a contaminated runway, because the deceleration rate is not reached with the autobrake properly functioning, whereas DECEL light might come up with LO selected on Dry runway while the only reversers achieve the selected deceleration rate without autobrake being actually activated. In other words, the DECEL light is not an indicator of the autobrake operation as such, but that the deceleration rate is reached.

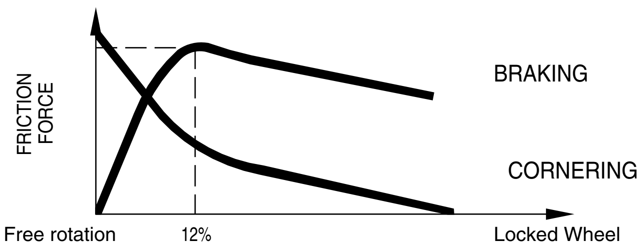
Since the auto brake system senses deceleration and modulates brake pressure accordingly, the timely application of MAX reverse thrust will reduce the actual operation of the brakes themselves, thus the brake wear and temperature.

Auto-brake does not relieve the pilot of the responsibility of achieving a safe stop within the available runway length.

## CROSS WIND CONDITIONS

The reverse thrust side force and crosswind component can combine to cause the aircraft to drift to the downwind side of the runway if the aircraft is allowed to weathercock into wind after landing. Additionally, as the anti-skid system will be operating at maximum braking effectiveness, the main gear tire cornering forces available to counteract this drift will be reduced.

BRAKING FORCE AND CORNERING FORCE VS ANTISKID

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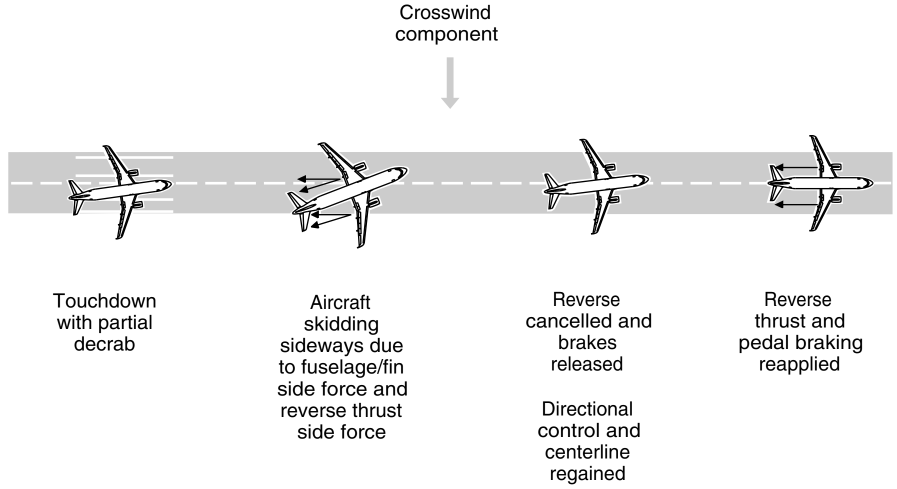
To correct back to the centreline, the pilot must reduce reverse thrust to reverse idle and release the brakes. This will minimise the reverse thrust side force component, without the requirement to go through a full reverser actuating cycle, and provide the total tire cornering forces for realignment with the runway centreline. Rudder and differential braking should be used, as required, to correct back to the runway centreline. When re-established on the runway centreline, the pilot should re-apply braking and reverse thrust as required.

DIRECTIONAL CONTROL DURING CROSSWIND LANDING




NOF 02160 04271 0001

## FACTORS AFFECTING LANDING DISTANCE

ALL

The field length requirements are contained in the Landing Performance chapter of the FCOM 2. The landing distance margin will be reduced if the landing technique is not correct. Factors that affect stopping distance include:

- Height and speed over the threshold
- Glide slope angle
- Landing flare technique
- Delay in lowering the nose on to the runway
- Improper use of braking system
- Runway conditions (discussed in adverse weather).

Height of the aircraft over the runway threshold has a significant effect on total landing distance. For example, on a 3° glide path, passing over the runway threshold at 100 ft altitude rather than 50 ft could increase the total landing distance by approximately 300m/950ft. This is due to the length of runway used before the aircraft touches down.

A 5 kts speed increment on VAPP produces a 5% increase in landing distance with auto brake selected.

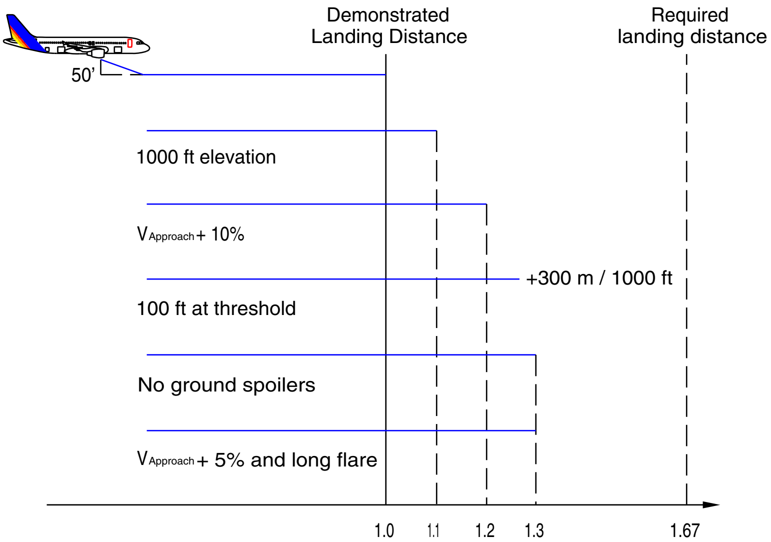
For a 50 ft Threshold Crossing Height, a shallower glide path angle increases the landing distance, as the projected touchdown point will be further down the runway.

Floating above the runway before touchdown must be avoided because it uses a large portion of the available runway. The aircraft should be landed as near the normal touchdown point as possible. Deceleration rate on the runway is approximately three times greater than in the air.

Reverse thrust and speedbrake drag are most effective during the high-speed portion of the landing. Therefore, reverse thrust should be selected without delay.

Speed brakes fully deployed, in conjunction with maximum reverse thrust and maximum manual anti-skid braking provides the minimum stopping distance.

OPERATIONAL FACTORS AFFECTING ACTUAL LANDING DISTANCE




NOF 02160 04272 0001

## CLEARANCE AT TOUCH DOWN

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

| Geometry limit at touch down | Pitch attitude at VAPP(Vref+5kt) (1) | Pitch attitude at touch down | Clearance(2) |
|---|---|---|---|
| 17.3° | tbd | tbd | tbd° |

*<u>Note</u>: (1) Flight path in approach: -3°*
*(2) Clearance = geometry limit - pitch attitude at touch down*

MSN 0546 0572 0578 0588 0598 0600 0608-0610 0612 0616 0618 0621 0623 0625 0627 0629 0634 0636-0637 0639 0641 0644 0646-0647 0649 0651 0654 0656 0660 0670 0672 0679 0682 0686 0688-0691 0693-0695 0697 0700 0711 0713 0717 0719 0721 0723 0727-0729 0732 0734 0736 0738 0740 0742 0744 0748 0750 0752 0755 0757 0759 0763 0767 0769 0773 0779 0783 0785 0788 0790 0794 0798 0800 0804 0813 0817 0821 0825 0829 0831 0833 0837 0840 0843 0845 0847 0850 0853 0858 0860 0862 0867 0869 0871 0873 0875 0880 0882 0885 0889-0890 0893 0896 0898 0904 0906 0910 0913 0917 0922 0924 0929 0931 0933 0938 0944 0946 0948-0949 0952 0965 0972 0976 0979-0980 0985 0989 0997-0998 1000 1002 1010 1016 1018-1020 1022 1025 1029 1031 1033-1034 1036 1038 1040 1043 1046 1048-1049 1051 1053 1055-1056 1058 1062 1064 1066 1068-1069 1071 1073-1074 1077-1078 1082 1084 1086 1088-1092 1095-1098 1100 1102-1103 1106-1107 1109 1111 1113 1115-1116 1118 1120 1122 1124 1126-1127 1129 1131 1135-1136 1139-1140 1142 1145 1147 1149 1151 1154-1155 1157 1159-1160 1164-1165 1167 1169-1170 1172 1176 1178 1180 1182 1184 1190-1191 1193 1197 1201 1203 1205 1209 1211-1212 1216 1222-1223 1225 1228 1230 1232 1236 1239 1243 1245 1247 1249 1252 1254 1256 1258 1261 1263 1265 1267 1269 1271 1275 1277-1279 1281 1283 1285 1287 1289 1291 1295 1297 1301 1303 1305 1309 1311 1313 1315 1317 1319 1321 1323-1326 1328-1329 1331 1335-1336 1338 1340 1342 1344 1346 1348 1350 1352 1354 1358 1360 1362 1364 1369 1371 1373 1375 1377-1378 1380 1382 1384 1386 1388-1389 1391-1393 1395 1397 1401 1404 1406 1410 1414-1415 1420 1423 1426 1429 1434 1440 1444-1445 1449 1453 1456 1460 1463 1466 1468 1471 1474 1477 1479 1483 1485 1488 1490 1494 1498 1501 1505 1507 1510 1513 1515 1520 1522 1524 1527 1529 1534 1537 1541 1543 1545 1547 1549 1551-1552 1556 1558 1560 1562-1563 1565 1567 1569-1570 1573-1577 1579 1581-1583 1585 1589-1590 1592 1594 1598 1600-1601 1603-1604 1606 1608 1612 1616 1618 1622 1625 1627 1630 1634 1640 1643 1645 1647 1649 1653-1654 1656 1659 1662 1664 1668 1671 1673 1677 1679 1683-1685 1688 1693 1698-1699 1703 1706 1709 1714 1718 1722 1727 1729 1731 1733 1737-1738 1740 1742-1743 1745-1746 1750 1752-1753 1756 1758-1759 1761 1765-1766 1768 1770 1774 1778-1779 1781 1786 1790-1791 1795-1796 1800-1801 1803 1805 1808 1810 1815 1819-1820 1824 1826 1828 1831 1833 1837 1839 1841 1844 1846 1851 1853 1855 1863 1866 1870 1872 1875-1876 1880 1882 1884 1886 1890 1893 1897 1901 1908 1912 1916 1923 1925 1934 1936 1938 1943 1947 1952 1955 1959 1962-1963 1971 1976 1980 1982 1986 1990 1997 1999-2000 2002 2004 2007-2008 2010 2012-2013 2015 2019 2023 2026 2028 2030 2032-2033 2037 2039 2043 2047 2050 2052-2053 2057 2062 2066 2069 2072 2074 2078 2083 2086-2087 2089 2091 2093 2095-2096 2098 2101 2103 2113 2119-2120 2122 2124 2126-2127 2129 2131 2170 2172 2174 2176 2179 2181 2184 2186 2188 2192 2194 2196 2198 2200 2202-2203 2205 2209 2213-2214 2222 2224 2228 2230 2232 2236-2237 2240-2241 2243 2245 2249 2251 2253 2258 2260 2262-2266 2268-2269 2271 2273 2277

MSN 2279 2281 2283 2285 2287 2289 2293 2295-2296 2298 2300 2302 2304 2306 2308 2311 2313 2318-2319 2321 2326 2332 2335 2339 2341 2346 2348 2353 2355 2360 2362 2365 2369-2371 2373 2375 2378-2380 2382-2383 2385 2387 2389 2392 2396 2398 2400 2402 2404 2406 2408 2412 2414 2416 2418 2420-2421 2424 2426-2427 2429 2431 2433 2435-2436 2438 2440 2442 2444 2446 2448 2450 2452 2454 2456 2458 2460 2463-2471 2473-2474 2477 2481 2483 2485 2487 2490 2492 2494-2495 2497 2499 2501 2503 2505 2507-2508 2510 2512 2514 2516 2518-2519 2525 2527-2528 2532 2534 2538 2541 2545-2548 2550-2551 2554-2561 2565 2567-2568 2570 2572 2574 2578-2579 2581 2585-2586 2588 2592-2593 2595 2597 2603 2605 2607 2611 2614-2615 2617-2618 2621-2622 2624-2625 2628-2629 2631-2632 2634 2636 2638-2639 2641 2643-2644 2646 2648 2650 2652 2655 2657 2659-2660 2662 2664 2666-2667 2669 2672-2673 2675 2677 2679 2681 2684 2690-2691 2693-2694 2697-2698 2700 2702 2704 2706 2709 2711 2715-2716 2718 2720 2723 2727 2729 2733 2735 2738-2739 2742 2744 2746 2748 2751 2754 2757 2762-2763 2765 2769 2771 2773-2774 2777 2779-2780 2782 2784 2786 2788 2790 2795 2797 2801 2803 2805-2806 2811-2813 2815 2818-2819 2821 2825 2827 2829 2831 2833 2836-2837 2839 2841 2843 2845 2847 2849-2850 2852 2854 2857-2858 2860 2864 2866 2870 2872-2873 2876 2878-2879 2884 2886-2894 2897-2898 2901 2905 2907 2913 2921 2923 2925 2929 2935 2938 2940 2942 2946 2948-2949 2954 2959 2961 2963 2969 2976 2978-2979 2981 2983 2985 2997 3003 3007 3011 3017 3019-3020 3024 3026 3028 3032 3036 3041 3043 3045-3046 3049 3053-3054 3057 3059 3061 3065 3069 3073 3077-3078 3082 3084-3085 3088 3090 3094 3096 3102 3104 3108 3114 3116 3118 3122 3124 3128 3133-3134 3137 3139 3144 3165 3168-3169 3171-3172 3175-3176 3179 3181 3184 3186 3188 3193 3195 3200 3202 3204 3209 3226 3231 3243-3260

| Geometry limit at touch down | Pitch attitude at VAPP(Vref+5kt) (1) | Pitch attitude at touch down | Clearance(2) |
|---|---|---|---|
| 15.5° | 3.4° | 7.7° | 7.8° |

*__Note__: (1) Flight path in approach: -3°*
*(2) Clearance = geometry limit - pitch attitude at touch down*

MSN 0002-0363 0365-0384 0386-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545 0548-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571 0573-0575 0577 0579-0580 0582 0584-0585 0587 0589-0590 0592 0594 0596 0601-0603 0605 0607 0611 0613 0615 0617 0619 0622 0624 0626 0628 0630 0635 0638 0640 0643 0645 0648 0650 0653 0655 0657-0659 0661-0662 0665 0667 0669 0671 0673 0676 0678 0681 0683 0685 0696 0698 0701-0710 0712 0714 0716 0718 0720 0722 0724 0726 0730 0733 0735 0737 0739 0741 0743 0745 0747 0749 0751 0753-0754 0756 0758 0760 0762 0764 0766 0768 0770 0772 0774 0776 0778 0780 0782 0784 0786 0789 0791 0793 0795 0797 0799 0801 0803 0805 0807 0809 0812 0814 0816 0818 0820 0822 0824 0826 0828 0830 0832 0834 0836 0838-0839 0842 0844 0846 0849 0851 0854 0856-0857 0859 0861 0863 0865-0866 0868 0870 0872 0874 0876-0877 0879 0881 0883-0884 0886 0888 0892 0894-0895 0897 0899-0900 0902-0903 0905 0907 0909 0911-0912 0914 0916 0918-0919 0921 0923 0925 0927-0928 0930 0932 0934 0936-0937 0939 0942-0943 0945 0947 0950-0951 0953 0955 0957-0958 0960 0962 0964 0966-0967 0969 0971 0973 0975 0977-0978 0981-0982 0984 0986 0988 0990 0992 0994 0996 0999 1001 1003 1005 1007 1009 1011 1013-1014 1026 1028 1030 1032 1035 1037 1039 1041 1044 1047 1050 1052 1054 1057 1059 1061 1063 1065 1067 1070 1072 1075-1076 1079 1081 1083 1085 1087 1093 1099 1101 1104-1105 1108 1110 1112 1114 1117 1119 1121 1123 1125 1128 1130 1132 1134 1137-1138 1141 1143 1146 1148 1150 1152 1156 1158 1162-1163 1166 1168 1171 1173 1175 1177 1179 1181 1183 1187 1189 1192 1194 1196 1198 1200 1206 1208 1210 1213 1215 1217 1221 1224 1226 1229 1231 1234-1235 1237 1240 1242 1244 1246 1248 1251 1253 1255 1257 1259 1262 1264 1266 1268 1270 1272 1274 1280 1282 1284 1286 1288 1290 1292 1294 1296 1298 1300 1302 1304 1306 1308 1310 1312 1314 1316 1318 1320 1322 1327 1330 1332 1334 1337 1339 1341 1343 1345 1347 1349 1351 1353 1355 1357 1359 1361 1363 1365 1367-1368 1370 1372 1374 1376 1379 1381 1383 1385 1387 1390 1394 1396 1398 1400 1402 1405 1407 1409 1411 1413 1416 1418-1419 1422 1424 1427 1430 1432 1435 1437 1439 1441 1443 1446 1448 1450 1452 1454 1457 1459 1461 1464 1467 1469-1470 1473 1475 1478 1480 1482 1484 1486 1489 1491 1493 1495 1497 1500 1502 1504 1506 1508-1509 1512 1514 1516 1518 1523 1526 1528 1530 1532-1533 1535 1538 1540 1542 1544 1546 1548 1550 1553 1555 1557 1559 1561 1564 1566 1568 1571 1578 1580 1584 1586 1588 1591 1593 1595 1597 1605 1609-1610 1613 1615 1617 1620-1621 1624 1626 1628 1631 1633 1635 1637 1639 1641 1644 1646 1648 1650 1652 1655 1657 1661 1663 1665 1667 1669 1672 1674 1676 1678 1680 1682 1686-1687 1689 1692 1694 1696-1697 1700 1702 1705 1708 1710 1712 1715 1717 1719 1721 1723 1725 1728 1730 1732 1735-1736 1739 1741 1744 1747 1749 1751 1754-1755 1757 1760 1762 1764 1767 1769 1771 1773 1775 1777 1780 1782 1784-1785

MSN 1787 1789 1792-1793 1797 1799 1802 1804 1806 1809 1812-1814 1816 1818 1821-1823 1825 1827 1829 1832 1834-1835 1838 1840 1842 1845 1847 1849 1852 1854 1856-1858 1860-1862 1864-1865 1867-1868 1871 1873-1874 1877 1879 1883 1885 1888-1889 1891-1892 1894-1896 1898-1900 1902-1904 1906-1907 1909-1911 1913-1915 1917-1920 1922 1924 1927 1929-1931 1933 1935 1937 1940 1942 1944-1945 1948-1949 1951 1954 1957-1958 1961 1964-1965 1968-1969 1973 1975 1979 1981 1983 1987 1989 1993 1996 1998 2001 2003 2006 2009 2011 2014 2016 2018 2020 2022 2024 2027 2029 2031 2034 2036 2038 2040 2042 2044 2046 2048-2049 2054 2056 2058 2061 2063 2065 2068 2070 2073 2075 2077 2079 2082 2084-2085 2088 2090 2092 2094 2097 2099 2102 2104 2106 2108 2112 2114 2116 2118 2121 2123 2125 2128 2130 2132-2169 2171 2173 2175 2177-2178 2180 2182-2183 2185 2187 2189 2191 2193 2195 2197 2199 2201 2204 2206-2207 2210 2212 2215 2217 2219 2221 2223 2225 2227 2229 2231 2233 2235 2238-2239 2242 2244 2246 2248 2250 2252 2254 2256-2257 2259 2272 2274-2275 2278 2280 2282 2284 2286 2288 2291-2292 2294 2297 2299 2301 2307 2310 2312 2314 2316 2322 2325 2327 2329 2331 2334 2336 2338 2340 2343 2345 2347 2349 2352 2354 2356 2359 2361 2364 2366 2368 2372 2374 2376 2384 2386 2388 2390-2391 2393 2395 2397 2399 2401 2403 2405 2407 2409 2411 2413 2415 2417 2419 2422-2423 2425 2428 2430 2432 2434 2437 2439 2441 2443 2445 2447 2449 2451 2453 2455 2457 2459 2461 2475 2478-2479 2482 2484 2486 2489 2491 2493 2496 2498 2500 2502 2504 2506 2509 2511 2513 2515 2517 2520 2522 2524 2526 2529 2531 2533 2535 2537 2539-2540 2542 2562 2564 2566 2569 2571 2573 2576-2577 2580 2583-2584 2587 2589 2591 2594 2596 2598 2600 2602 2604 2606 2608-2609 2612-2613 2616 2619-2620 2623 2626-2627 2630 2633 2635 2637 2640 2642 2645 2647 2649 2651 2654 2656 2658 2661 2663 2665 2668 2670-2671 2674 2676 2678 2680 2683 2685 2688-2689 2692 2695-2696 2699 2701 2703 2705 2708 2710 2712 2714 2717 2719 2721 2724-2725 2728 2731-2732 2734 2737 2740 2743 2745 2747 2749 2752-2753 2755 2758 2760-2761 2764 2766 2768 2770 2772 2775-2776 2778 2781 2783 2785 2787 2789 2791-2792 2794 2796 2798 2800 2802 2804 2807-2808 2810 2814 2816-2817 2820 2822 2824 2826 2828 2830 2832 2834-2835 2838 2840 2842 2844 2846 2848 2851 2853 2855-2856 2859 2861 2863 2865 2867 2869 2871 2874-2875 2877 2880-2881 2883 2885 2896 2899-2900 2902 2904 2906 2908-2909 2911 2914-2915 2917 2920 2922 2924 2926 2928 2930 2932 2934 2937 2939 2941 2943-2945 2947 2950 2952-2953 2956 2958 2960 2962 2964 2966 2968 2970 2973 2975 2977 2980 2982 2984 2986-2995 2998 3000 3002 3004 3006 3008 3010 3012 3014 3016 3018 3021 3023 3025 3027 3029 3031 3033 3035 3037 3039-3040 3042 3044 3047-3048 3050 3052 3055-3056 3058 3060 3063-3064 3066 3068 3071-3072 3074 3076 3079-3080 3083 3086-3087 3089 3091 3093 3095 3097 3099 3101 3103 3105 3107 3109 3111 3113 3115 3117 3119 3121 3123 3125 3127 3129 3131-3132 3135-3136 3138 3140-3143 3145 3147-3162 3164 3166-3167 3170 3173-3174 3177-3178 3180 3182-3183 3185 3187

MSN 3189-3190 3192 3194 3196-3197 3199 3201 3203 3205-3206 3208 3210 3213 3215

| Geometry limit at touch down | Pitch attitude at VAPP(Vref+5kt) (1) | Pitch attitude at touch down | Clearance(2) |
|---|---|---|---|
| 13.5 ° | 3.3 ° | 7.6 ° | 5.9 ° |

*<u>Note</u>: (1) Flight path in approach: -3 °*
*(2) Clearance = geometry limit - pitch attitude at touch down*

MSN 0364 0385 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532 0535 0538 0541 0544 0550 0552 0555 0557 0560 0563-0564 0567 0570 0576 0581 0583 0586 0591 0593 0595 0597 0599 0604 0606 0614 0620 0631 0642 0652 0664 0692 0699 0731 0746 0765 0802 0811 0819 0848 0887 0901 0940 0959 0987 1144 1220 1227 1356 1511

| Geometry limit at touch down | Pitch attitude at VAPP(Vref+5kt) (1) | Pitch attitude at touch down | Clearance(2) |
|---|---|---|---|
| 11.2 ° | 2.4 ° | 6.6 ° | 4.6 ° |

*Note: (1) Flight path in approach: -3 °*
*(2) Clearance = geometry limit - pitch attitude at touch down*

MSN 0633 0663 0666 0668 0674-0675 0677 0680 0684 0687 0715 0725 0761 0771 0775 0777 0781 0787 0792 0796 0806 0808 0810 0815 0823 0827 0835 0841 0852 0855 0864 0878 0891 0908 0915 0920 0926 0935 0941 0954 0956 0961 0963 0968 0970 0974 0983 0991 0993 0995 1004 1006 1008 1012 1015 1017 1021 1023-1024 1027 1042 1045 1060 1080 1094 1133 1153 1161 1174 1185 1188 1195 1199 1202 1204 1207 1214 1218-1219 1233 1238 1241 1250 1260 1273 1276 1293 1299 1307 1333 1366 1399 1403 1408 1412 1417 1421 1425 1428 1431 1433 1436 1438 1442 1447 1451 1455 1458 1462 1465 1472 1476 1481 1487 1492 1496 1499 1503 1517 1519 1521 1525 1531 1536 1539 1554 1572 1587 1596 1602 1607 1611 1614 1619 1623 1629 1632 1636 1638 1642 1651 1658 1666 1670 1675 1681 1690-1691 1695 1701 1704 1707 1711 1713 1716 1720 1724 1726 1734 1748 1763 1772 1776 1783 1788 1794 1798 1807 1811 1817 1836 1843 1848 1850 1859 1869 1878 1881 1887 1905 1921 1926 1928 1932 1941 1946 1950 1953 1956 1960 1966-1967 1970 1972 1974 1977-1978 1984 1988 1994-1995 2005 2021 2041 2045 2055 2060 2064 2067 2076 2080 2105 2107 2110 2115 2117 2190 2208 2211 2216 2220 2226 2234 2247 2255 2261 2267 2270 2290 2303 2305 2309 2315 2320 2323-2324 2330 2337 2342 2351 2357 2363 2381 2410 2462 2472 2476 2480 2488 2521 2530 2536 2543 2549 2553 2563 2590 2599 2610 2653 2682 2687 2707 2713 2726 2730 2736 2741 2756 2759 2767 2793 2799 2809 2823 2862 2868 2882 2895 2903 2912 2916 2919 2927 2933 2936 2957 2965 2971 2974 2996 2999 3005 3013 3015 3022 3034 3051 3067 3070 3075 3081 3098 3106 3112 3120 3126 3130 3146 3191 3198 3207 3212 3217 3222 3229 3233-3235 3241

| Geometry limit at touch down | Pitch attitude at VAPP(Vref+5kt) (1) | Pitch attitude at touch down | Clearance(2) |
|---|---|---|---|
| 10.8 ° | 2.4 ° | 6.6 ° | 4.2 ° |

*Note: (1) Flight path in approach: -3 °*
*(2) Clearance = geometry limit - pitch attitude at touch down*

## TAIL STRIKE AVOIDANCE

Although most of tail strikes are due to deviations from normal landing techniques, some are associated with such external conditions as turbulence and wind gradient.

## DEVIATION FROM NORMAL TECHNIQUES

Deviations from normal landing techniques are the most common causes of tail strikes. The main reasons for this are due to:

. Allowing the speed to decrease well below VAPP before flare
Flying at too low speed means high angle of attack and high pitch attitude, thus reducing ground clearance. When reaching the flare height, the pilot will have to significantly increase the pitch attitude to reduce the sink rate. This may cause the pitch to go beyond the critical angle.

. Prolonged hold off for a smooth touch down
As the pitch increases, the pilot needs to focus further ahead to assess the aircraft's position in relation to the ground. The attitude and distance relationship can lead to a pitch attitude increase beyond the critical angle.

. Too high flare
A high flare can result in a combined decrease in airspeed and a long float. Since both lead to an increase in pitch attitude, the result is reduced tail clearance.

. Too high sink rate, just prior reaching the flare height
In case of too high sink rate close to the ground, the pilot may attempt to avoid a firm touch down by commanding a high pitch rate. This action will significantly increase the pitch attitude and, as the resulting lift increase may be insufficient to significantly reduce the sink rate, the high pitch rate may be difficult to control after touch down, particularly in case of bounce.

. Bouncing at touch down
In case of bouncing at touch down, the pilot may be tempted to increase the pitch attitude to ensure a smooth second touch down. If the bounce results from a firm touch down, associated with high pitch rate, it is important to control the pitch so that it does not further increase beyond the critical angle.

## APPROACH AND LANDING TECHNIQUES

A stabilized approach is essential for achieving successful landings. It is imperative that the flare height be reached at the appropriate airspeed and flight path angle. The A/THR and FPV are effective aids to the pilot.

VAPP should be determined with the wind corrections (provided in FCOM/QRH) by using the FMGS functions. As a reminder, when the aircraft is close to the ground, the wind intensity tends to decrease and the wind direction to turn (direction in degrees decreasing in the northern latitudes). Both effects may reduce the head wind component close to the ground and the wind correction to VAPP is there to compensate for this effect.

When the aircraft is close to the ground, high sink rate should be avoided, even in an attempt to maintain a close tracking of the glideslope. Priority should be given to the attitude and sink rate. If a normal touchdown distance is not possible, a go-around should be performed.

If the aircraft has reached the flare height at VAPP, with a stabilized flight path angle, the normal SOP landing technique will lead to repetitive touch down attitude and airspeed.

During the flare, the pilot should not concentrate on the airspeed, but only on the attitude with external cues.

Specific PNF call outs have been reinforced for excessive pitch attitude at landing.

After touch down, the pilot must "fly" the nosewheel smoothly, but without delay, on to the runway, and must be ready to counteract any residual pitch up effect of the ground spoilers. However, the main part of the spoiler pitch up effect is compensated by the flight control law itself.

## BOUNCING AT TOUCH DOWN

In case of light bounce, maintain the pitch attitude and complete the landing, while keeping the thrust at idle. Do not allow the pitch attitude to increase, particularly following a firm touch down with a high pitch rate.

In case of high bounce, maintain the pitch attitude and initiate a go-around. Do not try to avoid a second touch down during the go-around. Should it happen, it would be soft enough to prevent damage to the aircraft, if pitch attitude is maintained.

Only when safely established in the go-around, retract flaps one step and the landing gear. A landing should not be attempted immediately after high bounce, as thrust may be required to soften the second touch down and the remaining runway length may be insufficient to stop the aircraft.

## CUMULATIVE EFFECTS

No single factor should result in a tail strike, but accumulation of several can significantly reduce the margin.

## PREFACE

ALL

Failure to recognize the need for and to execute a go-around, when required, is a major cause of approach and landing accidents. Because a go-around is an infrequent occurrence, it is important to be "go-around minded". The decision to go-around should not be delayed, as an early go-around is safer than a last minute one at lower altitude.

## CONSIDERATIONS ABOUT GO-AROUND

ALL

A go-around must be considered if:

. There is a loss or a doubt about situation awareness

. If there is a malfunction which jeopardizes the safe completion of the approach e.g. major navigation problem

. ATC changes the final approach clearance resulting in rushed action from the crew or potentially unstable approach

. The approach is unstable in speed, altitude, and flight path in such a way that stability will not be obtained by 1000 ft IMC or 500 ft VMC.

. Any GPWS, TCAS or windshears alert occur

. Adequate visual cues are not obtained reaching the minima.

## AP/FD GO-AROUND PHASE ACTIVATION

MSN 0022-0032 0034-0035 0037-0038 0040-0041 0043 0045-0051 0056-0058 0069-0072 0074-0075 0078-0080 0083 0085-0086 0088-0090 0093-0097 0104 0110-0111 0113-0114 0116-0119 0121 0123-0125 0132 0135 0137-0140 0142 0147-0148 0151-0153 0157 0160-0164 0167-0172 0179-0180 0189-0190 0192-0193 0196-0197 0200-0202 0205-0206 0208-0209 0212-0213 0216-0219 0221-0222 0225 0229-0230 0245 0247 0252 0256-0263 0267-0269 0272-0273 0275-0276 0280-0282 0288 0291-0301 0304 0306-0308 0313-0314 0316 0318-0322 0326-0329 0331-0332 0336 0338-0340 0343-0349 0353-0355 0357-0358 0360-0365 0367-0373 0376 0379-0383 0385-0394 0396-0402 0405-0406 0408 0410-0418 0420 0422-0425 0428-0432 0435-0437 0439 0441-0444 0446-0447 0449-0452 0454 0456-0458 0460-0465 0467-0470 0472-0476 0478-0479 0482-0487 0489-0490 0492-0493 0496 0499-0508 0510-0512 0518 0523 0525 0528 0530-0531 0534 0538-0539 0542 0549 0554 0558 0560-0561 0563-0564 0567-0569 0571 0575 0579-0580 0587 0589-0590 0592 0594-0595 0597 0601 0604-0605 0607 0609-0611 0613-0617 0619 0622-0624 0626-0628 0630 0634 0636 0638-0639 0641 0645 0648-0652 0655 0658-0659 0662 0665-0667 0669 0671 0677-0679 0683 0685-0686 0689-0690 0692 0694 0696 0698-0700 0702 0704-0706 0709-0710 0712 0717-0718 0720 0722-0724 0726 0729 0731 0737-0739 0743-0745 0748-0749 0751 0753-0754 0759 0766-0767 0772 0775 0778 0780 0783 0786-0789 0792 0798-0799 0801-0802 0804 0807 0811 0814 0818 0820 0824-0826 0828 0830 0832-0834 0836 0838 0842-0843 0846-0847 0849-0854 0857-0860 0862 0865 0867 0869 0871 0873-0876 0879-0883 0886-0888 0893 0895 0897-0898 0900-0901 0903 0907 0909 0911 0913-0914 0916 0918 0921 0923 0925 0939 0944 0948 0950 0952 0954-0955 0958 0962-0967 0975 0980-0981 0984 0986 0988-0990 0996 1001 1004-1006 1008-1009 1011 1017 1022 1029 1031-1032 1035 1037 1039 1041-1042 1057-1058 1062 1071-1072 1076 1078 1085 1090-1091 1093 1108 1117 1126 1129 1131 1149 1164-1165 1167 1187 1191 1194-1196 1199 1204 1218 1227 1230 1249 1316 1324-1325 1345-1346 1392 1408 1414 1421 1434 1438 1453 1456 1459 1479 1483 1487 1498 1501 1520 1535 1543 1549 1567 1570 1582 1633 1641 1646 1659 1662 1683 1685 1693 1700 1709 1714 1738 1746 1752 1766 1774 1789 1796 1800 1810 1812 1815 1819-1820 1824 1828 1833 1839 1870 1875 1897 1923 1959 1976 1982 1990 2002 2013 2026 2028 2039 2047 2082 2087 2092 2095 2369 2373 2464 2474 2618 2641

The go-around phase is activated when the thrust levers are set to TOGA, provided the flap lever is selected to Flap 1 or greater. The missed approach becomes the active F-PLN and the previously flown approach is strung back into the F-PLN.

For the go-around, the appropriate flying reference is the attitude, since it is dynamic manoeuvre. So, if the "bird" is ON, the PF will ask the PNF to select HDG/VS, in order to remove the "bird". This also permits to replace the FPD by the FD bars, if the flight director is in use.

If the autopilot or the flight director is in use, SRS and GA TRK modes engage.

If the autopilot and both flight directors are off, the PF will maintain 15° of pitch.

If TOGA thrust is not required during a go-around for any reason, e.g. an early go-around ordered by ATC, it is essential that thrust levers are set to TOGA momentarily to sequence the F-PLN. If this is not done, the destination airfield will be sequenced and the primary F-PLN will become PPOS - DISCONT- .

MSN 0002-0021 0033 0036 0039 0042 0044 0052-0055 0059-0068 0073 0076-0077 0081-0082 0084 0087 0091 0098-0103 0108-0109 0112 0115 0120 0122 0126-0131 0133-0134 0136 0141 0143-0146 0149-0150 0154-0156 0158-0159 0165-0166 0173-0178 0181-0188 0191 0194-0195 0198-0199 0203-0204 0207 0210-0211 0214-0215 0220 0223-0224 0226-0228 0231-0244 0246 0248-0251 0253-0255 0264-0266 0270 0274 0277-0279 0283-0287 0289-0290 0302-0303 0305 0309-0312 0315 0317 0323-0325 0330 0333-0335 0337 0341-0342 0350-0352 0356 0359 0366 0375 0377-0378 0384 0395 0403-0404 0407 0409 0419 0421 0426-0427 0434 0438 0440 0445 0448 0453 0455 0459 0466 0471 0477 0480 0488 0491 0494-0495 0497-0498 0509 0513-0517 0519-0522 0524 0526-0527 0529 0532-0533 0535-0537 0540-0541 0543-0548 0550-0553 0555-0557 0559 0562 0565-0566 0570 0572-0574 0576-0578 0581-0586 0588 0591 0593 0596 0598-0600 0603 0606 0608 0612 0618 0620-0621 0625 0629 0631-0633 0635 0637 0640 0642-0644 0646-0647 0653-0654 0656-0657 0660-0661 0663-0664 0668 0670 0672-0676 0680-0682 0684 0687-0688 0691 0693 0695 0697 0701 0703 0707 0711 0713-0716 0719 0721 0725 0727-0728 0730 0732-0736 0740-0742 0746-0747 0750 0752 0755-0758 0760-0765 0768-0771 0773-0774 0776-0777 0779 0781-0782 0784-0785 0790-0791 0793-0797 0800 0803 0805-0806 0808-0810 0812-0813 0815-0817 0819 0821-0823 0827 0829 0831 0835 0837 0839-0841 0844-0845 0848 0855-0856 0861 0863-0864 0866 0868 0870 0872 0877-0878 0884-0885 0889-0892 0894 0896 0899 0902 0904-0906 0908 0910 0912 0915 0917 0919-0920 0922 0924 0926-0938 0940-0943 0945-0947 0949 0951 0953 0956-0957 0959-0961 0968-0974 0976-0979 0982-0983 0985 0987 0991-0995 0997-1000 1002-1003 1007 1010 1012-1016 1018-1021 1023-1028 1030 1033-1034 1036 1038 1040 1043-1056 1059-1061 1063-1070 1073-1075 1077 1079-1084 1086-1089 1092 1094-1107 1109-1116 1118-1125 1127-1128 1130 1132-1148 1150-1163 1166 1168-1185 1188-1190 1192-1193 1197-1198 1200-1203 1205-1217 1219-1226 1228-1229 1231-1248 1250-1315 1317-1323 1326-1344 1347-1391 1393-1407 1409-1413 1415-1420 1422-1433 1435-1437 1439-1452 1454-1455 1457-1458 1460-1478 1480-1482 1484-1486 1488-1497 1499-1500 1502-1519 1521-1534 1536-1542 1544-1548 1550-1566 1568-1569 1571-1581 1583-1632 1634-1640 1642-1645 1647-1658 1660-1661 1663-1682 1684 1686-1692 1694-1699 1701-1708 1710-1713 1715-1737 1739-1745 1747-1751 1753-1765 1767-1773 1775-1788 1790-1795 1797-1799 1801-1809 1811 1814 1816-1818 1821-1823 1825-1827 1829-1832 1834-1838 1840-1869 1871-1874 1876-1896 1898-1922 1924-1958 1960-1975 1977-1981 1983-1989 1991-2001 2003-2012 2014-2024 2027 2029-2038 2040-2046 2048-2081 2083-2086 2088-2091 2093-2094 2096-2368 2370-2372 2374-2463 2465-2473 2475-2617 2619-2640 2642-3260

The go-around phase is activated when the thrust levers are set to TOGA, provided the flap lever is selected to Flap 1 or greater. The FDs bars are displayed automatically and SRS and GA TRK modes engage. The missed approach becomes the active F-PLN and the previously flown approach is strung back into the F-PLN.

For the go-around, the appropriate flying reference is the attitude, since it is dynamic manoeuvre. This is why, if the "bird" is ON, it is automatically removed, and the FD bars automatically replace the FPD.

If TOGA thrust is not required during a go-around for any reason, e.g. an early go-around ordered by ATC, it is essential that thrust levers are set to TOGA momentarily to sequence the F-PLN. If this is not done, the destination airfield will be sequenced and the primary F-PLN will become PPOS - DISCONT-

## GO-AROUND PHASE

MSN 0022-0032 0034-0035 0037-0038 0040-0041 0043 0045-0051 0056-0058 0069-0072 0074-0075 0078-0080 0083 0085-0086 0088-0090 0093-0097 0104 0110-0111 0113-0114 0116-0119 0121 0123-0125 0132 0135 0137-0140 0142 0147-0148 0151-0153 0157 0160-0164 0167-0172 0179-0180 0189-0190 0192-0193 0196-0197 0200-0202 0205-0206 0208-0209 0212-0213 0216-0219 0221-0222 0225 0229-0230 0245 0247 0252 0256-0263 0267-0269 0272-0273 0275-0276 0280-0282 0288 0291-0301 0304 0306-0308 0313-0314 0316 0318-0322 0326-0329 0331-0332 0336 0338-0340 0343-0349 0353-0355 0357-0358 0360-0365 0367-0373 0376 0379-0383 0385-0394 0396-0402 0405-0406 0408 0410-0418 0420 0422-0425 0428-0432 0435-0437 0439 0441-0444 0446-0447 0449-0452 0454 0456-0458 0460-0465 0467-0470 0472-0476 0478-0479 0482-0487 0489-0490 0492-0493 0496 0499-0508 0510-0512 0518 0523 0525 0528 0530-0531 0534 0538-0539 0542 0549 0554 0558 0560-0561 0563-0564 0567-0569 0571 0575 0579-0580 0587 0589-0590 0592 0594-0595 0597 0601 0604-0605 0607 0609-0611 0613-0617 0619 0622-0624 0626-0628 0630 0634 0636 0638-0639 0641 0645 0648-0652 0655 0658-0659 0662 0665-0667 0669 0671 0677-0679 0683 0685-0686 0689-0690 0692 0694 0696 0698-0700 0702 0704-0706 0709-0710 0712 0717-0718 0720 0722-0724 0726 0729 0731 0737-0739 0743-0745 0748-0749 0751 0753-0754 0759 0766-0767 0772 0775 0778 0780 0783 0786-0789 0792 0798-0799 0801-0802 0804 0807 0811 0814 0818 0820 0824-0826 0828 0830 0832-0834 0836 0838 0842-0843 0846-0847 0849-0854 0857-0860 0862 0865 0867 0869 0871 0873-0876 0879-0883 0886-0888 0893 0895 0897-0898 0900-0901 0903 0907 0909 0911 0913-0914 0916 0918 0921 0923 0925 0939 0944 0948 0950 0952 0954-0955 0958 0962-0967 0975 0980-0981 0984 0986 0988-0990 0996 1001 1004-1006 1008-1009 1011 1017 1022 1029 1031-1032 1035 1037 1039 1041-1042 1057-1058 1062 1071-1072 1076 1078 1085 1090-1091 1093 1108 1117 1126 1129 1131 1149 1164-1165 1167 1187 1191 1194-1196 1199 1204 1218 1227 1230 1249 1316 1324-1325 1345-1346 1392 1408 1414 1421 1434 1438 1453 1456 1459 1479 1483 1487 1498 1501 1520 1535 1543 1549 1567 1570 1582 1633 1641 1646 1659 1662 1683 1685 1693 1700 1709 1714 1738 1746 1752 1766 1774 1789 1796 1800 1810 1812 1815 1819-1820 1824 1828 1833 1839 1870 1875 1897 1923 1959 1976 1982 1990 2002 2013 2026 2028 2039 2047 2082 2087 2092 2095 2369 2373 2464 2474 2618 2641

### GO AROUND WITH FD ON

The SRS mode guides the aircraft with a maximum speed of VAPP or IAS at time of TOGA selection (limited to maximum of VAPP + 25 with all engines operative or VAPP + 15 with one engine inoperative with FMS2) until the acceleration altitude where the target speed increases to green dot.

Some FMS misbehaviour may prevent this automatic target speed increase. Should this occur, pulling the FCU ALT knob for OP CLB manually disengages SRS mode and allows the target speed to increase to green dot. It should be noted however, that the target speed increases to green dot speed as soon as ALT* mode engages when approaching the FCU clearance altitude.

The GA TRK mode guides the aircraft on the track memorised at the time of TOGA selection. The missed approach route becomes the ACTIVE F-PLN provided the waypoints have been correctly sequenced on the approach. Pushing for NAV enables the missed approach F-PLN to be followed.

Above the go-around acceleration altitude, or when the flight crew engages another vertical mode (CLB, OP CLB), the target speed is green dot.

## GO AROUND WITH FD OFF

The PF maintains 15° of pitch.

The crew will not select the FD ON before the acceleration altitude, since this would not activate the SRS mode. (V/S mode would be activated, maintaining the V/S at mode engagement).

At the thrust reduction/acceleration altitude, the crew will set the selected speed to green dot before setting CLB thrust, since the autothrust will activate in selected speed mode.

The crew will then set the FD ON , and select the appropriate modes.

MSN 0002-0021 0033 0036 0039 0042 0044 0052-0055 0059-0068 0073 0076-0077 0081-0082 0084 0087 0091 0098-0103 0108-0109 0112 0115 0120 0122 0126-0131 0133-0134 0136 0141 0143-0146 0149-0150 0154-0156 0158-0159 0165-0166 0173-0178 0181-0188 0191 0194-0195 0198-0199 0203-0204 0207 0210-0211 0214-0215 0220 0223-0224 0226-0228 0231-0244 0246 0248-0251 0253-0255 0264-0266 0270 0274 0277-0279 0283-0287 0289-0290 0302-0303 0305 0309-0312 0315 0317 0323-0325 0330 0333-0335 0337 0341-0342 0350-0352 0356 0359 0366 0375 0377-0378 0384 0395 0403-0404 0407 0409 0419 0421 0426-0427 0434 0438 0440 0445 0448 0453 0455 0459 0466 0471 0477 0480 0488 0491 0494-0495 0497-0498 0509 0513-0517 0519-0522 0524 0526-0527 0529 0532-0533 0535-0537 0540-0541 0543-0548 0550-0553 0555-0557 0559 0562 0565-0566 0570 0572-0574 0576-0578 0581-0586 0588 0591 0593 0596 0598-0600 0603 0606 0608 0612 0618 0620-0621 0625 0629 0631-0633 0635 0637 0640 0642-0644 0646-0647 0653-0654 0656-0657 0660-0661 0663-0664 0668 0670 0672-0676 0680-0682 0684 0687-0688 0691 0693 0695 0697 0701 0703 0707 0711 0713-0716 0719 0721 0725 0727-0728 0730 0732-0736 0740-0742 0746-0747 0750 0752 0755-0758 0760-0765 0768-0771 0773-0774 0776-0777 0779 0781-0782 0784-0785 0790-0791 0793-0797 0800 0803 0805-0806 0808-0810 0812-0813 0815-0817 0819 0821-0823 0827 0829 0831 0835 0837 0839-0841 0844-0845 0848 0855-0856 0861 0863-0864 0866 0868 0870 0872 0877-0878 0884-0885 0889-0892 0894 0896 0899 0902 0904-0906 0908 0910 0912 0915 0917 0919-0920 0922 0924 0926-0938 0940-0943 0945-0947 0949 0951 0953 0956-0957 0959-0961 0968-0974 0976-0979 0982-0983 0985 0987 0991-0995 0997-1000 1002-1003 1007 1010 1012-1016 1018-1021 1023-1028 1030 1033-1034 1036 1038 1040 1043-1056 1059-1061 1063-1070 1073-1075 1077 1079-1084 1086-1089 1092 1094-1107 1109-1116 1118-1125 1127-1128 1130 1132-1148 1150-1163 1166 1168-1185 1188-1190 1192-1193 1197-1198 1200-1203 1205-1217 1219-1226 1228-1229 1231-1248 1250-1315 1317-1323 1326-1344 1347-1391 1393-1407 1409-1413 1415-1420 1422-1433 1435-1437 1439-1452 1454-1455 1457-1458 1460-1478 1480-1482 1484-1486 1488-1497 1499-1500 1502-1519 1521-1534 1536-1542 1544-1548 1550-1566 1568-1569 1571-1581 1583-1632 1634-1640 1642-1645 1647-1658 1660-1661 1663-1682 1684 1686-1692 1694-1699 1701-1708 1710-1713 1715-1737 1739-1745 1747-1751 1753-1765 1767-1773 1775-1788 1790-1795 1797-1799 1801-1809 1811 1814 1816-1818 1821-1823 1825-1827 1829-1832 1834-1838 1840-1869 1871-1874 1876-1896 1898-1922 1924-1958 1960-1975 1977-1981 1983-1989 1991-2001 2003-2012 2014-2024 2027 2029-2038 2040-2046 2048-2081 2083-2086 2088-2091 2093-2094 2096-2368 2370-2372 2374-2463 2465-2473 2475-2617 2619-2640 2642-3260

The SRS mode guides the aircraft with a maximum speed of VAPP or IAS at time of TOGA selection (limited to maximum of VAPP + 25 with all engines operative or VAPP + 15 with one engine inoperative with FMS2) until the acceleration altitude where the target speed increases to green dot.

Some FMS misbehaviour may prevent this automatic target speed increase. Should this occur, pulling the FCU ALT knob for OP CLB manually disengages SRS mode and allows the target speed to increase to green dot. It should be noted however, that the target speed increases to green dot speed as soon as ALT* mode engages when approaching the FCU clearance altitude.

The GA TRK mode guides the aircraft on the track memorised at the time of TOGA selection. The missed approach route becomes the ACTIVE F-PLN provided the waypoints have been correctly sequenced on the approach. Pushing for NAV enables the missed approach F-PLN to be followed.

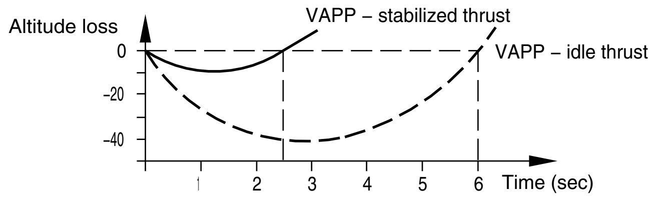
Above the go-around acceleration altitude, or when the flight crew engages another vertical mode (CLB, OP CLB), the target speed is green dot.

## ENGINES ACCELERATION

ALL

When the pilot sets TOGA thrust for go-around, it takes some time for the engines to spool up due to the acceleration capability of the high by pass ratio engines. Therefore, the pilot must be aware that the aircraft will initially loose some altitude. This altitude loss will be greater if initial thrust is close to idle and/or the aircraft speed is lower than VAPP.

ATTITUDE LOSS FOLLOWING A GO-AROUND

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ALL

## LEAVING THE GO-AROUND PHASE

The purpose of leaving the go-around phase is to obtain the proper target speed and proper predictions depending upon the strategy chosen by the crew. During the missed approach, the crew will elect either of the following strategies:

. Fly a second approach

. Carry out a diversion

## SECOND APPROACH

If a second approach is to be flown, the crew will activate the approach phase in the MCDU PERF GO-AROUND page. The FMS switches to Approach phase and the target speed moves according to the flaps lever setting, e.g. green dot for Flaps 0.

The crew will ensure proper waypoint sequencing during the second approach in order to have the missed approach route available, should a further go-around be required.

## DIVERSION

Once the aircraft path is established and clearance has been obtained, the crew will modify the FMGS to allow the FMGS switching from go-around phase to climb phase:

. If the crew has prepared the ALTN FPLN in the active F-PLN, a lateral revision at the TO WPT is required to access the ENABLE ALTN prompt. On selecting the ENABLE ALTN prompt, the lateral mode reverts to HDG if previously in NAV. The aircraft will be flown towards the next waypoint using HDG or NAV via a DIR TO entry.

. If the crew has prepared the ALTN FPLN in the SEC F-PLN, the SEC F-PLN will be activated, and a DIR TO performed as required. AP/FD must be in HDG mode for the ACTIVATE SEC F-PLN prompt to be displayed.

. If the crew has not prepared the ALTN FPLN, a selected climb will be initiated. Once established in climb and clear of terrain, the crew will make a lateral revision at any waypoint to insert a NEW DEST. The route and a CRZ FL (on PROG page) can be updated as required.

# REJECTED LANDING

ALL

A rejected landing is defined as a go-around manoeuvre initiated below the minima.

Once the decision is made to reject the landing, the flight crew must be committed to proceed with the go-around manoeuvre and not be tempted to retard the thrust levers in a late decision to complete the landing.
TOGA thrust must be applied but a delayed flap retraction should be considered. If the aircraft is on the runway when thrust is applied, a CONFIG warning will be generated if the flaps are in conf full. The landing gear should be retracted when a positive rate of climb is established with no risk of further touch down. Climb out as for a standard go-around.

In any case, if reverse thrust has been applied, a full stop landing must be completed.

## BRAKE FANS (IF INSTALLED)

ALL

The use of brake fans could increase oxidation of the brake surface hot spots if brakes are not thermally equalized, leading to the rapid degradation of the brakes. For this reason, selection of brake fans should be delayed until approximately five minutes after touchdown or just prior to stopping at the gate (whichever occurs first).

## BRAKE TEMPERATURE

MSN 0002-0042 0044-0112 0115-0363 0365-0384 0386-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571-0574 0577-0579 0582 0584-0585 0587-0590 0592 0594 0596 0598 0600-0603 0605 0607-0613 0615-0619 0621-0630 0634-0641 0643-0651 0653-0658 0660-0662 0665 0669-0673 0676 0678-0679 0681-0683 0685-0686 0688-0691 0693-0698 0700-0714 0716-0724 0726-0730 0732-0745 0747-0760 0762-0764 0766-0770 0772-0774 0776 0778-0780 0782-0786 0788-0791 0793-0795 0797-0801 0803-0805 0807 0809 0812-0814 0816-0818 0820-0822 0824-0826 0828-0834 0836-0840 0842-0847 0849-0851 0853-0854 0856-0863 0865-0877 0879-0886 0888-0890 0892-0900 0902-0907 0909-0914 0916-0919 0921-0925 0927-0934 0936-0939 0942-0953 0955 0957-0958 0960 0962 0964-0967 0969 0971-0973 0975-0982 0984-0986 0988-0990 0992 0994 0996-1003 1005 1007 1009-1011 1013-1014 1016 1018-1020 1022 1025-1026 1028-1041 1043-1044 1046-1059 1061-1079 1081-1093 1095-1132 1134-1143 1145-1152 1154-1160 1162-1173 1175-1182 1184 1187 1189-1194 1196-1198 1200-1201 1203 1205-1206 1208-1213 1215-1217 1221-1226 1228-1232 1234-1237 1239-1240 1242-1249 1251-1259 1261-1272 1274-1275 1277-1292 1294-1298 1300-1306 1308-1332 1334-1355 1357-1365 1367-1398 1400-1402 1404-1406 1409-1411 1413-1416 1419-1420 1422-1423 1426-1427 1429-1430 1432 1434-1435 1437 1439-1441 1443-1446 1448-1450 1452-1454 1456-1457 1459-1461 1463-1464 1466-1471 1473-1475 1477-1480 1482-1486 1488-1491 1493-1495 1497-1498 1500-1502 1504-1510 1512-1516 1518 1520 1522-1524 1526-1530 1532-1535 1537-1538 1540-1553 1555-1571 1573-1586 1588-1595 1597-1601 1603-1606 1608-1610 1612-1613 1615-1618 1620-1622 1624-1628 1630-1631 1633-1635 1637 1639-1641 1643-1650 1652-1657 1659-1665 1667-1669 1671-1674 1676-1680 1682-1689 1692-1694 1696-1700 1702-1703 1705-1706 1708-1710 1712 1714-1715 1717-1719 1721-1723 1725 1727-1733 1735-1747 1749-1762 1764-1771 1773-1775 1777-1782 1784-1787 1789-1793 1795-1797 1799-1806 1808-1810 1812-1816 1818-1835 1837-1842 1844-1847 1849 1851-1858 1860-1868 1870-1877 1879-1880 1882-1886 1888-1904 1906-1920 1922-1925 1927 1929-1931 1933-1940 1942-1945 1947-1949 1951-1952 1954-1955 1957-1959 1961-1965 1968-1969 1971 1973 1975-1976 1979-1983 1986-1987 1989-1993 1996-2004 2006-2020 2022-2040 2042-2044 2046-2054 2056-2059 2061-2063 2065-2066 2068-2075 2077-2079 2081-2104 2106 2108-2109 2112-2114 2116 2118-2189 2191-2207 2209-2210 2212-2215 2217-2219 2221-2225 2227-2233 2235-2246 2248-2254 2256-2260 2262-2266 2268-2269 2271-2289 2291-2302 2304 2306-2308 2310-2314 2316-2319 2321-2322 2325-2329 2331-2336 2338-2341 2343-2350 2352-2356 2358-2362 2364-2380 2382-2409 2411-2461 2463-2471 2473-2475 2477-2479 2481-2487 2489-2520 2522-2529 2531-2535 2537-2542 2544-2548 2550-2552 2554-2562 2564-2589 2591-2598 2600-2609 2611-2652 2654-2681 2683-2686 2688-2706

MSN 2708-2712 2714-2725 2727-2729 2731-2735 2737-2740 2742-2755 2757-2758 2760-2766 2768-2792 2794-2798 2800-2808 2810-2822 2824-2861 2863-2867 2869-2881 2883-2894 2896-2902 2904-2911 2913-2915 2917-2918 2920-2926 2928-2932 2934-2935 2937-2956 2958-2964 2966-2970 2972-2973 2975-2995 2997-2998 3000-3004 3006-3012 3014 3016-3021 3023-3033 3035-3050 3052-3066 3068-3069 3071-3074 3076-3080 3082-3097 3099-3105 3107-3111 3113-3119 3121-3125 3127-3129 3131-3145 3147-3190 3192-3197 3199-3206 3208-3210 3213-3216 3220 3225-3226 3231 3238 3243-3260

When reaching the gate, if there is a significant difference in brake temperature between the wheels of the same gear, this materializes a potential problem with brake and a maintenance action is due e.g. if one wheel reaches the limit temperature of 600 °C while all others wheels brakes indicate less than 450 °C, this indicates that there is a potential problem of brake binding or permanent brake application on that wheel. Conversely, if one wheel brake is at or below 60 °C whereas the others are beyond 210 °C, this indicates that there is a potential loss of braking on that wheel.

If brake temperature is above 500 °C with fans OFF (350 °C fans ON), use of the parking brake, unless operationally necessary, should be avoided to prevent brake damage.

If one brake temperature exceeds 900 °C, a maintenance action is due.

The MMEL provides information regarding brake ground cooling time, both with and without brake fans.

MSN 0043 0113-0114 0434 0477 0488 0494-0495 0513-0517 0520 0522 0524 0526 0532 0535 0541 0552 0570 0575-0576 0580-0581 0583 0586 0593 0599 0642 0659 0664 0667 0765 0771 0806 0810 0819 0827 0835 0848 0855 0891 0920 0935 0940-0941 0959 0961 0968 0974 0987 1021 1027 1045 1144 1153 1174 1183 1185 1199 1207 1218 1220 1241 1356 1407 1418 1424 1458 1487 1511 1554 1572 1636 1670 1681 1716 1734 1836 1850 1926 1978 2041 2045 2110 2115 2208 2220 2226 2247 2270 2290 2357 2381 2472 2488 2563 2599 3222 3229

When reaching the gate, if there is a significant difference in brake temperature between the wheels of the same gear, this materializes a potential problem with brake and a maintenance action is due e.g. if one wheel reaches the limit temperature of 425 °C while all others wheels brakes indicate less than 325 °C, this indicates that there is a potential problem of brake binding or permanent brake application on that wheel. Conversely, if one wheel brake is at or below 60 °C whereas the others are beyond 160 °C, this indicates that there is a potential loss of braking on that wheel.

If brake temperature is above 500 °C with fans OFF (350 °C fans ON), use of the parking brake, unless operationally necessary, should be avoided to prevent brake damage.

If one brake temperature exceeds 500 °C, a maintenance action is due.

The MMEL provides information regarding brake ground cooling time, both with and without brake fans.

MSN 0364 0385 0412 0458 0468 0473-0474 0484 0493 0498 0502 0505 0509 0518-0519 0521 0529 0538 0544 0550 0555 0557 0560 0563-0564 0567 0591 0595 0597 0604 0606 0614 0620 0631-0633 0652 0663 0666 0668 0674-0675 0677 0680 0684 0687 0692 0699 0715 0725 0731 0746 0761 0775 0777 0781 0787 0792 0796 0802 0808 0811 0815 0823 0841 0852 0864 0878 0887 0901 0908 0915 0926 0954 0956 0963 0970 0983 0991 0993 0995 1004 1006 1008 1012 1015 1017 1023-1024 1042 1060 1080 1094 1133 1161 1188 1195 1202 1204 1214 1219 1227 1233 1238 1250 1260 1273 1276 1293 1299 1307 1333 1366 1399 1403 1408 1412 1417 1421 1425 1428 1431 1433 1436 1438 1442 1447 1451 1455 1462 1465 1472 1476 1481 1492 1496 1499 1503 1517 1519 1521 1525 1531 1536 1539 1587 1596 1602 1607 1611 1614 1619 1623 1629 1632 1638 1642 1651 1658 1666 1675 1690-1691 1695 1701 1704 1707 1711 1713 1720 1724 1726 1748 1763 1772 1776 1783 1788 1794 1798 1807 1811 1817 1843 1848 1859 1869 1878 1881 1887 1905 1921 1928 1932 1941 1946 1950 1953 1956 1960 1966-1967 1970 1972 1974 1977 1984 1988 1994-1995 2005 2021 2055 2060 2064 2067 2076 2080 2105 2107 2117 2190 2211 2216 2234 2255 2261 2267 2303 2305 2309 2315 2320 2323-2324 2330 2337 2342 2351 2363 2410 2462 2476 2480 2521 2530 2536 2543 2549 2553 2590 2610 2653 2682 2687 2707 2713 2726 2730 2736 2741 2756 2759 2767 2793 2799 2809 2823 2862 2868 2882 2895 2903 2912 2916 2919 2927 2933 2936 2957 2965 2971 2974 2996 2999 3005 3013 3015 3022 3034 3051 3067 3070 3075 3081 3098 3106 3112 3120 3126 3130 3146 3191 3198 3207 3212 3217 3233-3235 3241

When reaching the gate, if there is a significant difference in brake temperature between the wheels of the same gear, this materializes a potential problem with brake and a maintenance action is due. e.g. if one wheel reaches the limit temperature of 600 °C while all others wheels brakes indicate less than 450 °C, this indicates that there is a potential problem of brake binding or permanent brake application on that wheel. Conversely, if one wheel brake is at or below 60 °C whereas the others are beyond 210 °C, this indicates that there is a potential loss of braking on that wheel.

If brake temperature is above 500 °C with fans OFF (350 °C fans ON), use of the parking brake, unless operationally necessary, should be avoided to prevent brake damage.

If one brake temperature exceeds 800 °C, a maintenance action is due.

The MMEL provides information regarding brake ground cooling time, both with and without brake fans.

## ENGINES COOLING PERIOD

ALL

To avoid engine thermal stress, it is required that the engine be operated at, or near, idle for a cooling period as described in FCOM 3.03.25

## TAXI WITH ONE ENGINE SHUTDOWN

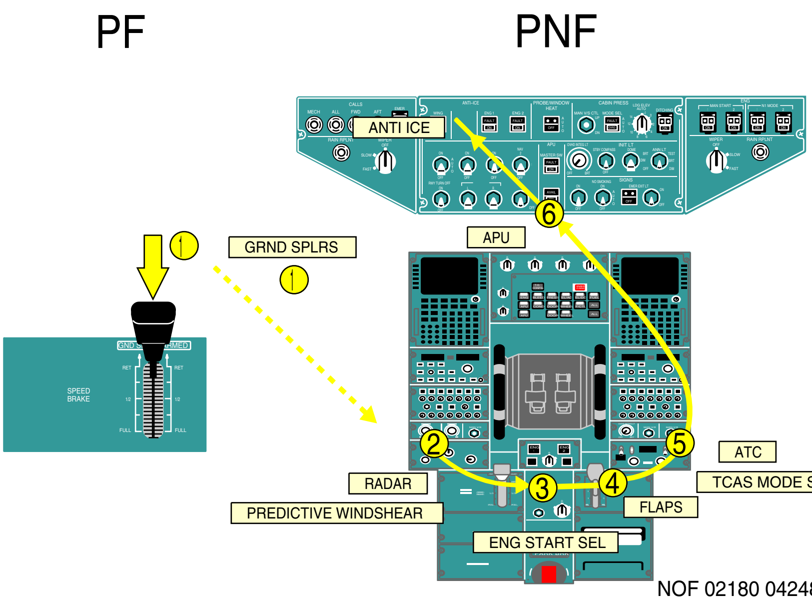
ALL

Refer to FCTM 02.040

## AFTER LANDING FLOW PATTERN

ALL

AFTER LANDING FLOW PATTERN




NOF 02180 04248 0001

## PREFACE

ALL

The ABNORMAL OPERATIONS chapter highlights techniques that will be used in some abnormal and emergency operations. Some of the procedures discussed in this chapter are the result of double or triple failures. Whilst it is very unlikely that any of these failures will be encountered, it is useful to have a background understanding of the effect that they have on the handling and management of the aircraft. In all cases, the ECAM should be handled as described in FCTM OPERATIONAL PHILOSOPHY- ECAM 01.040.

## LANDING DISTANCE PROCEDURE

ALL

Should a failure occur with "LANDING DISTANCE PROC....APPLY" message displayed on the ECAM STATUS page, the crew will enter the LDG CONF/APP SPD/LDG DIST/ CORRECTIONS FOLLOWING FAILURES table in QRH chapter 2 and read:

. The flap lever position for landing

. Delta VREF if required for VAPP determination

. The landing distance factor for landing distance calculation

## VAPP DETERMINATION

ALL

### BACKGROUND

Some failures affect the approach speed.

. Some failures (typically slat or flap failure) increase the VLS. In this case, the VLS displayed on the PFD (if available) takes into account the actual configuration.

. In some others failures, it is required to fly at speed higher than VLS to improve the handling characteristics of the aircraft. This speed increment is to be added to the VLS displayed on the PFD when the landing configuration is reached.

In order to prepare the approach and landing, the crew needs to know VAPP in advance. The appropriate VLS is not necessarily available at that time on the PFD, because the landing configuration is not yet established. Hence, VAPP is determined using VREF, which is the VLS of CONF FULL, and is available both in MCDU PERF APPR page and QRH. Delta VREF, extracted from the QRH, is then added.

$$\text{Vapp} = \text{Vref} + \underbrace{\Delta\text{Vref} + \text{Wind correction}}_{\text{When required}}$$

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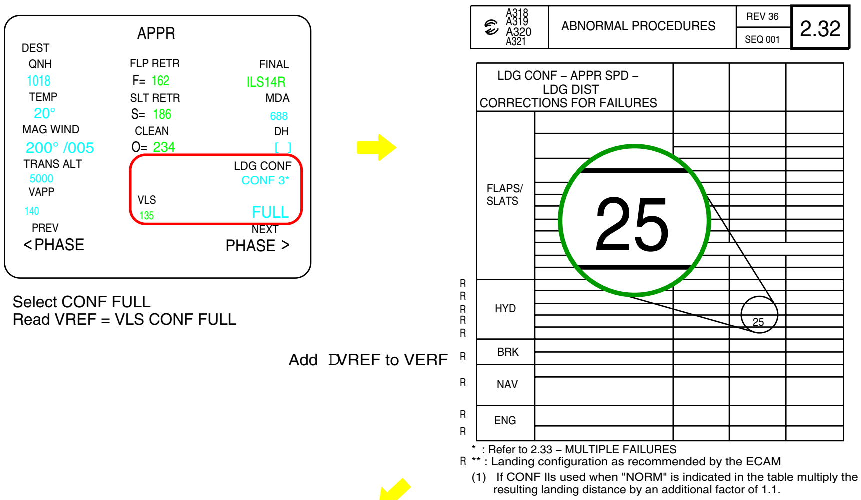
**METHOD**

**If QRH shows a Delta Vref**

VAPP COMPUTATION PRINCIPLE WITH DELTA VREF

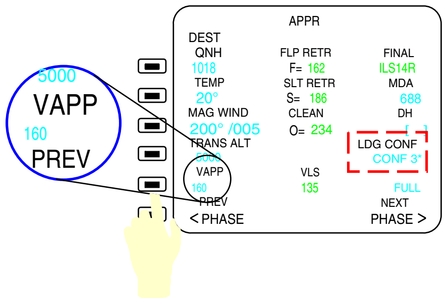



Select CONF FULL
Read VREF = VLS CONF FULL

Add ΔVREF to VERF

| WIND CORRECTION | |
|---|---|
| ΔVREF ⩾ 20KT | ΔVREF < 20KT |
| NO WIND CORRECTION | 1/3 HEADWIND ( ΔVREF + WIND CORR LIMITED TO 20KT) |

Add wind correction, if applicable




Enter VAPP manually
Select CONF 3, if LDG IN CONF 3

NOF 03010 00001 0001

When fully configured in final approach, the crew will check the reasonableness of the final approach speed computed by the crew with regard to VLS on the PFD speed scale.

**If the QRH shows no Delta Vref:**

Proceed as for normal operations (Use the MCDU VAPP, as computed by FMS).

# IN FLIGHT LANDING DISTANCE CALCULATION FOLLOWING FAILURES

ALL

## GENERAL

The actual landing distance (from 50 ft above the runway surface until the aircraft comes to the complete stop) is measured during specific flight tests for the certification of the aircraft. This distance represents the absolute performance capability of the aircraft. It is published without safety margin under the name "LANDING DISTANCE WITHOUT AUTOBRAKE" in the QRH.

To compute the actual landing distance following any failure affecting the landing performance, the crew multiplies the "LANDING DISTANCE WITHOUT AUTOBRAKE" CONFIGURATION FULL by the associated landing distance factor found in the QRH. This actual landing distance following a failure is computed with no safety margin.

The flight crew checks this actual landing distance against the Landing Distance Available (LDA) of the runway used for landing applying the relevant safety margins.

The safety margins to be applied depend of the circumstances according to:

. the Captain judgement

. the Airline policy

. the applicable regulations

*Note: For example:*
*The US-FAA recommends to apply a minimum safety margin of 15% between the actual landing distance and the Landing Distance Available (LDA) in case of*
*. in-flight determination of the landing distance*
*. normal and abnormal conditions (except in an emergency)*
*Ref: US-FAA SAFO 06012 dated 31 Aug 2006.*

## DRY RUNWAY

The landing distance calculation does NOT include the effect of thrust reversers.

**Landing distance with failure = Landing distance (1) x Failure factor "dry" (2)**

**(1)**: LANDING DISTANCE WITHOUT AUTOBRAKE CONFIGURATION FULL (QRH chapter 4 IN FLIGHT PERFORMANCE)

**(2)**: Failure factor "dry" from QRH chapter 2 ABNORMAL PROCEDURES APPR SPD increment and Landing distance factor table

Reverse thrust credit:

For the failure cases for which ALL thrust reversers remain available it is possible to include the effect of reverse thrust in the calculation.

**Landing distance with failure = Landing distance (1) x Reverse credit (3) x Failure factor "dry" (2)**

**(3)**: LANDING DISTANCE WITHOUT AUTOBRAKE CONFIGURATION FULL - CORRECTIONS table Reversers operative (QRH chapter 4 IN FLIGHT PERFORMANCE)

**WET OR CONTAMINATED RUNWAY**

The landing distance calculation includes the effect of all available thrust reversers.

Whatever is the failure, the actual landing distance found in the table "LANDING DISTANCE WITHOUT AUTOBRAKE" CONFIGURATION FULL must be corrected by the reversers credit.

When applicable, the failure factors take into account the loss of one or more thrust reversers due to the related failure.

*Note: This method does not permit to compute the landing distance with NO REVERSE thrust credit*

**Landing distance with failure = Landing distance (1) x Reverse credit (3) x Failure factor "wet or contaminated" (2)**

## LOW SPEED ENGINE FAILURE

ALL

If an engine failure occurs at low speed, the resultant yaw may be significant, leading to rapid displacement from the runway centreline. For this reason, it is essential that the Captain keeps his hand on the thrust levers once take-off thrust has been set. Directional control is achieved by immediately closing the thrust levers and using maximum rudder and braking. If necessary, the nosewheel tiller should be used to avoid runway departure.

## REJECTED TAKE-OFF

ALL

### FACTORS AFFECTING RTO

Experience has shown that a rejected take-off can be hazardous, even if correct procedures are followed. Some factors that can detract from a successful rejected take-off are as follows:

- Tire damage
- Brakes worn or not working correctly
- Error in gross weight determination
- Incorrect performance calculations
- Incorrect runway line-up technique
- Initial brake temperature
- Delay in initiating the stopping procedure
- Runway friction coefficient lower than expected

Thorough pre-flight preparation and a conscientious exterior inspection can eliminate the effect of some of these factors.

During the taxi-out, a review of the take-off briefing is required. During this briefing, the crew should confirm that the computed take-off data reflects the actual take-off conditions e.g. wind and runway condition. Any changes to the planned conditions require the crew to re-calculate the take-off data. In this case, the crew should not be pressurised into accepting a take-off clearance before being fully ready. Similarly, the crew should not accept an intersection take-off until the take-off performance has been checked.

The line-up technique is very important. The pilot should use the over steer technique to minimize field length loss and consequently, to maximize the acceleration-stop distance available.

## DECISION MAKING

A rejected take-off is a potentially hazardous manoeuvre and the time for decision-making is limited. To minimize the risk of inappropriate decisions to reject a take-off, many warnings and cautions are inhibited between 80 kts and 1500 ft. Therefore, any warnings received during this period must be considered as significant.

To assist in the decision making process, the take-off is divided into low and high speeds regimes, with 100 kts being chosen as the dividing line. The speed of 100 kts is not critical but was chosen in order to help the Captain make the decision and to avoid unnecessary stops from high speed:

- Below 100 kts, the Captain will seriously consider discontinuing the take-off if any ECAM warning/caution is activated.
- Above 100 kts, and approaching V1, the Captain should be "go-minded" and only reject the take-off in the event of a major failure, sudden loss of thrust, any indication that the aircraft will not fly safely, or if one of the following ECAM warning/caution occurs:
  - ENG or APU FIRE
  - ENG FAIL
  - ENG OIL LO PR
  - CONFIG
  - ENG REV UNLOCK
  - L+R ELEV FAULT
  - SIDESTICK FAULT

  If a tire fails within 20 kts of V1, unless debris from the tire has caused noticeable engine parameter fluctuations, it is better to get airborne, reduce the fuel load and land with a full runway length available.

The decision to reject the take-off is the responsibility of the Captain and must be made prior to V1 speed:

- If a malfunction occurs before V1, for which the Captain does not intend to reject the take-off, he will announce his intention by calling "GO".
- If a decision is made to reject the take-off, the Captain calls "STOP". This call both confirms the decision to reject the take-off and also states that the Captain now has control. It is the only time that hand-over of control is not accompanied by the phrase "I have control".

## RTO PROCEDURE

Should a RTO procedure is initiated, the following task sharing will be applied.

| CAPT | F/O |
|---|---|
| Calls ..........................................."STOP"<br>Thrust levers ................................. IDLE<br>Reverse thrust .................. MAX AVAIL | Calls ...................... "REVERSE GREEN"<br>"DECEL(*)"<br>"70 kt"<br><br>Cancels any audio warning |
| Aircraft stopped<br><br>Reverse ................................ STOWED<br>Parking brake ........................... APPLY<br>PA call ........... "ATTENTION CREW AT STATION"<br>Calls for .................... "ECAM ACTION" | Advises ATC<br>Locates on ground EMER EVAC C/L<br><br>Completes the ECAM ACTIONS |

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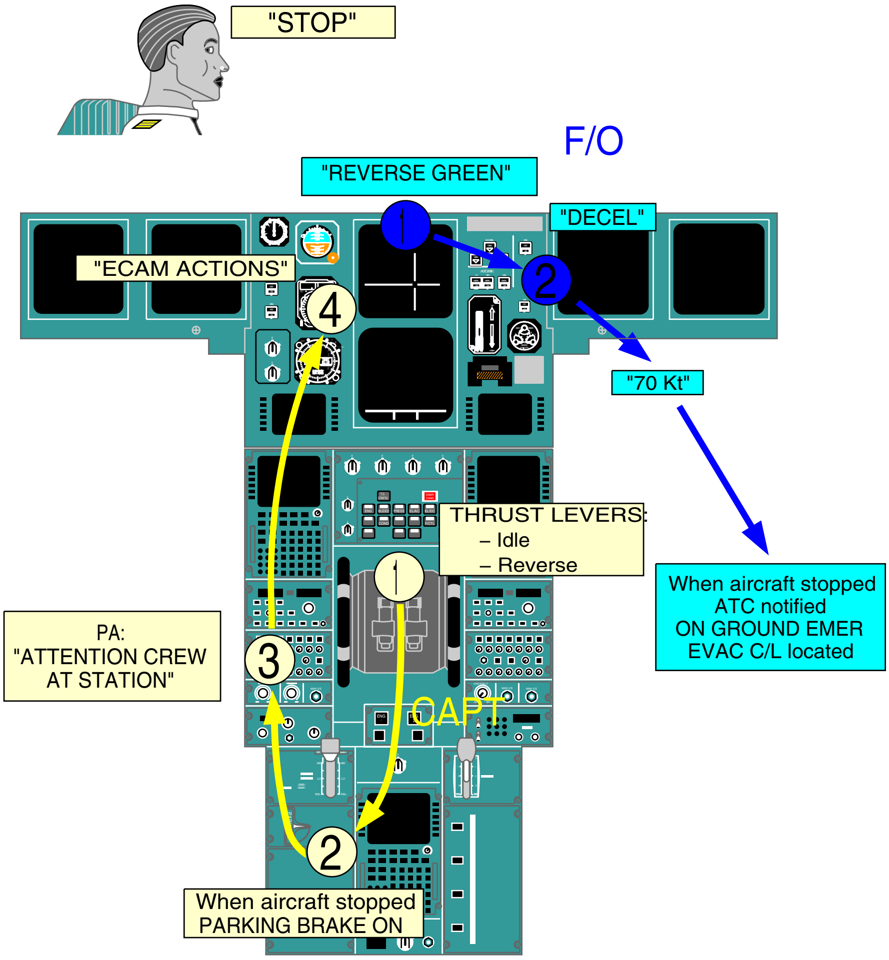
(*): "DECEL" call means that the deceleration is felt by the crew, and confirmed by the Vc trend on the PFD. It can also be confirmed by the DECEL light; however, this light only indicates that the selected deceleration rate is or is not achieved, irrespective of the functioning of the autobrake. DECEL light might not come up on a contaminated runway, with the autobrake working properly,due to the effect of the antiskid.

If the take-off is rejected prior to 72kts, the spoilers will not deploy and the auto-brake will not function.

If a rejected take-off is initiated and MAX auto brake decelerates the aircraft, the captain will avoid pressing the pedals (which might be a reflex action). Conversely, if deceleration is not felt, the captain will press the brake pedals fully down.

If take-off has been rejected due to an engine fire, the ECAM actions will be completed until shutting down the remaining engines.

REJECTED TAKE-OFF FLOW PATTERN

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## INTRODUCTION TO EMERGENCY EVACUATION

ALL

## GENERAL

The typical case, which may require an emergency evacuation, is an uncontrollable on ground engine fire. This situation, which may occur following a rejected take-off or after landing, requires good crew coordination to cope with a high workload situation.

## DECISION MAKING

As soon as aircraft is stopped, the parking brake set, the captain notifies the cabin crew and calls for ECAM ACTIONS. At this stage, the task sharing is defined as follow:

. The first officer carries out the ECAM actions until shutting down the remaining engine.

. The captain builds up his decision to evacuate depending on the circumstances. Considerations should be given to:
  – Possible passenger evacuation of the aircraft on the runway.
  – Vacating the runway as soon as possible.
  – Communicating intentions or requests to ATC.

If fire remains out of control after having discharged the fire agents, the captain calls for the **EMER**GENCY **EVAC**UATION C/L located in the inside back cover of the QRH.

## THE EMERGENCY EVACUATION C/L

MSN 0002-1598 1600-2812 2814-2832 2834-2842 2845-2849 2851-2855 2857-2862 2864-2868 2871-2877 2879-2882 2884-2887 2890-2896 2898-2909 2912-2915 2917-2918 2920-2924 2926 2928-2930 2934-2953 2956-2957 2959-2973 2975 2977-2980 2982-2989 2991-2994 2996-2997 2999-3000 3002-3003 3006-3009 3015 3017 3019-3020 3026 3028-3029 3031-3032 3035-3036 3039 3041-3043 3045 3047-3048 3051 3053 3056 3058-3061 3065 3068 3072 3081-3082 3084 3088 3090-3091 3094 3097-3098 3103 3106 3111 3113 3118-3119 3122 3129 3134 3136-3137 3150 3156 3158 3167-3168 3176 3180 3184 3186 3190 3196 3210 3233

Some items need to be highlighted:

. It is essential that the differential pressure be zeroed.

In automatic pressurization mode, the crew can rely on the CPC, and the Delta P check is therefore not applicable.
If MAN CAB PRESS is used in flight, the CAB PR SYS (1+2) FAULT procedure requires selecting MAN V/S CTL to FULL UP position during final approach to cancel any residual cabin pressure. However, since the residual pressure sensor indicator, installed in the cabin door, is inhibited with slides armed, an additional Delta P check is required by the **EMER**GENCY **EVAC**UATION C/L.
Since MAN CAB PRESS is never used for take-off as at least one automatic cabin pressure control must be operative for departure, the Delta P check does not apply to the case of emergency evacuation following a rejected takeoff.

. CABIN CREW (PA)ALERT reminds the captain for the "CABIN CREW AT STATION" call out.

. EVACUATIONINITIATE requires:
  - The cabin crew to be notified to launch evacuation and
  - EVAC command activation.
  This will be done preferably in this order for a clear understanding by cabin crew.

On ground with engines stopped, the right dome light automatically illuminates whatever the dome switch position is, allowing the **EMER**GENCY **EVAC**UATION C/L completion.

When aircraft is on batteries power, the crew seats can only be operated mechanically.

MSN 1599 2813 2833 2843-2844 2850 2856 2863 2869-2870 2878 2883 2888-2889 2897 2910-2911 2916 2919 2925 2927 2931-2933 2954-2955 2958 2974 2976 2981 2990 2995 2998 3001 3004-3005 3010-3014 3016 3018 3021-3025 3027 3030 3033-3034 3037-3038 3040 3044 3046 3049-3050 3052 3054-3055 3057 3062-3064 3066-3067 3069-3071 3073-3080 3083 3085-3087 3089 3092-3093 3095-3096 3099-3102 3104-3105 3107-3110 3112 3114-3117 3120-3121 3123-3128 3130-3133 3135 3138-3149 3151-3155 3157 3159-3166 3169-3175 3177-3179 3181-3183 3185 3187-3189 3191-3195 3197-3209 3212-3231 3235-3260

Some items need to be highlighted:

. CABIN CREW (PA)ALERT reminds the captain for the "CABIN CREW AT STATION" call out.

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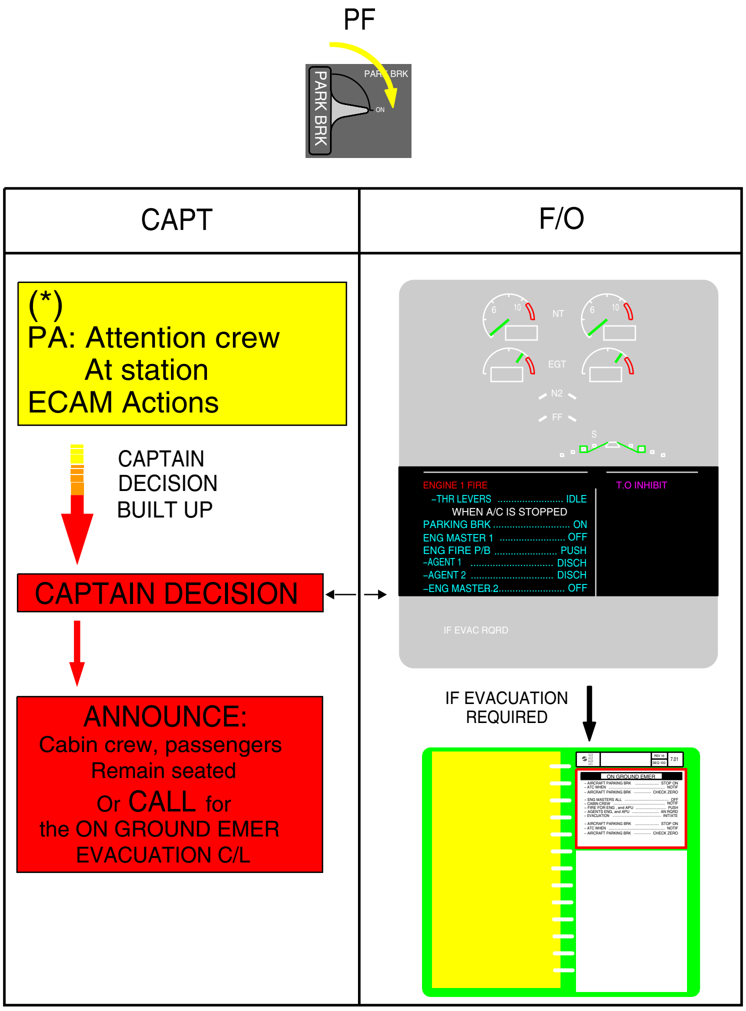
ALL

## TASKSHARING IN CASE OF EMERGENCY EVACUATION

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(*) In the rejected take-off case, the captain calls STOP. This confirms that the captain has controls.

Following landing and after the parking brake is set, the captain calls "I HAVE CONTROLS" if required to state the control hand over.

When applying the emergency evacuation procedure, the F/O can select the engine masters OFF and push the FIRE pusbuttons, without any confirmation from the Captain.

## ENGINE FAILURE AFTER V1

ALL

### AIRCRAFT HANDLING

If an engine fails after V1 the take-off must be continued. The essential and primary tasks are linked to aircraft handling. The aircraft must be stabilized at the correct pitch and airspeed, and established on the correct track prior to the initiation of the ECAM procedure.

**ON THE GROUND:**

Rudder is used conventionally to maintain the aircraft on the runway centreline.

At VR, rotate the aircraft smoothly, at a slower rate than with all engines operation, using a continuous pitch rate to an initial pitch attitude of 12.5°. The combination of high FLEX temperature and low V speeds requires precise handling during the rotation and lift off. The 12.5° pitch target will ensure the aircraft becomes airborne.

**WHEN SAFELY AIRBORNE:**

The SRS orders should then be followed which may demand a lower pitch attitude to acquire or maintain V2.

With a positive rate of climb and when the Radio Altitude has increased, the PNF will call "positive climb". This will suggest to the PF for landing gear retraction.

Shortly after lift off, the lateral normal law commands some rudder surface deflection to minimize the sideslip (there is no feedback of this command to the pedals). Thus, the lateral behavior of the aircraft is safe and the pilot should not be in a hurry to react on the rudder pedals and to chase the beta target.

The blue beta target will replace the normal sideslip indication on the PFD. Since the lateral normal law does not command the full needed rudder surface deflection, the pilot will have to adjust conventionally the rudder pedals to center the beta target.

When the beta target is centred, total drag is minimised even though there is a small amount of sideslip. The calculation of the beta target is a compromise between drag produced by deflection of control surfaces and airframe drag produced by a slight sideslip. Centering the beta target produces less total drag than centering a conventional ball, as rudder deflection, aileron deflection, spoiler deployment and aircraft body angle are all taken into account.

The crew will keep in mind that the yaw damper reacts to a detected side slip. This means that, with hands off the stick and no rudder input, the aircraft will bank at about 5° maximum and then, will remain stabilized. Thus, laterally, the aircraft is a stable platform and no rush is required to laterally trim the aircraft. Control heading conventionally with bank, keeping the beta target at zero with rudder. Accelerate if the beta target cannot be zeroed with full rudder. Trim the rudder conventionally.

The use of the autopilot is STRONGLY recommended. Following an engine failure, the rudder should be trimmed out prior to autopilot engagement.

Once AP is engaged, the rudder trim is managed through the AP and, hence, manual rudder trim command, including reset, is inhibited.

## THRUST CONSIDERATIONS

Consider the use of TOGA thrust, keeping in mind the following:

. For a FLEX take-off, selecting the operating engine to TOGA provides additional performance margin but is not a requirement of the reduced thrust take-off certification. The application of TOGA will very quickly supply a large thrust increase but this comes with a significant increase in yawing moment and an increased pitch rate. The selection of TOGA restores thrust margins but it may be at the expense of increased workload in aircraft handling.

. TOGA thrust is limited to 10 minutes.

## PROCEDURE

### INITIATION OF THE PROCEDURE

The PNF will closely monitor the aircraft's flight path. He will cancel any Master Warning/Caution and read the ECAM title displayed on the top line of the E/WD.

Procedures are initiated on PF command. No action is taken (apart from cancelling audio warnings through the MASTER WARNING light) until:

. The appropriate flight path is established and,

. The aircraft is at least 400 ft above the runway, if a failure occurs during take-off approach or go-around.

A height of 400 ft is recommended because it is a good compromise between the necessary time for stabilization and the excessive delay in procedure initiation. In some emergency cases and provided the flight path is established, the PF may initiate the ECAM actions before 400 ft.

Once the PF has stabilised the flight path, the PNF confirms the failure. If it is necessary to delay the ECAM procedure, the PF should order "Standby", otherwise he should announce "ECAM actions".

Priority must be given to the control of aircraft trajectory, and acceleration phase should not be delayed for the purpose of applying the ENG FAIL ECAM procedure. Should the PF require an action from the PNF during ECAM procedures, the order "STOP ECAM" should be used. When ready to resume ECAM procedure, the order "CONTINUE ECAM" should be used.

The procedure may be continued until "ENG MASTER OFF" (in case of engine failure without damage) or until AGENT 1 DISCH (in case of engine failure with damage) before acceleration.

*Note: In case of ENG FIRE, fire drill remains high priority.*

**ACCELERATION SEGMENT**

At the engine-out acceleration altitude, push ALT to level off and allow the speed to increase. If the aircraft is being flown manually, the PF should remember that, as airspeed increases, the rudder input needed to keep the beta target centred will reduce. Retract the flaps as normal. When the flap lever is at zero, the beta target reverts to the normal sideslip indication.

**FINAL TAKE-OFF SEGMENT**

As the speed trend arrow reaches Green Dot speed, pull for OPEN CLIMB, set THR MCT when the LVR MCT message flashes on the FMA (triggered as the speed index reaches green dot) and resume climb using MCT. If the thrust lever are already in the FLX/MCT detent, move lever to CL and then back to MCT.

When an engine failure occurs after take-off, noise abatement procedures are no longer a requirement. Additionally, the acceleration altitude provides a compromise between obstacle clearance and engine thrust limiting time. It allows the aircraft to be configured to Flap 0 and green dot speed, which provides the best climb gradient.

Once established on the final take-off flight path, continue the ECAM until the STATUS is displayed. At this point, the AFTER T/O checklist should be completed, computer reset considered and OEBs consulted (if applicable). STATUS should then be reviewed.

**ONE ENGINE OUT FLIGHT PATH**

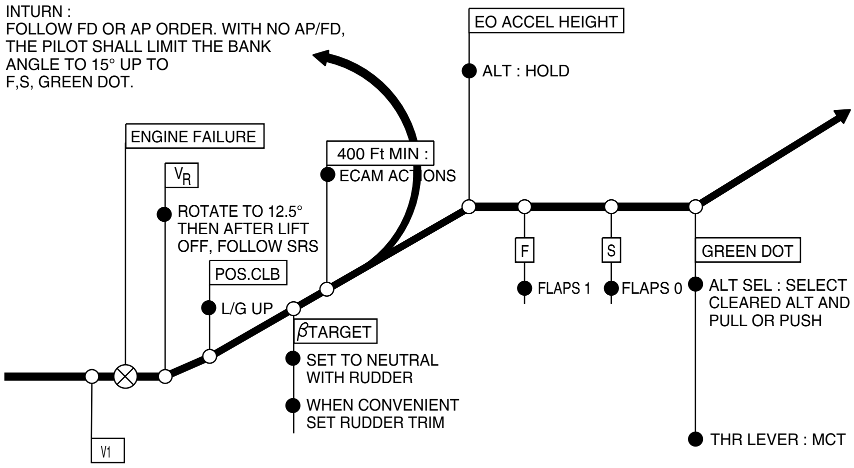
The one engine out flight path will be flown according to the take-off briefing made at the gate:

. The EOSID (with attention to the decision point location)

. The SID

. Radar vectors...

ENGINE FAILURE AFTER V1

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## ENGINE FAILURE DURING INITIAL CLIMB-OUT

ALL

Proceed as above. If the failure occurs above V2 however, maintain the SRS commanded attitude. In any event the minimum speed must be V2.

When an engine failure is detected, the FMGS produces predictions based on the engine-out configuration and any pre-selected speeds entered in the MCDU are deleted.

## ENGINE FAILURE DURING CRUISE

ALL

### GENERAL

There are three strategies available for dealing with an engine failure in the cruise:

. The standard strategy

. The obstacle strategy

. The fixed speed strategy

The fixed speed strategy refers to ETOPS. It is discussed in FCOM 2 "special operations" and is taught as a separate course.

Unless a specific procedure has been established before dispatch (considering ETOPS or mountainous areas), the standard strategy is used.

### PROCEDURE

As soon as the engine failure is recognized, the PF will simultaneously:

. Set MCT on the remaining engine(s)

. Disconnect A/THR

Then, PF will

. Select the SPEED according to the strategy

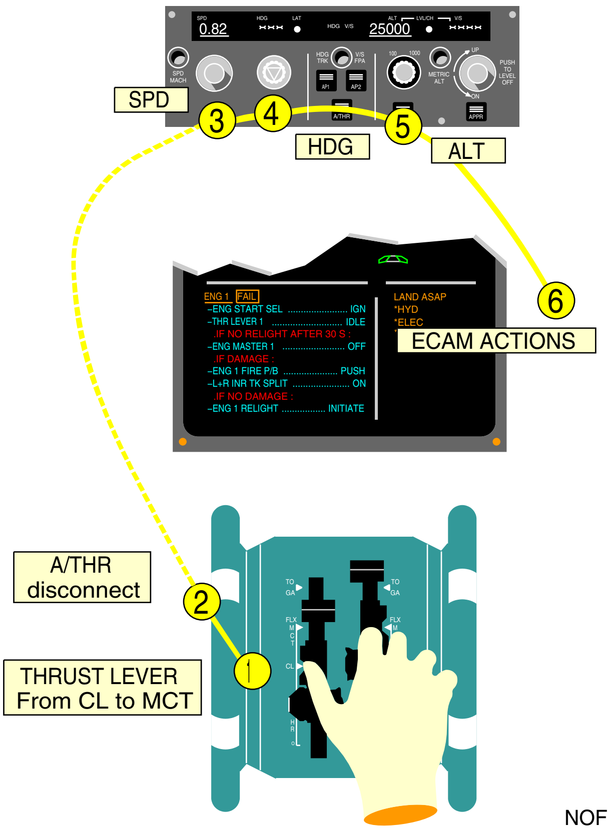
. If appropriate, select a HDG to keep clear of the airway, preferably heading towards an alternate. Consideration should be given to aircraft position relative to any relevant critical point

. Select the appropriate engine inoperative altitude in the FCU ALT window and pull for OPEN DES

Then, PF will

. Require the ECAM actions

At high flight levels close to limiting weights, crew actions should not be delayed, as speed will decay quickly requiring prompt crew response. The crew will avoid decelerating below green dot.

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The A/THR is disconnected to avoid any engine thrust reduction when selecting speed according to strategy or when pulling for OPEN DES to initiate the descent. With the A/THR disconnected, the target speed is controlled by the elevator when in OPEN DES.

Carrying out the ECAM actions should not be hurried, as it is important to complete the drill correctly. Generally, there will be sufficient time to cross check all actions.

**STANDARD STRATEGY**

Set speed target .78/300kt. The speed of .78/300kt is chosen to ensure the aircraft is within the stabilised windmill engine relight in-flight envelope.

The REC MAX EO Cruise altitude, which equates to LRC with anti-icing off, is displayed on the MCDU PROG page and should be set on the FCU. (One engine out gross ceiling at long-range speed is also available in the QRH in case of double FM failure).

If V/S becomes less than 500 fpm, select V/S 500 fpm and A/THR on. This is likely to occur as level off altitude is approached.

Once established at level off altitude, long-range cruise performance with one engine out may be extracted from QRH or FCOM 3.06.30.

**OBSTACLE STRATEGY**

To maintain the highest possible level due to terrain, the drift down procedure must be adopted. The speed target in this case is green dot. The procedure is similar to the standard strategy, but as the speed target is now green dot, the rate and angle of descent will be lower.

The MCDU PERF CRZ page in EO condition will display the drift down ceiling, assuming green dot speed and should be set on FCU. (One engine out gross ceiling at green dot speed is also available in the QRH and FCOM).

If, having reached the drift down ceiling altitude, obstacle problems remain, the drift down procedure must be maintained so as to fly an ascending cruise profile.

When clear of obstacles, set LRC ceiling on FCU, return to LRC speed and engage A/THR.

## ENGINE-OUT LANDING

ALL

Autoland is available with one engine inoperative, and maximum use of the AP should be made to minimise crew workload. If required, a manual approach and landing with one engine inoperative is conventional. The pilot should trim to keep the slip indication centred. It remains yellow as long as the thrust on the remaining engine(s) is below a certain value.

With flap selected and above this threshold value, the indicator becomes the blue beta target. This is a visual cue that the aircraft is approaching its maximum thrust capability.

Do not select the gear down too early, as large amounts of power will be required to maintain level flight at high weights and/or high altitude airports.

To make the landing run easier, the rudder trim may be reset to zero in the later stages of the approach. On pressing the rudder trim reset button, the trim is removed and the pilot should anticipate the increased rudder force required. With rudder trim at zero, the neutral rudder pedal position corresponds to zero rudder and zero nose wheel deflection.

## CIRCLING ONE ENGINE INOPERATIVE

ALL

In normal conditions, circling with one engine inoperative requires the down wind leg to be flown in CONF 3, with landing gear extended.

In hot and high conditions and at high landing weight, the aircraft may not be able to maintain level flight in CONF 3 with landing gear down. The flight crew should check the maximum weight showed in the QRH CIRCLING APPROACH WITH ONE ENGINE INOPERATIVE procedure table. If the landing weight is above this maximum value, the landing gear extension should be delayed until established on final approach.

If the approach is flown at less than 750 ft RA, the warning "L/G NOT DOWN" will be triggered. "TOO LOW GEAR" warning is to be expected, if the landing gear is not downlocked at 500 ft RA. Therefore, if weather conditions permit, it is recommended to fly a higher circling pattern.

ALL

## ONE ENGINE INOPERATIVE GO-AROUND

A one engine inoperative go-around is similar to that flown with all engines. On the application of TOGA, rudder must be applied promptly to compensate for the increase in thrust and consequently to keep the beta target centred. Provided the flap lever is selected to Flap 1 or greater, SRS will engage and will be followed. If SRS is not available, the initial target pitch attitude is 12.5°. The lateral FD mode will be GA TRK and this must be considered with respect to terrain clearance. ALT should be selected at the engine inoperative acceleration altitude, with the flap retraction and further climb carried out using the same technique as described earlier in "ENGINE FAILURE AFTER V1" section.

# FMGC FAILURE

ALL

## SINGLE FMGC FAILURE

Should a single FMGC failure occur, the AP, if engaged on affected side, will disconnect. The AP will be restored using the other FMGC. The A/THR remains operative. Furthermore, flight plan information on the affected ND may be recovered by using same range as the opposite ND. The crew should consider a FMGC reset as detailed in QRH.

## DUAL FMGC FAILURE

Should a dual FMGC failure occur, the AP/FD and A/THR will disconnect. The crew will try to recover both AP and A/THR by selecting them back ON (The AP and A/THR can be recovered if the FG parts of the FMGS are still available).

If both AP and A/THR cannot be recovered, the thrust levers will be moved to recover manual thrust. The pilot will switch off the FDs and select TRK / FPA to allow the blue track index and the bird to be displayed. The RMPs will be used to tune the navaids.

The crew will refer to the QRH for computer reset considerations and then will refer to FCOM 4.06.20 to reload both FMGC as required.

## INTRODUCTION TO EMERGENCY ELECTRICAL CONFIGURATION

ALL

The procedure discussed in this section is the EMERGENCY ELECTRICAL CONFIGURATION. Whilst it is very unlikely that this failure will be encountered, it is useful:

. To refresh on the technical background

. To recall the general guidelines that must be followed in such a case

. To outline the main available systems according to the electrical power source.

## TECHNICAL BACKGROUND

MSN 0002-0363 0365-0384 0386-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545 0548-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571 0573-0575 0577 0579-0580 0582 0584-0585 0587 0589-0590 0592 0594 0596 0601-0603 0605 0607 0611 0613 0615 0617 0619 0622 0624 0626 0628 0630 0635 0638 0640 0643 0645 0648 0650 0653 0655 0657-0659 0661-0662 0665 0667 0669 0671 0673 0676 0678 0681 0683 0685 0696 0698 0701-0710 0712 0714 0716 0718 0720 0722 0724 0726 0730 0733 0735 0737 0739 0741 0743 0745 0747 0749 0751 0753-0754 0756 0758 0760 0762 0764 0766 0768 0770 0772 0774 0776 0778 0780 0782 0784 0786 0789 0791 0793 0795 0797 0799 0801 0803 0805 0807 0809 0812 0814 0816 0818 0820 0822 0824 0826 0828 0830 0832 0834 0836 0838-0839 0842 0844 0846 0849 0851 0854 0856-0857 0859 0861 0863 0865-0866 0868 0870 0872 0874 0876-0877 0879 0881 0883-0884 0886 0888 0892 0894-0895 0897 0899-0900 0902-0903 0905 0907 0909 0911-0912 0914 0916 0918-0919 0921 0923 0925 0927-0928 0930 0932 0934 0936-0937 0939 0942-0943 0945 0947 0950-0951 0953 0955 0957-0958 0960 0962 0964 0966-0967 0969 0971 0973 0975 0977-0978 0981-0982 0984 0986 0988 0990 0992 0994 0996 0999 1001 1003 1005 1007 1009 1011 1013-1014 1026 1028 1030 1032 1035 1037 1039 1041 1044 1047 1050 1052 1054 1057 1059 1061 1063 1065 1067 1070 1072 1075-1076 1079 1081 1083 1085 1087 1093 1099 1101 1104-1105 1108 1110 1112 1114 1117 1119 1121 1123 1125 1128 1130 1132 1134 1137 1141 1146 1163 1166 1187 1200 1208 1221 1229 1234 1237 1255 1262 1274 1288 1292 1296 1316 1318 1337 1345 1347 1365 1367 1379 1396 1430 1454 1461 1484 1516 1530 1535 1540 1550 1633 1641 1646 1655 1674 1694 1700 1736 1789 1793 1809 1812 2082 2092 2104 2143 2225 2242 2248 2347 2391

The emergency electrical configuration is due to the loss of AC BUS 1 and 2. The RAT extends automatically. This powers the blue hydraulic circuit which drives the emergency generator. The emergency generator supplies both AC and DC ESS BUS.

When landing gear is down, the emergency generator is no longer powered. The emergency generation network is automatically transferred to the batteries and AC SHED ESS and DC SHED ESS BUS are shed.

Below 100 kts, the DC BAT BUS is automatically connected and below 50 kts, the AC ESS BUS is shed.

MSN 0364 0385 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502
0505 0509 0513-0522 0524 0526 0529 0532 0535 0538 0541 0544 0546 0550 0552 0555
0557 0560 0563-0564 0567 0570 0572 0576 0578 0581 0583 0586 0588 0591 0593 0595
0597-0600 0604 0606 0608-0610 0612 0614 0616 0618 0620-0621 0623 0625 0627 0629
0631-0634 0636-0637 0639 0641-0642 0644 0646-0647 0649 0651-0652 0654 0656 0660
0663-0664 0666 0668 0670 0672 0674-0675 0677 0679-0680 0682 0684 0686-0695 0697
0699-0700 0711 0713 0715 0717 0719 0721 0723 0725 0727-0729 0731-0732 0734 0736
0738 0740 0742 0744 0746 0748 0750 0752 0755 0757 0759 0761 0763 0765 0767
0769 0771 0773 0775 0777 0779 0781 0783 0785 0787-0788 0790 0792 0794 0796 0798
0800 0802 0804 0806 0808 0810-0811 0813 0815 0817 0819 0821 0823 0825 0827 0829
0831 0833 0835 0837 0840-0841 0843 0845 0847-0848 0850 0852-0853 0855 0858 0860
0862 0864 0867 0869 0871 0873 0875 0878 0880 0882 0885 0887 0889-0891 0893 0896
0898 0901 0904 0906 0908 0910 0913 0915 0917 0920 0922 0924 0926 0929 0931
0933 0935 0938 0940-0941 0944 0946 0948-0949 0952 0954 0956 0959 0961 0963 0965
0968 0970 0972 0974 0976 0979-0980 0983 0985 0987 0989 0991 0993 0995 0997-0998
1000 1002 1004 1006 1008 1010 1012 1015-1025 1027 1029 1031 1033-1034 1036 1038
1040 1042-1043 1045-1046 1048-1049 1051 1053 1055-1056 1058 1060 1062 1064 1066
1068-1069 1071 1073-1074 1077-1078 1080 1082 1084 1086 1088-1092 1094-1098 1100
1102-1103 1106-1107 1109 1111 1113 1115-1116 1118 1120 1122 1124 1126-1127 1129 1131
1133 1135-1136 1138-1140 1142-1145 1147-1162 1164-1165 1167-1185 1188-1199 1201-1207
1209-1220 1222-1228 1230-1233 1235-1236 1238-1254 1256-1261 1263-1273 1275-1287
1289-1291 1293-1295 1297-1315 1317 1319-1336 1338-1344 1346 1348-1364 1366 1368-1378
1380-1395 1397-1429 1431-1453 1455-1460 1462-1483 1485-1515 1517-1529 1531-1534
1536-1539 1541-1549 1551-1632 1634-1640 1642-1645 1647-1654 1656-1673 1675-1693
1695-1699 1701-1735 1737-1788 1790-1792 1794-1808 1810-1811 1814-2081 2083-2091
2093-2103 2105-2142 2144-2224 2226-2241 2243-2247 2249-2346 2348-2390 2392-3260

The emergency electrical configuration is due to the loss of AC BUS 1 and 2. The RAT extends automatically. This powers the blue hydraulic circuit which drives the emergency generator. The emergency generator supplies both AC and DC ESS BUS.

Below 125 kts, the RAT stalls and the emergency generator is no longer powered. The emergency generation network is automatically transferred to the batteries and AC SHED ESS and DC SHED ESS BUS are shed.

Below 100 kts, the DC BAT BUS is automatically connected and below 50 kts, the AC ESS BUS is shed.

## GENERAL GUIDELINES

MSN 0002-0363 0365-0384 0386-0411 0413-0432 0435-0457 0459-0467 0469-0472 0475-0476 0478-0483 0485-0487 0489-0492 0496-0497 0499-0501 0503-0504 0506-0508 0510-0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545 0548-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571 0573-0575 0577 0579-0580 0582 0584-0585 0587 0589-0590 0592 0594 0596 0601-0603 0605 0607 0611 0613 0615 0617 0619 0622 0624 0626 0628 0630 0635 0638 0640 0643 0645 0648 0650 0653 0655 0657-0659 0661-0662 0665 0667 0669 0671 0673 0676 0678 0681 0683 0685 0696 0698 0701-0710 0712 0714 0716 0718 0720 0722 0724 0726 0730 0733 0735 0737 0739 0741 0743 0745 0747 0749 0751 0753-0754 0756 0758 0760 0762 0764 0766 0768 0770 0772 0774 0776 0778 0780 0782 0784 0786 0789 0791 0793 0795 0797 0799 0801 0803 0805 0807 0809 0812 0814 0816 0818 0820 0822 0824 0826 0828 0830 0832 0834 0836 0838-0839 0842 0844 0846 0849 0851 0854 0856-0857 0859 0861 0863 0865-0866 0868 0870 0872 0874 0876-0877 0879 0881 0883-0884 0886 0888 0892 0894-0895 0897 0899-0900 0902-0903 0905 0907 0909 0911-0912 0914 0916 0918-0919 0921 0923 0925 0927-0928 0930 0932 0934 0936-0937 0939 0942-0943 0945 0947 0950-0951 0953 0955 0957-0958 0960 0962 0964 0966-0967 0969 0971 0973 0975 0977-0978 0981-0982 0984 0986 0988 0990 0992 0994 0996 0999 1001 1003 1005 1007 1009 1011 1013-1014 1026 1028 1030 1032 1035 1037 1039 1041 1044 1047 1050 1052 1054 1057 1059 1061 1063 1065 1067 1070 1072 1075-1076 1079 1081 1083 1085 1087 1093 1099 1101 1104-1105 1108 1110 1112 1114 1117 1119 1121 1123 1125 1128 1130 1132 1134 1137 1141 1146 1163 1166 1187 1200 1208 1221 1229 1234 1237 1255 1262 1274 1288 1292 1296 1316 1318 1337 1345 1347 1365 1367 1379 1396 1430 1454 1461 1484 1516 1530 1535 1540 1550 1633 1641 1646 1655 1674 1694 1700 1736 1789 1793 1809 1812 2082 2092 2104 2143 2225 2242 2248 2347 2391

As only PFD1 is available, the left hand seat pilot becomes PF. Once a safe flight path is established, and the aircraft is under control, ECAM actions will be carried out.

This is a serious emergency and ATC should be notified using appropriate phraseology ("MAYDAY"). Although the ECAM displays LAND ASAP in red, it would be unwise to attempt an approach at a poorly equipped airfield in marginal weather. However, prolonged flight in this configuration is not recommended.

AP/FD and ATHR are lost. The flight is to be completed manually in alternate and then, when gear down, in direct law. Crews should be aware that workload is immediately greatly increased.

As only the EWD is available, disciplined use of the ECAM Control Panel (ECP) is essential, (see FCTM Chapter 1- ECAM).

In case of simultaneous engine generator, the probability of a successful APU gen coupling is low. Therefore, APU start attempts should be avoided as this will significantly reduce the flight time on batteries (about 3.5 minutes for one start attempt).

A clear reading of STATUS is essential to assess the aircraft status and properly sequence actions during the approach.

The handling of this failure is referred to as a "complex procedure". A summary for handling the procedure is included in the QRH, which will be referred to upon completion of the ECAM procedure.

The ELEC EMER CONFIG SYS REMAINING list is available in QRH.

When landing gear is down, flight time is limited to 22 mn as batteries are the only remaining electrical source and flight control law reverts to direct law. Additionally, some convenient loads are lost e.g. FAC for characteristic speed or FMGC1 for ILS tuning. It is the reason why:

. Landing gear extension will be delayed until reaching 1000 ft

. Navaids tuning on RMP1 will be anticipated.

The BSCU are lost. Consequently, the NWS and anti skid are lost. Alternate braking with yellow hydraulic pressure modulation up to 1000 PSI will be used. Additionally, reversers are not available.
RA 1+2 are lost with their associated call out. Call out will be made by PNF.

Approaching 50 kts during the landing roll, all CRTs will be lost.

MSN 0364 0385 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532 0535 0538 0541 0544 0546 0550 0552 0555 0557 0560 0563-0564 0567 0570 0572 0576 0578 0581 0583 0586 0588 0591 0593 0595 0597-0600 0604 0606 0608-0610 0612 0614 0616 0618 0620-0621 0623 0625 0627 0629 0631-0634 0636-0637 0639 0641-0642 0644 0646-0647 0649 0651-0652 0654 0656 0660 0663-0664 0666 0668 0670 0672 0674-0675 0677 0679-0680 0682 0684 0686-0695 0697 0699-0700 0711 0713 0715 0717 0719 0721 0723 0725 0727-0729 0731-0732 0734 0736 0738 0740 0742 0744 0746 0748 0750 0752 0755 0757 0759 0761 0763 0765 0767 0769 0771 0773 0775 0777 0779 0781 0783 0785 0787-0788 0790 0792 0794 0796 0798 0800 0802 0804 0806 0808 0810-0811 0813 0815 0817 0819 0821 0823 0825 0827 0829 0831 0833 0835 0837 0840-0841 0843 0845 0847-0848 0850 0852-0853 0855 0858 0860 0862 0864 0867 0869 0871 0873 0875 0878 0880 0882 0885 0887 0889-0891 0893 0896 0898 0901 0904 0906 0908 0910 0913 0915 0917 0920 0922 0924 0926 0929 0931 0933 0935 0938 0940-0941 0944 0946 0948-0949 0952 0954 0956 0959 0961 0963 0965 0968 0970 0972 0974 0976 0979-0980 0983 0985 0987 0989 0991 0993 0995 0997-0998 1000 1002 1004 1006 1008 1010 1012 1015-1025 1027 1029 1031 1033-1034 1036 1038 1040 1042-1043 1045-1046 1048-1049 1051 1053 1055-1056 1058 1060 1062 1064 1066 1068-1069 1071 1073-1074 1077-1078 1080 1082 1084 1086 1088-1092 1094-1098 1100 1102-1103 1106-1107 1109 1111 1113 1115-1116 1118 1120 1122 1124 1126-1127 1129 1131 1133 1135-1136 1138-1140 1142-1145 1147-1162 1164-1165 1167-1185 1188-1199 1201-1207 1209-1220 1222-1228 1230-1233 1235-1236 1238-1254 1256-1261 1263-1273 1275-1287 1289-1291 1293-1295 1297-1315 1317 1319-1336 1338-1344 1346 1348-1364 1366 1368-1378 1380-1395 1397-1429 1431-1453 1455-1460 1462-1483 1485-1515 1517-1529 1531-1534 1536-1539 1541-1549 1551-1632 1634-1640 1642-1645 1647-1654 1656-1673 1675-1693 1695-1699 1701-1735 1737-1788 1790-1792 1794-1808 1810-1811 1814-2081 2083-2091 2093-2103 2105-2142 2144-2224 2226-2241 2243-2247 2249-2346 2348-2390 2392-3260

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This is a serious emergency and ATC should be notified using appropriate phraseology ("MAYDAY"). Although the ECAM displays LAND ASAP in red, it would be unwise to attempt an approach at a poorly equipped airfield in marginal weather. However, prolonged flight in this configuration is not recommended. AP/FD and ATHR are lost. The flight is to be completed manually in alternate and then, when gear down, in direct law. Crews should be aware that workload is immediately greatly increased.

As only the EWD is available, disciplined use of the ECAM Control Panel (ECP) is essential, (see FCTM Chapter 1- ECAM).

Consideration should be given to starting the APU as indicated by the ECAM and taking into account the probability to restore using APU generator.

A clear reading of STATUS is essential to assess the aircraft status and properly sequence actions during the approach.

The handling of this failure is referred to as a "complex procedure". A summary for handling the procedure is included in the QRH, which will be referred to upon completion of the ECAM procedure.

The ELEC EMER CONFIG SYS REMAINING list is available in QRH.

When landing gear is down, flight control law reverts to direct law.

The approach speed must be at least min RAT speed (140 knots) to keep the emergency generator supplying the electrical network.

The BSCU are lost. Consequently, the NWS and anti skid are lost. Alternate braking with yellow hydraulic pressure modulation up to 1000 PSI will be used. Additionally, reversers are not available.

RA 1+2 are lost with their associated call out. Call out will be made by PNF.

Approaching 50 kts during the landing roll, all CRTs will be lost.

## REMAINING SYSTEMS

ALL

The electrical distribution has been designed to fly, navigate, communicate and ensure passengers comfort. The ELEC EMER CONFIG SYS REMAINING list is available in QRH. The significant remaining systems are:

| Significant remaining systems in ELEC EMER CONFIG | |
|---|---|
| FLY | PFD1, alternate law |
| NAVIGATE | ND1, FMGC1,, RMP1, VOR1/ILS1 |
| COMMUNICATE | VHF1, HF1, ATC1 |

On BAT, some additional loads are lost such as FAC1 and FMGC1.

## PREFACE

ALL

Fire and/or smoke in the fuselage present the crew with potentially difficult situations. Not only will they have to deal with the emergency itself but also the passengers are likely to panic should they become aware of the situation. It is essential therefore, that action to control the source of combustion is not delayed.

An immediate diversion should be considered as soon as the smoke is detected. If the source is not immediately obvious, accessible and extinguishable, it should be initiated without delay.

## SMOKE DETECTION AND PROCEDURE APPLICATION

ALL

The smoke will be identified either by an ECAM warning, or by the crew without any ECAM warning.

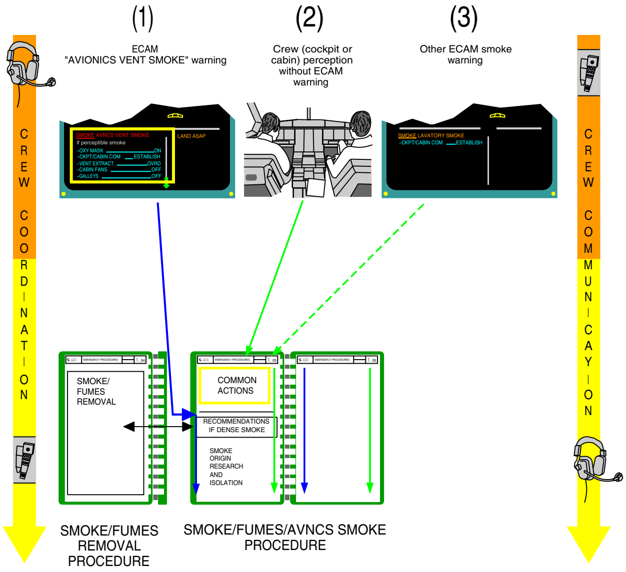
If the smoke is detected by the crew, without any ECAM warning, the flight crew will refer directly to the QRH SMOKE/FUMES/AVNCS SMOKE paper procedure.

If the "AVNCS VENT SMOKE "ECAM caution is activated, the flight crew can refer directly to the QRH SMOKE/FUMES/AVNCS SMOKE paper procedure, or apply first the ECAM actions, before entering the QRH.

After the immediate actions, the ECAM displays a countdown (5 min.). The flight crew will take the opportunity of this countdown to switch to paper procedure. When the paper procedure is entered, the flight crew will continue with this procedure, rather than coming back to the ECAM.

If another ECAM SMOKE warning (e.g. LAVATORY SMOKE) is triggered, the flight crew must apply the ECAM procedure. If any doubt exists about the smoke origin, the flight crew will than refer to the QRH SMOKE/FUMES/AVNCS SMOKE paper procedure

SMOKE/FUMES PROCEDURE ARCHITECTURE




NOF 03026 04289 0001

ALL

## COORDINATION WITH CABIN CREW

Good coordination between cockpit and cabin crew is a key element .

In case of smoke in the cabin, it is essential that the cabin crew estimate and inform the cockpit concerning the density of smoke and the severity of the situation.

## SMOKE/FUMES/AVNCS SMOKE PAPER PROCEDURE

ALL

## GENERAL

The SMOKE/FUMES/AVNCS SMOKE paper procedure implements a global philosophy that is applicable to both cabin and cockpit smoke cases. This philosophy includes the following main steps:

. Diversion to be anticipated

. Immediate actions

► If smoke source not immediately isolated:

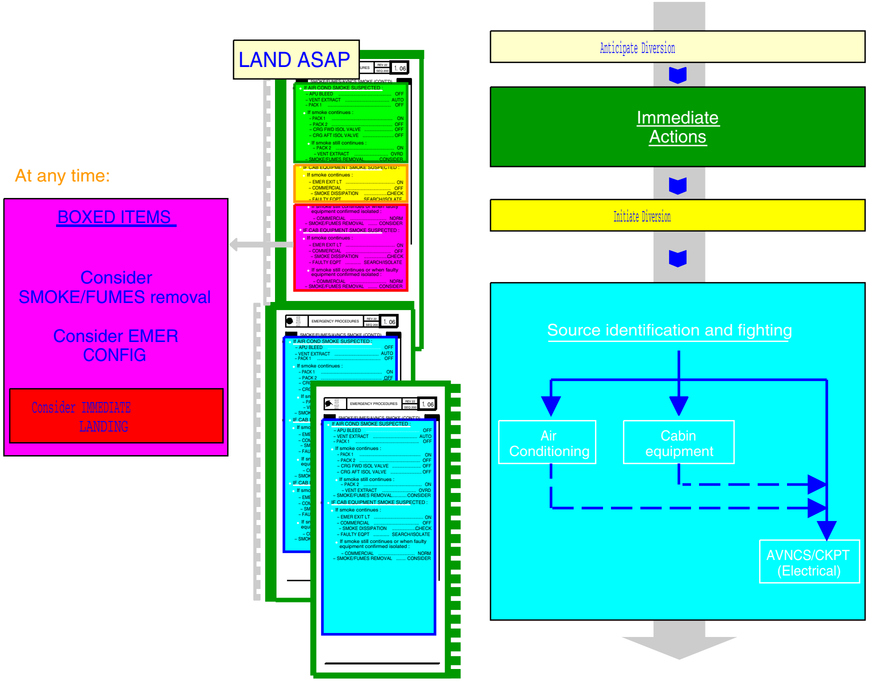
. Diversion initiation

. Smoke origin identification and fighting

Furthermore, at any time during the procedure application, if smoke/fumes becomes the greatest threat, the boxed items will be completed.

The main steps of this global philosophy may be visualized in the SMOKE/FUMES/AVNCS SMOKE QRH procedure.

SMOKE/FUMES/AVNCS SMOKE PROCEDURE PRESENTATION IN QRH

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## CONSIDERATIONS ABOUT DIVERSION

Time is critical.

This is why a diversion must be immediately anticipated (as indicated by LAND ASAP).

Then, after the immediate actions, if the smoke source cannot immediately identified and isolated, the diversion must be initiated before entering the SMOKE ORIGIN IDENTIFICATION AND FIGHTING part of the procedure.

## IMMEDIATE ACTIONS

These actions are common to all cases of smoke and fumes, whatever the source.

Their objectives are:

. avoiding any further contamination of the cockpit/cabin,

. communication with cabin crew

. flight crew protection.

## SMOKE ORIGIN IDENTIFICATION AND FIGHTING

The crew tries to identify the smoke source by isolating systems. Some guidelines may help the crew to identify the origin of smoke:

. If smoke initially comes out of the cockpit's ventilation outlets, or if smoke is detected in the cabin, the crew may suspect an AIR COND SMOKE. In addition, very shortly thereafter, several SMOKE warnings (cargo, lavatory, avionics) will be triggered. The displayed ECAM procedures must therefore be applied.

. Following an identified ENG or APU failure, smoke may emanate from the faulty item through the bleed system and be perceptible in the cockpit or the cabin. In that case, it will be re-circulated throughout the aircraft, until it completely disappears from the air conditioning system.

. If only the AVIONICS SMOKE warning is triggered, the crew may suspect an AVIONICS SMOKE.

. If smoke is detected, while an equipment is declared faulty, the crew may suspect that smoke is coming from this equipment.

According to the source he suspects, the crew will enter one of the 3 paragraphs:

1. IF AIR COND SMOKE SUSPECTED

2. IF CAB EQUIPMENT SMOKE SUSPECTED

3. IF AVNCS/COCKPIT SMOKE SUSPECTED

Since electrical fire is the most critical case, he will also enter paragraph 3 if he doesn't know the source of the smoke, or if the application of paragraph 1 and/or 2 has been unsuccessful.

This part of procedure consists of shedding one side, then the other. If unsuccessful, setting the electrical emergency configuration is the last means to isolate the smoke source.

## BOXED ITEMS

These items (applying SMOKE REMOVAL procedure, setting electrical emergency configuration, or considering immediate landing) may be applied at any time, in the procedure (but not before the immediate actions).

When necessary, the SMOKE REMOVAL procedure must be applied before the electrical emergency configuration is set. Indeed, in electrical emergency configuration SMOKE REMOVAL procedure cannot be applied, since manual control of cabin pressure cannot be selected.

Once the first step of the smoke removal procedure have been applied, the flight crew will come back to the SMOKE/FUMES/AVNCS SMOKE procedure, to apply the appropriate steps, depending on the suspected smoke source while descending to FL 100. Reaching FL 100, the smoke removal procedure will be completed.

## CARGO SMOKE

ALL

The crew should be aware that, even after successful operation of the cargo fire bottle, the CARGO SMOKE warning might persist due to the smoke detectors being sensitive to the extinguishing agent.

On the ground, the crew should instruct the ground crew not to open the cargo door until the passengers have disembarked and fire services are present.

If SMOKE warning is displayed on ground with the cargo compartment door open, do not initiate an AGENT DISCHARGE. Request the ground crew to investigate and eliminate the smoke source. On ground, the warning may be triggered due to a high level of humidity.

# ABNORMAL FLAPS/SLATS CONFIGURATION

ALL

## CAUSES

Abnormal operation of the flaps and/or slats may be due to one of the following problems:

. Double SFCC failure

. Double hydraulic failure (B+G or Y+G)

. Flaps/Slats jammed (operation of the WTB)

## CONSEQUENCES

Abnormal operation of the flaps and slats has significant consequences since:

. The control laws may change

. The selected speed must be used

. A stabilized approach should be preferred

. The approach attitudes change

. Approach speeds and landing distances increase

. The go-around procedure may have to be modified.

*Note: The FMS predictions do not take into account the slat or flap failures. Since fuel consumption is increased, these predictions are not valid.*

## FAILURE AT TAKE-OFF

Should a flap/slat retraction problem occur at take-off, the crew will PULL the speed knob for selected speed to stop the acceleration and avoid exceeding VFE. The over speed warning is computed according to the actual slats/flaps position.

The landing distance available at the departure airport and the aircraft gross weight will determine the crew's next course of action.

## FAILURE DURING THE APPROACH

The detection of a slat or flap failure occurs with the selection of flap lever during the approach. With A/THR operative, the managed speed target will become the next manoeuvring characteristic speed e.g. S speed when selecting flap lever to 1. At this stage, if a slat or flap failure occurs, the crew will:

. Pull the speed knob for selected speed to avoid further deceleration

. Delay the approach to complete the ECAM procedure

. Refer to LANDING WITH FLAPS OR SLATS JAMMED paper check list.

. Update the approach briefing

In the QRH, the line, "SPEED SEL............VFE NEXT - 5kt" is designed to allow the crew to configure the aircraft for landing whilst controlling the speed in a safe manner. This procedure may involve reducing speed below the manoeuvring speed for the current configuration which is acceptable provided the speed is kept above VLS. The speed reduction and configuration changes should preferably be carried out wings level.

The landing distance factors and approach speed increments are available in the QRH. (See FCTM 03.010)

Assuming VLS is displayed on the PFD, VAPP should be close to VLS+wind correction, since this speed is computed on the actual slat/flap position.

The AP may be used down to 500 ft AGL. As the AP is not tuned for the abnormal configurations, its behaviour can be less than optimum and must be monitored.

During the approach briefing, emphasis should be made of:

. Tail strike awareness

. The go-around configuration

. Any deviation from standard call out

. The speeds to be flown, following a missed approach

. At the acceleration altitude, selected speed must be used to control the acceleration to the required speed for the configuration.

Consider the fuel available and the increased consumption associated with a diversion when flying with flaps and/or slats jammed. Additionally, when diverting with flaps/slats extended, cruise altitude is limited to 20,000 ft.

# FUEL LEAK

ALL

Significant fuel leaks although rare, are sometimes difficult to detect. Fuel check will be carried out by

. Checking that the remaining fuel added to the burnt fuel corresponds to the fuel on board at the gate.

. Maintaining the fuel log and comparing fuel on board to expected flight plan fuel would alert the crew to any discrepancy.

Fuel checks should be carried out when sequencing a waypoint and at least every 30 minutes. Any discrepancy should alert the crew and investigation should be carried out without delay.

Should an engine failure occur, the ECAM requires the opening of the fuel X feed to avoid fuel imbalance. In case of supposed or obvious engine damages, the opening of the fuel X feed will be performed only after being certain that there is no fuel leak.

Any time an unexpected fuel quantity indication, ECAM fuel message or imbalance is noted, a fuel leak should be considered as a possible cause. Initial indications should be carefully cross-checked by reference to other means, including if possible, a visual inspection.

If a leak is suspected, the crew should action the "FUEL LEAK" abnormal checklist available in QRH:

. If leak is positively identified as coming from engine, the affected engine is shut down to isolate the fuel leak and fuel cross-feed valve may be used as required.

. If the leak is not from the engine or cannot be located, it is imperative that the cross-feed valve is not opened.

## HYDRAULIC GENERATION PARTICULARITIES

ALL

### PREFACE

The aircraft has three continuously operating hydraulic systems: green, blue and yellow. A bidirectional Power Transfer Unit (PTU) enables the yellow system to pressurize the green system and vice versa. Hydraulic fluid cannot be transferred from one system to another.

### PTU PRINCIPLE

In flight, the PTU operates automatically if differential pressure between green and yellow systems exceeds 500 PSI. This allows to cover the loss of one engine or one engine driven pump cases.

### USE OF PTU IN CASE OF FAILURE

In case of reservoir low level, reservoir overheat, reservoir low air pressure, the PTU must be switched OFF as required by ECAM to avoid a PTU overheat which may occur two minutes later. Indeed, a PTU overheat may lead to the loss of the second hydraulic circuit.

### RECOMMENDATIONS

When required by the ECAM, the PTU should switched off without significant delay in case of:

. HYD G(Y) RSVR LO LVL

. HYD G(Y) RSVR LO PR

. HYD G(Y) RSVR OVHT

However, if PTU has been switched off because of HYD G(Y) RSVR OVHT and the alert disappears, affected pump may be restored and PTU switched back to AUTO.

## DUAL HYDRAULIC FAILURES

ALL

## PREFACE

Single hydraulic failures have very little effect on the handling of the aircraft but will cause a degradation of the landing capability to Cat 3 Single.

Dual hydraulic failures however, although unlikely, are significant due to the following consequences:

. Loss of AP

. Flight control law degradation (ALTN)

. Landing in abnormal configuration

. Extensive ECAM procedures with associated workload and task-sharing considerations

. Significant considerations for approach and landing.

## GENERAL GUIDELINES

It is important to note that the AP will not be available to the crew but both FD and A/THR still remain. Additionally, depending on the affected hydraulic circuits, aircraft handling characteristics may be different due to the loss of some control surfaces. The PF will maneuver with care to avoid high hydraulic demand on the remaining systems.

The PF will be very busy flying the aircraft and handling the communications with the flight controls in Alternate Law.

A double hydraulic failure is an emergency situation, with red LAND ASAP displayed, and a MAYDAY should be declared to ATC. A landing must be carried out as soon as possible bearing in mind, however, that the ECAM actions should be completed prior the approach.
PF will then require the ECAM actions. A clear reading of STATUS is essential to assess the aircraft status and properly sequence actions during the approach.

This failure is called a "complex procedure" and the QRH summary should be referred to upon completion of the ECAM procedure. See FCTM 01.040 USE OF SUMMARIES.

While there is no need to remember the following details, an understanding of the structure of the hydraulic and flight control systems would be an advantage. The F/CTL SD page and the OPS DATA section of the QRH provide an overview of the flight controls affected by the loss of hydraulic systems.

The briefing will concentrate on safety issues since this will be a hand-flown approach with certain handling restrictions:

. Use of the selected speeds on the FCU.

. Landing gear gravity extension

. Approach configuration and flap lever position

. Approach speed VAPP

. Tail strike awareness

. Braking and steering considerations

. Go around call out, aircraft configuration and speed

The STATUS page requires, in each case, a landing gear gravity extension. The LANDING GEAR GRAVITY EXTENSION procedure will be completed with reference to the QRH.

A stabilized approach will be preferred.

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036 2038-2042 2044-2049 2052 2054-2058 2060-2061 2063-2070 2072-2080 2082-2099 2101-2108 2110-2118 2121-2128 2130-2169 2171-2175 2177-2180 2182-2183 2185 2187-2188 2190-2195 2197-2212 2215-2217 2219-2223 2225-2227 2229 2231-2244 2246-2248 2250 2252-2256 2258-2264 2266-2267 2269-2270 2272-2275 2278 2280 2282 2284-2288 2290 2293-2295 2298 2301-2305 2307 2309-2316 2318 2320-2321 2323-2325 2327 2330-2331 2334 2336-2337 2339-2343 2345 2347-2349 2351-2352 2356-2357 2359 2363-2365 2368-2369 2371-2374 2381 2384 2386 2388-2391 2393 2397 2399 2405 2407-2411 2415-2416 2421-2422 2425-2426 2428-2430 2432 2435 2437 2447 2449 2451 2454 2458-2459 2461-2462 2464 2466 2472 2474 2478-2480 2482 2486 2488-2489 2491 2493-2494 2498-2499 2504-2505 2507-2510 2517 2520-2521 2525 2530 2532 2534-2536 2542-2543 2545 2547 2549 2551 2559 2562-2563 2568 2570 2574 2577 2579-2580 2583 2589 2591 2595 2597 2599 2606 2613-2615 2618 2627 2630 2635 2639-2641 2643 2647 2652 2667 2669 2671 2682 2690 2710 2725 2755 2775 2781 2802 2805 2814-2815 2819 2832 2839 2847-2848 2871 2880 2890 2900-2901 2940 2945 2948 2969-2970 2977 2992 3020 3029 3039 3072 3091 3104 3106 3119 3144 3150 3190 3195 3200 3226

## REMAINING SYSTEMS

| | | Remaining systems | | |
|---|---|---|---|---|
| Flight phase | Systems | HYD G+B SYS LO PR | HYD G+Y SYS LO PR | HYD B+Y SYS LO PR |

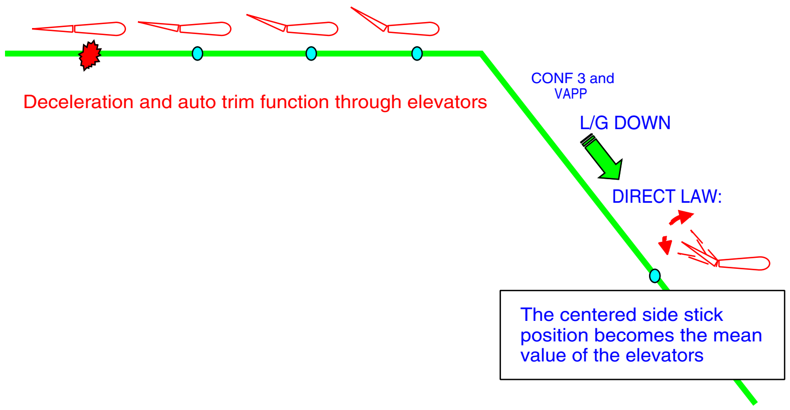
| | | | | |
|---|---|---|---|---|
| Cruise | Auto pilot | Inop | Inop | Inop |
| | Yaw damper | YD2 only | Inop | YD1 only |
| | Control law | ALTN LAW and DIRECT LAW when L/G DN | ALTN LAW and DIRECT LAW when L/G DN | NORM LAW |
| | Stabilizer | Avail | Inop (1) | Avail |
| | Spoilers | 2 SPLRS/wing | 1 SPLR/wing | 2 SPLRS/wing |
| | Elevator | R ELEV only | Avail | L ELEV only |
| | Aileron | Inop | Avail | Avail |
| Landing | Slats/Flaps | FLAPS slow only | SLATS slow Only (2) | SLATS/FLAPS slow only |
| | L/G extension | Gravity | Gravity | Gravity |
| | Braking | ALTN BRK only | Y ACCU PRESS only | NORM BRK only |
| | Anti skid | Avail | Inop | Avail |
| | Nose wheel steering | Inop | Inop | Inop |
| | Reverse | REV 2 only | Inop | REV 1 only |
| Go/around | L/G retraction | Inop | Inop | Inop |

## SYSTEMS PARTICULARITIES

**(1)** The stabilizer is lost. In alternate law, the auto trim function is provided through the elevators. At landing gear extension, switching to direct law, the auto trim function is lost. However, the mean elevator position at that time is memorized, and becomes the reference for centered sidestick position. This is why, in order to ensure proper centered sidestick position for approach and landing, the procedure requires to wait for stabilization at VAPP, before landing gear extension.

If this procedure is missed, the flare and pitch control in case of go-around may be difficult.

The PFD message USE MAN PITCH TRIM after landing gear extension should thus be disregarded.

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**(2)** High pitch during approach should be expected. Approach briefing should outline it for tail strike awareness and pitch attitude will be monitored during flare.

MSN 1599 1660 1939 1991 2017 2035 2037 2043 2050-2051 2053 2059 2062 2071 2081 2100 2109 2119-2120 2129 2170 2176 2181 2184 2186 2189 2196 2213-2214 2218 2224 2228 2230 2245 2249 2251 2257 2265 2268 2271 2276-2277 2279 2281 2283 2289 2291-2292 2296-2297 2299-2300 2306 2308 2317 2319 2322 2326 2328-2329 2332-2333 2335 2338 2344 2346 2350 2353-2355 2358 2360-2362 2366-2367 2370 2375-2380 2382-2383 2385 2387 2392 2394-2396 2398 2400-2404 2406 2412-2414 2417-2420 2423-2424 2427 2431 2433-2434 2436 2438-2446 2448 2450 2452-2453 2455-2457 2460 2463 2465 2467-2471 2473 2475-2477 2481 2483-2485 2487 2490 2492 2495-2497 2500-2503 2506 2511-2516 2518-2519 2522-2524 2526-2529 2531 2533 2537-2541 2544 2546 2548 2550 2552-2558 2560-2561 2564-2567 2569 2571-2573 2575-2576 2578 2581-2582 2584-2588 2590 2592-2594 2596 2598 2600-2605 2607-2612 2616-2617 2619-2626 2628-2629 2631-2634 2636-2638 2642 2644-2646 2648-2651 2653-2666 2668 2670 2672-2681 2683-2689 2691-2709 2711-2724 2726-2754 2756-2774 2776-2780 2782-2801 2803-2804 2806-2813 2816-2818 2820-2831 2833-2838 2840-2846 2849-2870 2872-2879 2881-2889 2891-2899 2902-2939 2941-2944 2946-2947 2949-2968 2971-2976 2978-2991 2993-3019 3021-3028 3030-3038 3040-3071 3073-3090 3092-3103 3105 3107-3118 3120-3143 3145-3149 3151-3189 3191-3194 3196-3199 3201-3225 3229-3260

## REMAINING SYSTEMS

| | | Remaining systems | | |
|---|---|---|---|---|
| Flight phase | Systems | HYD G+B SYS LO PR | HYD G+Y SYS LO PR | HYD B+Y SYS LO PR |
| Cruise | Auto pilot | Inop | Inop | Inop |
| | Yaw damper | YD2 only | Inop | YD1 only |
| | Control law | ALTN LAW and DIRECT LAW when L/G DN | ALTN LAW and DIRECT LAW when L/G DN | NORM LAW |
| | Stabilizer | Avail | Inop (1) | Avail |
| | Spoilers | 2 SPLRS/wing | 1 SPLR/wing | 2 SPLRS/wing |
| | Elevator | R ELEV only | Avail | L ELEV only |
| | Aileron | Inop | Avail | Avail |
| Landing | Slats/Flaps | FLAPS slow only | SLATS slow Only (2) | SLATS/FLAPS slow only |
| | L/G extension | Gravity | Gravity | Gravity |
| | Braking | ALTN BRK only | Y ACCU PRESS only | NORM BRK only |
| | Anti skid | Avail | Inop | Avail |
| | Nose wheel steering | Avail | Inop | Inop |
| | Reverse | REV 2 only | Inop | REV 1 only |
| Go/around | L/G retraction | Inop | Inop | Inop |

## SYSTEMS PARTICULARITIES

**(1)** The stabilizer is lost. In alternate law, the auto trim function is provided through the elevators. At landing gear extension, switching to direct law, the auto trim function is lost. However, the mean elevator position at that time is memorized, and becomes the reference for centered sidestick position. This is why, in order to ensure proper centered sidestick position for approach and landing, the procedure requires to wait for stabilization at VAPP, before landing gear extension.

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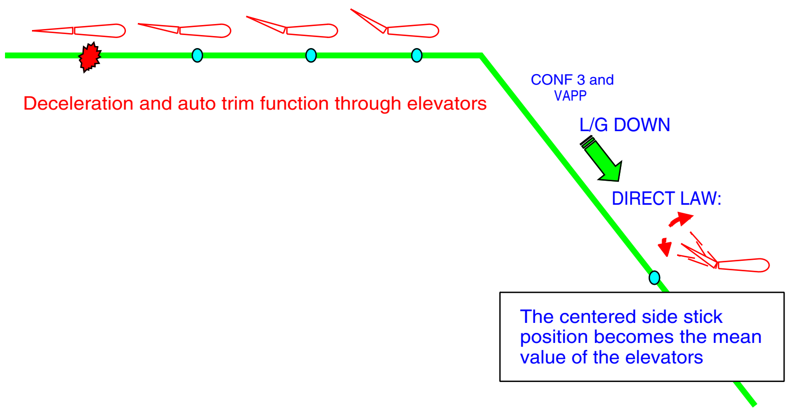


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**(2)** High pitch during approach should be expected. Approach briefing should outline it for tail strike awareness and pitch attitude will be monitored during flare.

## LDG WITH ABNORMAL L/G

ALL

This situation might occur following completion of a L/G GEAR NOT DOWNLOCKED procedure. It is always better to land with any available gear rather than carry out a landing without any gear.

In all cases, weight should be reduced as much as possible to provide the slowest possible touchdown speed. Although foaming of the runway is not a requirement, full advantage should be taken of any ATC offer to do so.

The passengers and cabin crew should be informed of the situation in good time. This will allow the cabin crew to prepare the cabin and perform their emergency landing and evacuation procedures.

If one or both main landing gears in abnormal position, the ground spoilers will not be armed to keep as much roll authority as possible for maintaining the wings level. Ground spoiler extension would prevent spoilers from acting as roll surfaces.

The crew will not arm the autobrake as manual braking will enable better pitch and roll control. Furthermore, with at least one main landing gear in the abnormal position, the autobrake cannot be activated (ground spoilers not armed).

With one main landing gear not extended, the reference speed used by the anti-skid system is not correctly initialized. Consequently, the anti-skid must be switched off to prevent permanent brake release.

In all cases, a normal approach should be flown and control surfaces used as required to maintain the aircraft in a normal attitude for as long as possible after touchdown. The engines should be shut down early enough to ensure that fuel is cut off prior to nacelle touchdown, but late enough to keep sufficient authority on control surfaces in order to:

. Maintain runway axis

. Prevent nacelle contact on first touch down

. Maintain wing level and pitch attitude as long as possible.

Considering a realistic hydraulic demand, the hydraulic power remains available up to approximately 30 seconds after the shut down of the related engine. It is the reason why the recommendations to switch the ENG masters OFF are as follow:

. If NOSE L/G abnormal
  Before nose impact

. If one MAIN L/G abnormal
  At touch down.

. If both MAIN L/G abnormal
  In the flare, before touch down

The reversers will not be used to prevent the ground spoilers extension and because the engine will touch the ground during roll out.

The engines and APU fire pbs are pushed when the use of flight controls is no longer required i.e. when aircraft has stopped.

## ADR/IRS FAULT

ALL

Each ADIRS has two parts (ADR and IRS), that may fail independently of each other. Additionally the IRS part may fail totally or may be available in ATT mode.

Single NAV ADR FAULT or NAV IRS FAULT are simple procedures, and only require action on the switching panel as indicated by the ECAM.

Dual NAV ADR or NAV IRS failures will cause the loss of AP, A/THR and flight controls revert to ALTN LAW.

Due to the low probability of a triple ADR failure, the associated procedure will not be displayed on the ECAM. In this case, the crew will refer to QRH procedure for ADR 1 + 2 + 3 failure.

There is no procedure for IRS 1 + 2 + 3 failure but the ECAM status page will give approach procedure and inoperative systems. In this unlikely event, the standby instruments are the only attitude, altitude, speed and heading references.

*Note: To switch off an ADR, the flight crew must use the ADR pushbutton. Do not use the rotary selector, because this would also cut off the electrical supply to the IR part.*

## UNRELIABLE AIRSPEED INDICATIONS

ALL

### PREFACE

Most failures modes of the airspeed/altitude system are detected by the ADIRS. These failures modes lead to the loss of corresponding cockpit indications and the triggering of associated ECAM drills.

However, there may be some cases where the airspeed or altitude output is erroneous without being recognized as such by the ADIRS. In these cases, the cockpit indications appear normal but are actually false and pilots must rely on their basic flying skills to identify the faulty source and take the required corrective actions.  When only one source provides erroneous data, a straightforward crosscheck of the parameters provided by the three ADRs allows the faulty ADR to be identified. This identification becomes more difficult in extreme situation when two, or even all of three, sources provide erroneous information.

## MAIN REASONS FOR ERRONEOUS AIRSPEED/ALTITUDE DATA

The most probable reason for erroneous airspeed and altitude information is obstructed pitot tubes or static sources. Depending on the level of obstruction, the symptoms visible to the flight crew will be different. However, in all cases, the data provided by the obstructed probe will be false. Since it is highly unlikely that the aircraft probes will be obstructed at the same time, to the same degree and in the same way, the first indication of erroneous airspeed/altitude data available to flight crews, will most probably be a discrepancy between the various sources.

## CONSEQUENCES OF OBSTRUCTED PITOT TUBES OR STATIC PORTS

All aircraft systems, using anemometric data, have been built-in fault accommodation logics. The fault accommodation logics are not the same for various systems but, all rely on voting principle whereby when one source diverges from the average value, it is automatically rejected and the system continues to operate normally with the remaining two sources. This principle applies to flight controls and flight guidance systems.

## NORMAL SITUATION

Each ELAC receives speed information from all ADIRUs and compares the 3 values. Pressure altitude information is not used by the ELAC.

Each FAC (Flight Augmentation Computer) receives speed information from all ADIRUs and compares the 3 values.

## ONE ADR OUTPUT IS ERRONEOUS AND THE TWO REMAINING ARE CORRECT

The ELAC and the FAC and/or FMGC eliminate it without any cockpit effect (no caution, normal operation is continued), except that one display is wrong and CATIII DUAL is displayed as INOP SYS on STATUS page.

## TWO ADR OUTPUTS ARE ERRONEOUS, BUT DIFFERENT, AND THE REMAINING ADR IS CORRECT, OR IF ALL THREE ARE ERRONEOUS, BUT DIFFERENT :

The autopilot and the auto thrust are disconnected (whichever autopilot is engaged). The ELAC triggers the F/CTL ADR DISAGREE ECAM caution. Flight controls revert to Alternate law (without high and low speed protection). On both PFDs, the "SPD LIM" flag is shown; no VLS, no VSW and no VMAX is displayed.

This situation is latched, until an ELAC reset is performed on ground, without any hydraulic pressure.

However, if the anomaly was only transient, the autopilot and the autothrust can be re-engaged when the disagree has disappeared.

**ONE ADR IS CORRECT, BUT THE OTHER TWO ADRS PROVIDE THE SAME ERRONEOUS OUTPUT, OR IF ALL THREE ADRS PROVIDE CONSISTENT AND ERRONEOUS DATA :**

The systems will reject the "good" ADR and will continue to operate normally using the two "bad" ADRs. This condition can be met when, for example, two or all three pitot tubes are obstructed at the same time, to the same degree, and in the same way. (Flight through a cloud of volcanic ash, takeoff with two pitots obstructed by foreign matter (mud, insects)).

The following chart provides a non-exhaustive list of the consequences of various cases of partially or totally obstructed pitot tubes and static ports on airspeed and altitude indications. It should be noted that the cases described below cover extreme situations (e.g. totally obstructed or unobstructed drain holes), and that there could be multiple intermediate configurations with similar, but not identical, consequences.

| FAILURE CASE | CONSEQUENCES |
|---|---|
| Water accumulated due to heavy rain.Drain holes unobstructed. | Transient speed drop until water drains.IAS fluctuations.IAS step drop and gradual return to normal. |
| Water accumulated due to heavy rain.Drain holes obstructed. | Permanent speed drop. |
| Ice accretion due to pitot heat failure, ortransient pitot blocked due to severe icing.Unobstructed drain holes. | Total pressure leaks towards static pressure.IAS drop until obstruction cleared/fluctuation, if transient erratic A/THR istransient. |
| Ice accretion due to pitot heat failure, orpitot obstruction due to foreign objects.Obstructed drain holes. | Total pressure blocked.Constant IAS in level flight, until obstruction is cleared. In climb, IAS increases.In descent, IAS decreases. Abnormal AP/FD/ATHR behavior :a) AP/FD pitch up in OPN CLB to hold target IAS.b) AP/FD pitch down in OPN DES to hold target IAS |
| Total obstruction of static ports on ground. | Static pressure blocked at airfield level.Normal indications during T/O roll.After lift-off altitude remains constant.IAS decreases, after lift-off.IAS decreases, when aircraft climbs.IAS increases, when aircraft descends. |

The above table clearly illustrates that no single rule can be given to conclusively identify all possible erroneous airspeed/altitude indications cases.

## ADR CHECK PROC / UNRELIABLE SPEED INDICATION QRH PROCEDURE

ALL

### INTRODUCTION

The ADR CHECK PROC / UNRELIABLE SPEED INDICATIONS procedure has two objectives: to identify and isolate the faulty ADR (s), and, if not successful, to fly the aircraft until landing without any speed reference.

It includes the following steps:

1. Memory items
2. Trouble shooting and isolation
3. Flight using Pitch/thrust references.

### WHEN TO APPLY THIS PROCEDURE?

The flight crew may enter this procedure, either upon ECAM request (ADR DISAGREE or ANTI-ICE PITOT caution), or because he suspects an erroneous indication, without any ECAM warning.

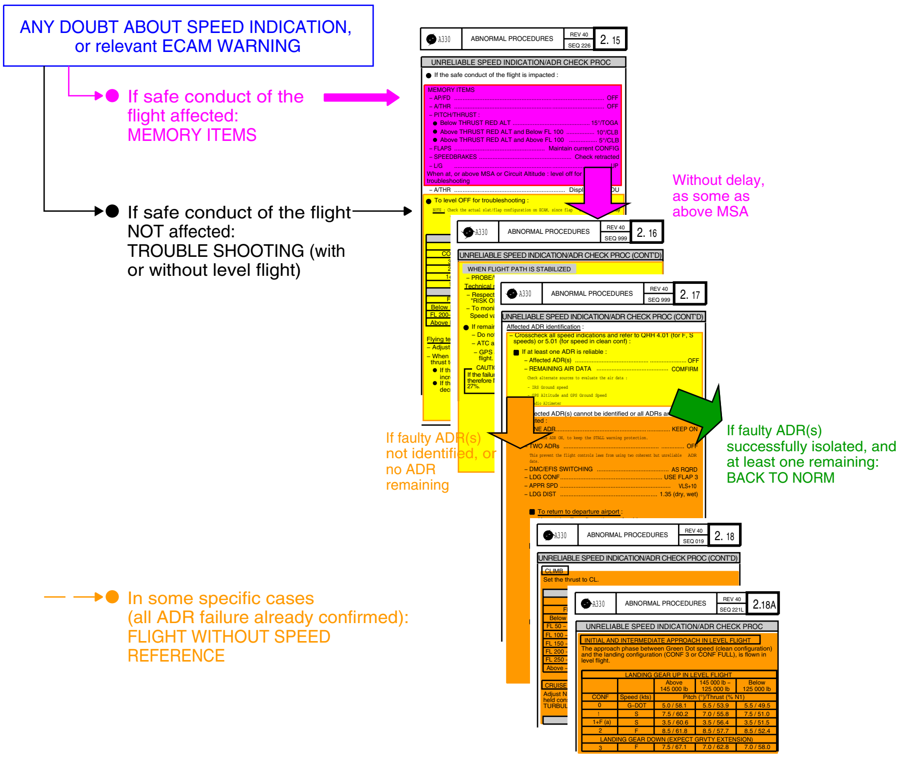
Erroneous speed/altitude indication can be suspected by:

1. Speed discrepancy (between ADR1, 2, 3, and standby indication)
2. Fluctuating or unexpected increase/decrease/permanent indicated speed, or pressure altitude.
3. 3. Abnormal correlation of basic flight parameters (IAS, pitch, attitude, thrust, climb rate) :
   . IAS increasing, with large nose-up pitch attitude
   . IAS decreasing, with large nose down pitch attitude
   . IAS decreasing, with nose down pitch attitude and aircraft descending
4. Abnormal AP/FD/ATHR behavior
5. STALL warning, or OVERSPEED warnings, or a Flap RELIEF ECAM message, that contradicts with at least one of the indicated speeds.

. Rely on the stall warning that could be triggered in alternate or direct law. It is not affected by unreliable speeds, because it is based on angle of attack.
. Depending on the failure, the OVERSPEED warning may be false or justified. Buffet, associated with the OVERSPEED VFE warning, is a symptom of a real overspeed condition.

6. Inconsistency between radio altitude and pressure altitude.
7. Reduction in aerodynamic noise with increasing speed, or increase in aerodynamic noise with decreasing speed.
8. Impossibility of extending the landing gear by the normal landing gear system.

**HOW TO APPLY THIS PROCEDURE?**

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Because the displayed information may be erroneous, the flying accuracy cannot be assumed. Incorrect transponder altitude reporting could cause confusion. Therefore, a MAYDAY should be declared to advise ATC and other aircraft of the situation.

## PART 1: MEMORY ITEMS

If the safe conduct of the flight is affected, the flight crew applies the memory items. They allow safe flight conditions to be rapidly established in all flight phases (takeoff, climb, cruise) and aircraft configurations (weight and slats/flaps).The memory items apply more particularly when a failure appears just after takeoff.

Once the target pitch attitude and thrust values have been stabilized, as soon as above safe altitude, the flight crew will enter the 2nd part of the QRH procedure, to level off the aircraft and perform trouble shooting. This should not be delayed, since using the memory item parameters for a prolonged period may lead to speed limit exceedance.

## PART 2: TROUBLE SHOOTING AND ISOLATION

### GENERAL

If the wrong speed or altitude information does not affect the safe conduct of the flight, the crew will not apply the memory items, and will directly enter the part 2 of the QRH procedure.

Depending of the cause of the failure, the altitude indication may also be unreliable. There are however, a number of correct indications available to the crew. GPS altitude and ground speed are available on MCDU GPS monitor page and RA may be used at low level.

For faulty ADR (s) identification, the flight crew may, either level off and stabilize the flight using the dedicated table in PART 2, or, if for instance already stabilized in climb, use the CLIMB table given in part 3. The trouble shooting will be more accurate, using the level off table.

### LEVEL OFF AND STABILIZATION (IF REQUIRED)

The table gives the proper pitch and thrust values for stabilization in level off according to weight, configuration and altitude.

It must be noticed that, if the altitude information is unreliable, FPV and V/S are also affected. In this case, the GPS altitude, if available, is the only means to confirm when the aircraft is maintaining a level. When reliable, the FPV should be used.

If the memory items have been maintained for a significant period of time, the current speed may be quite above the target.

If FPV is reliable, or if GPS altitude information is available:

- Maintain level flight (FPV on the horizon or constant GPS altitude)
- Adjust thrust according to the table
- Observe the resulting pitch attitude, and compare it with the recommended table pitch target.
  - . If the aircraft pitch to maintain level flight is above the table pitch target, the aircraft is slow, then increase thrust
  - . If the aircraft pitch to maintain level flight is below the table pitch target, the aircraft is fast, then decrease thrust

When the pitch required to maintain level off gets close to the table pitch target, re-adjust thrust according to table thrust target.

This technique permits to stabilize the speed quickly, without inducing altitude changes.

If FPV is not reliable and GPS altitude information is not available (no means to ensure level flight):

Adjust pitch and thrust according to table, and wait for speed stabilization. Expect a significant stabilization time and important altitude variations.

**TROUBLE SHOOTING AND FAULT ISOLATION**

When one indication differs from the others, flight crews may be tempted to reject the outlier information. They should be aware, however, that in very extreme circumstances, it may happen that two, or even all three ADRs may provide identical and erroneous data.

BEWARE OF INSTINCTIVELY REJECTING AN OUTLIER ADR

Once the faulty ADR has (or have) been positively identified, it (they) should be switched OFF. This will trigger the corresponding ECAM warnings and associated drills, which should be followed to address all the consequences on the various aircraft systems.

In the extreme case where the faulty ADR(s) cannot be identified and all speed indications remain unreliable, 2 ADRs should be selected OFF to prevent the flight control laws from using two coherent but unreliable ADR data. One must be kept ON to keep the stall warning protection.

If at least one ADR remains reliable, the flight crew will use it (after having confirmed its validity), and so, will stop the application of the ADR CHECK PROC / UNRELIABLE SPEED INDICATION PROC.

**PART 3: FLYING WITHOUT ANY SPEED REFERENCE**

When the trouble shooting procedure did not permit to identify at least one correct indication, this part of the procedure gives pitch/thrust reference to fly the aircraft safely, in all flight phases, down to landing.

The flight crew may enter directly this part if he knows already that no speed information is reliable (for instance in case of dual pitot heating failure, plus an ADR failure), or if level off for trouble shooting is not convenient from an operational point of view, for instance in descent, close to destination.

When flying the aircraft with unreliable speed and/or altitude indications, it is recommended to change only one flying parameter at a time i.e. speed, altitude or configuration. For this reason, a wide pattern and a stabilized approach are recommended.

For final approach, if available, an ILS (with a -3° G/S) will ensure path guidance.

If final descent is started with stabilized speed (VAPP), flying a -3° flight path with the recommended table thrust, the resulting pitch attitude should be close to the recommended table pitch value. If an adjustment is required, vary the thrust, as explain in the initial level off paragraph.

## DUAL RADIO ALTIMETER FAILURE

ALL

The Radio Altimeters (RAs) provide inputs to a number of systems, including the GPWS and FWC for auto-callouts. They also supply information to the AP and A/THR modes, plus inputs to switch flight control laws at various stages. Although the ECAM procedure for a RA 1 + 2 FAULT is straightforward, the consequences of the failure on the aircraft operation require consideration.

Instead of using RA information, the flight control system uses inputs from the LGCIU to determine mode switching. Consequently, mode switching is as follows:

. On approach, flare law becomes active when the L/G is selected down and provided AP is disconnected. At this point, "USE MAN PITCH TRIM" is displayed on the PFD.

. After landing, ground law becomes active when the MLG is compressed and the pitch attitude becomes less than 2.5°

It is not possible to capture the ILS using the APPR pb and the approach must be flown to CAT 1 limits only. However, it is possible to capture the localiser using the LOC pb.

Furthermore, the final stages of the approach should be flown using raw data in order to avoid possible excessive roll rates if LOC is still engaged. Indeed, as the autopilot gains are no longer updated with the radio altitude signal, the AP/FD behaviour may be unsatisfactory when approaching the ground.

There will be no auto-callouts on approach, and no "RETARD" call in the flare

The GPWS/EGPWS will be inoperative; therefore terrain awareness becomes very important. Similarly, the "SPEED, SPEED, SPEED" low energy warning is also inoperative, again requiring increased awareness.

## ALL ENGINE FLAMEOUT

ALL

Following an all engine flame out, the flight deck indications change dramatically as the generators drop off line. The RAT is deployed to supply the emergency generator and pressurize the blue hydraulic circuit.

Control of the aircraft must be taken immediately by the left hand seat pilot, and a safe flight path established.

When convenient, an emergency will be declared to ATC using VHF1. Depending on the exact situation, assistance may be available from ATC regarding position of other aircraft, safe direction etc.

| Significant remaining systems in ALL ENGINES FLAME OUT | |
|---|---|
| FLY | PFD1, Alternate law |
| NAVIGATE | RMP1, VOR1 |
| COMMUNICATE | VHF1/HF1/ATC1 |

*Note: The AP and pitch trim are not available. Rudder trim is recoverable.*

If engine wind milling is sufficient, additional hydraulic power may be recovered.

The ECAM actions are displayed and allow coping with this situation. However, as the ECAM cannot distinguish whether fuel is available or not, they provide a dimensioning procedure which cover all cases. Furthermore, The ECAM procedure refers to paper QRH for OPERATING SPEEDS, L/G GRAVITY EXTENSION and DITCHING or FORCED LANDING.

It is the reason why the ENG DUAL FAILURE FUEL REMAINING or ENG DUAL FAILURE - NO FUEL REMAINING are available in the QRH. As they distinguish whether fuel is available or not, these single paper procedures are optimized for each case and include the required paper procedure until landing, including FORCED LANDING and DITCHING. Consequently, the crew should apply the QRH procedure and then, if time permits, clear ECAM warning to read status.

In the fuel remaining case,

. The actions should be commenced, with attention to the optimum relight speed without starter assist (with wind milling). If there is no relight within 30 seconds, the ECAM will order engine masters off for 30 seconds. This is to permit ventilation of the combustion chamber. Then, the engine masters may be set ON again. Without starter assist (wind milling), this can be done at the same time.

. If the crew wants to take credit of the APU bleed air, the APU should be started below FL 250. Below FL 200, an engine relight should be attempted with starter assist (using the APU bleed).

. Green dot, which corresponds to the optimum relight speed with starter assist, is displayed on the left PFD. With starter assist (APU bleed), only one engine must be started at a time.

ALL ENGINE FLAME OUT PROCEDURE


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## EMERGENCY DESCENT

ALL

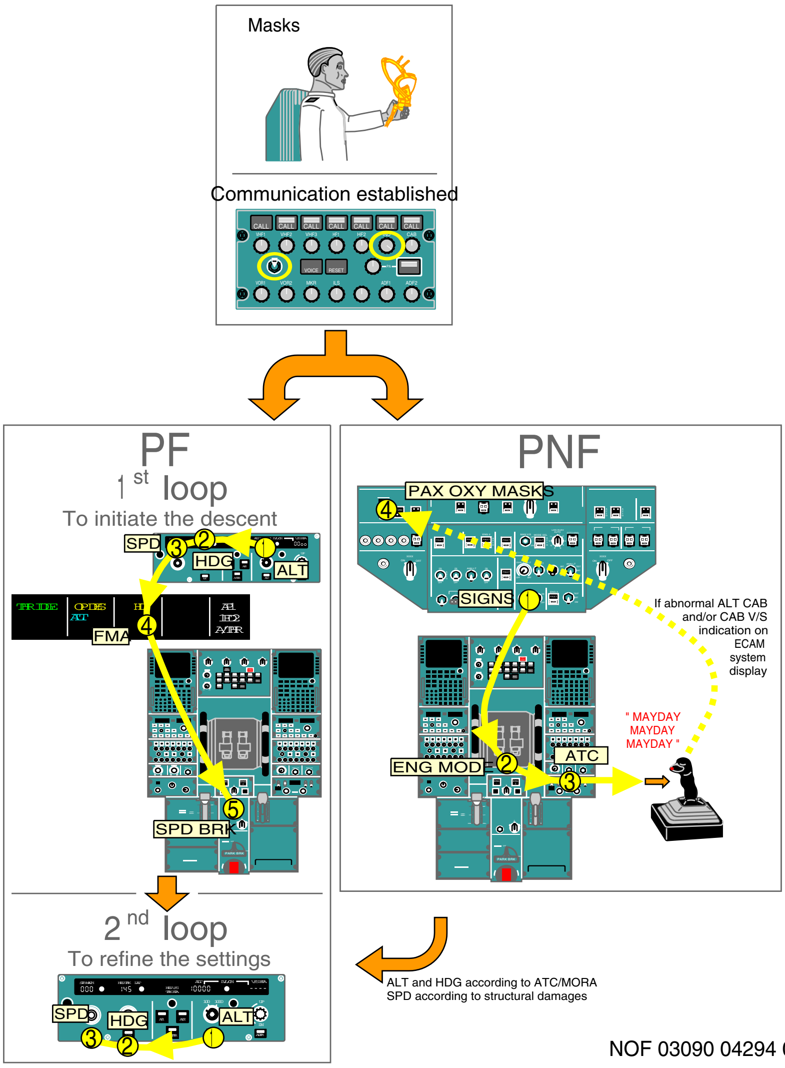
The emergency descent should only be initiated upon positive confirmation that cabin altitude and rate of climb is excessive and uncontrollable. This procedure should be carried out by the crew from memory. The use of AP and auto thrust is strongly recommended for an emergency descent. The FCU selections for an emergency descent progress from right to left, i.e. ALT, HDG, SPD.

At high flight levels, the speed brake should be extended slowly while monitoring VLS to avoid the activation of angle of attack protection This would cause the speed brakes to retract and may also result in AP disconnection. If structural damage is suspected, caution must be used when using speed brakes to avoid further airframe stress. When the aircraft is established in the descent, the PF should request the ECAM actions if any or QRH.

The passenger oxygen MASK MAN ON pb should be pressed only when it is clear that cabin altitude will exceed 14,000 ft.

When in idle thrust, high speed and speed brake extended, the rate of descent is approximately 7000 ft/mn. To descend from FL390 to FL100, it takes approximately 4 minutes and 40 NM. The crew will be aware that MORA displayed on ND (if available) is the highest MORA within a 80NM circle round the aircraft.

After taking off the emergency mask following an emergency descent, the crew should close the mask box and reset the control slide in order to activate the regular microphone again.

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## OVERWEIGHT LANDING

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

Automatic landing is certified up to MLW, but has been demonstrated in flight up to MTOW. In determining the best course of action, the flight crew may consider the option to perform an automatic landing, provided the runway is approved for automatic landing.

Should an overweight landing be required, a long straight in approach, or a wide visual pattern, should be flown in order to configure the aircraft for a stabilized approach.

The stabilized approach technique should be used, and VAPP established at the FAF. The speed will be reduced to reach VLS at runway threshold, to minimize the aircraft energy.

The crew will elect the landing configuration according to the "maximum weight for go-around in CONF 3" table provided both in QRH and in FCOM:

. If aircraft weight is below the maximum weight for go-around in CONF 3, landing will be performed CONF full (and go-around CONF 3) as it is the preferred configuration for optimized landing performance

. If aircraft weight is above the maximum weight for go-around in CONF 3, landing will be performed CONF 3 (and go-around CONF 1+F). The CONF 1+F meets the approach climb gradient requirement in all cases except in high/hot conditions. In those cases, the hot/high procedure (also available in the QRH) is to be applied. This procedure enables to increase the go around speed, in order to increase the climb gradient.

The crew may briefly recall the main point of the go-around procedure (Configuration, call-out and any speed increase) once established in final approach.

If a go-around CONF 1+F is carried out following an approach CONF3, VLS CONF 1+F may be higher than VLS CONF3+5 kt. The recommendation in such a case is to follow FD bars orders which will accelerate the aircraft up to the go-around speed. It should be noted, however, that VLS CONF 1+F equates to 1.23 VS1G whereas the minimum go-around speed required by regulations is 1.13 VS1G. This requirement is always satisfied.

The crew should be aware that the transition from -3° flight path angle to go around climb gradient requires a lot of energy and therefore some altitude loss.

Taking into account the runway landing distance available, the use of brakes should be modulated to avoid very hot brakes and the risk of tire deflation.

When the aircraft weight exceeds the maximum landing weight, structural considerations impose the ability to touch down at 360 ft/mn without damage. This means that no maintenance inspection is required if vertical speed is below 360 ft/mn. If vertical speed exceeds 360 ft/mn at touch down, a maintenance inspection is required.

MSN 0546 0572 0578 0588 0598 0600 0608-0610 0612 0616 0618 0621 0623 0625 0627 0629 0634 0636-0637 0639 0641 0644 0646-0647 0649 0651 0654 0656 0660 0670 0672 0679 0682 0686 0688-0691 0693-0695 0697 0700 0711 0713 0717 0719 0721 0723 0727-0729 0732 0734 0736 0738 0740 0742 0744 0748 0750 0752 0755 0757 0759 0763 0767 0769 0773 0779 0783 0785 0788 0790 0794 0798 0800 0804 0813 0817 0821 0825 0829 0831 0833 0837 0840 0843 0845 0847 0850 0853 0858 0860 0862 0867 0869 0871 0873 0875 0880 0882 0885 0889-0890 0893 0896 0898 0904 0906 0910 0913 0917 0922 0924 0929 0931 0933 0938 0944 0946 0948-0949 0952 0965 0972 0976 0979-0980 0985 0989 0997-0998 1000 1002 1010 1016 1018-1020 1022 1025 1029 1031 1033-1034 1036 1038 1040 1043 1046 1048-1049 1051 1053 1055-1056 1058 1062 1064 1066 1068-1069 1071 1073-1074 1077-1078 1082 1084 1086 1088-1092 1095-1098 1100 1102-1103 1106-1107 1109 1111 1113 1115-1116 1118 1120 1122 1124 1126-1127 1129 1131 1135-1136 1139-1140 1142 1145 1147 1149 1151 1154-1155 1157 1159-1160 1164-1165 1167 1169-1170 1172 1176 1178 1180 1182 1184 1190-1191 1193 1197 1201 1203 1205 1209 1211-1212 1216 1222-1223 1225 1228 1230 1232 1236 1239 1243 1245 1247 1249 1252 1254 1256 1258 1261 1263 1265 1267 1269 1271 1275 1277-1279 1281 1283 1285 1287 1289 1291 1295 1297 1301 1303 1305 1309 1311 1313 1315 1317 1319 1321 1323-1326 1328-1329 1331 1335-1336 1338 1340 1342 1344 1346 1348 1350 1352 1354 1358 1360 1362 1364 1369 1371 1373 1375 1377-1378 1380 1382 1384 1386 1388-1389 1391-1393 1395 1397 1401 1404 1406 1410 1414-1415 1420 1423 1426 1429 1434 1440 1444-1445 1449 1453 1456 1460 1463 1466 1468 1471 1474 1477 1479 1483 1485 1488 1490 1494 1498 1501 1505 1507 1510 1513 1515 1520 1522 1524 1527 1529 1534 1537 1541 1543 1545 1547 1549 1551-1552 1556 1558 1560 1562-1563 1565 1567 1569-1570 1573-1577 1579 1581-1583 1585 1589-1590 1592 1594 1598 1600-1601 1603-1604 1606 1608 1612 1616 1618 1622 1625 1627 1630 1634 1640 1643 1645 1647 1649 1653-1654 1656 1659 1662 1664 1668 1671 1673 1677 1679 1683-1685 1688 1693 1698-1699 1703 1706 1709 1714 1718 1722 1727 1729 1731 1733 1737-1738 1740 1742-1743 1745-1746 1750 1752-1753 1756 1758-1759 1761 1765-1766 1768 1770 1774 1778-1779 1781 1786 1790-1791 1795-1796 1800-1801 1803 1805 1808 1810 1815 1819-1820 1824 1826 1828 1831 1833 1837 1839 1841 1844 1846 1851 1853 1855 1863 1866 1870 1872 1875-1876 1880 1882 1884 1886 1890 1893 1897 1901 1908 1912 1916 1923 1925 1934 1936 1938 1943 1947 1952 1955 1959 1962-1963 1971 1976 1980 1982 1986 1990 1997 1999-2000 2002 2004 2007-2008 2010 2012-2013 2015 2019 2023 2026 2028 2030 2032-2033 2037 2039 2043 2047 2050 2052-2053 2057 2062 2066 2069 2072 2074 2078 2083 2086-2087 2089 2091 2093 2095-2096 2098 2101 2103 2113 2119-2120 2122 2124 2126-2127 2129 2131 2170 2172 2174 2176 2179 2181 2184 2186 2188 2192 2194 2196 2198 2200 2202-2203 2205 2209 2213-2214 2222 2224 2228 2230 2232 2236-2237 2240-2241 2243 2245 2249 2251 2253 2258 2260 2262-2266 2268-2269 2271 2273 2277

MSN 2279 2281 2283 2285 2287 2289 2293 2295-2296 2298 2300 2302 2304 2306 2308 2311 2313 2318-2319 2321 2326 2332 2335 2339 2341 2346 2348 2353 2355 2360 2362 2365 2369-2371 2373 2375 2378-2380 2382-2383 2385 2387 2389 2392 2396 2398 2400 2402 2404 2406 2408 2412 2414 2416 2418 2420-2421 2424 2426-2427 2429 2431 2433 2435-2436 2438 2440 2442 2444 2446 2448 2450 2452 2454 2456 2458 2460 2463-2471 2473-2474 2477 2481 2483 2485 2487 2490 2492 2494-2495 2497 2499 2501 2503 2505 2507-2508 2510 2512 2514 2516 2518-2519 2525 2527-2528 2532 2534 2538 2541 2545-2548 2550-2551 2554-2561 2565 2567-2568 2570 2572 2574 2578-2579 2581 2585-2586 2588 2592-2593 2595 2597 2603 2605 2607 2611 2614-2615 2617-2618 2621-2622 2624-2625 2628-2629 2631-2632 2634 2636 2638-2639 2641 2643-2644 2646 2648 2650 2652 2655 2657 2659-2660 2662 2664 2666-2667 2669 2672-2673 2675 2677 2679 2681 2684 2690-2691 2693-2694 2697-2698 2700 2702 2704 2706 2709 2711 2715-2716 2718 2720 2723 2727 2729 2733 2735 2738-2739 2742 2744 2746 2748 2751 2754 2757 2762-2763 2765 2769 2771 2773-2774 2777 2779-2780 2782 2784 2786 2788 2790 2795 2797 2801 2803 2805-2806 2811-2813 2815 2818-2819 2821 2825 2827 2829 2831 2833 2836-2837 2839 2841 2843 2845 2847 2849-2850 2852 2854 2857-2858 2860 2864 2866 2870 2872-2873 2876 2878-2879 2884 2886-2894 2897-2898 2901 2905 2907 2913 2921 2923 2925 2929 2935 2938 2940 2942 2946 2948-2949 2954 2959 2961 2963 2969 2976 2978-2979 2981 2983 2985 2997 3003 3007 3011 3017 3019-3020 3024 3026 3028 3032 3036 3041 3043 3045-3046 3049 3053-3054 3057 3059 3061 3065 3069 3073 3077-3078 3082 3084-3085 3088 3090 3094 3096 3102 3104 3108 3114 3116 3118 3122 3124 3128 3133-3134 3137 3139 3144 3165 3168-3169 3171-3172 3175-3176 3179 3181 3184 3186 3188 3193 3195 3200 3202 3204 3209 3226 3231 3243-3260

Automatic landing is certified up to MLW, but has been demonstrated in flight up to MTOW. In determining the best course of action, the flight crew may consider the option to perform an automatic landing, provided the runway is approved for automatic landing.

Should an overweight landing be required, a long straight in approach, or a wide visual pattern, should be flown in order to configure the aircraft for a stabilized approach.

The stabilized approach technique should be used, and VAPP established at the FAF. The speed will be reduced to reach VLS at runway threshold, to minimize the aircraft energy.

The crew will elect the landing configuration according to the "maximum weight for go-around in CONF 3" table provided both in QRH and in FCOM:

. If aircraft weight is below the maximum weight for go-around in CONF 3, landing will be performed CONF full (and go-around CONF 3) as it is the preferred configuration for optimized landing performance

. If aircraft weight is above the maximum weight for go-around in CONF 3, landing will be performed CONF 3 (and go-around CONF 1+F). The CONF 1+F meets the approach climb gradient requirement in all cases (high weights, high altitude and temperature).

If a go-around CONF 1+F is carried out following an approach CONF3, VLS CONF 1+F may be higher than VLS CONF3+5 kt. The recommendation in such a case is to follow SRS orders which will accelerate the aircraft up to the displayed VLS. It should be noted, however, that VLS CONF 1+F equates to 1.23 VS1g whereas the minimum go-around speed required by regulations is 1.13 VS1g. This requirement is always satisfied.

The crew should be aware that the transition from -3° flight path angle to go around climb gradient requires a lot of energy and therefore some altitude loss.

Taking into account the runway landing distance available, the use of brakes should be modulated to avoid very hot brakes and the risk of tire deflation.

When the aircraft weight exceeds the maximum landing weight, structural considerations impose the ability to touch down at 360 ft/mn without damage. This means that no maintenance inspection is required if vertical speed is below 360 ft/mn. If vertical speed exceeds 360 ft/mn at touch down, a maintenance inspection is required.

MSN 0002-0021 0024 0027 0043 0045-0051 0056-0058 0074-0075 0080 0089-0090 0095-0097 0113-0114 0119 0123-0124 0165-0166 0178 0181-0182 0194-0195 0198 0205 0229 0247 0251 0257 0288 0291-0292 0308 0322 0331 0351 0366 0370-0371 0373 0390 0396-0398 0402 0416 0423 0431-0432 0440 0447 0451 0469 0486 0490 0492 0499 0511 0575 0580 0659 0667 0707 0724 0857 1181 1183 1210 1407 1418 1424 1621 1644 1710 1764 1792 3215

Should an overweight landing be required, a long straight in approach, or a wide visual pattern, should be flown in order to configure the aircraft for a stabilized approach.

The stabilized approach technique should be used, and VAPP established at the FAF. The speed will be reduced to reach VLS at runway threshold, to minimize the aircraft energy.

The crew will refer to the corresponding RTOW chart, or to FCOM to find the approach and landing configuration given as a function of the approach climb limiting weight.

If a go around CONF 1+F is carried out following an approach CONF3, VLS CONF 1+F may be higher than VLS CONF3+5 kt. The recommendation in such a case is to follow SRS orders which will accelerate the aircraft up to the displayed VLS. It should be noted, however, that VLS CONF 1+F equates to 1.23 VS1g whereas the minimum go-around speed required by regulations is 1.13 VS1g. This requirement is always satisfied.

The crew should be aware that the transition from -3° flight path angle to go around climb gradient requires a lot of energy and therefore some altitude loss.

Taking into account the runway landing distance available, the use of brakes should be modulated to avoid very hot brakes and the risk of tire deflation.

When the aircraft weight exceeds the maximum landing weight, structural considerations impose the ability to touch down at 360 ft/mn without damage.

This means that no maintenance inspection is required if vertical speed is below 360 ft/mn. If vertical speed exceeds 360 ft/mn at touch down, a maintenance inspection is required.

MSN 0022-0023 0025-0026 0029-0042 0044 0052-0055 0059-0073 0076-0078 0081-0088 0091-0094 0098-0112 0115-0118 0120-0122 0125-0164 0167-0177 0179-0180 0183-0193 0196-0197 0199-0204 0206-0228 0230-0246 0248-0250 0252-0256 0258-0287 0289-0290 0293-0307 0309-0321 0323-0330 0332-0350 0352-0363 0365 0367-0369 0372 0375-0384 0386-0389 0391-0395 0399-0401 0403-0411 0413-0415 0417-0422 0424-0430 0435-0439 0441-0446 0448-0450 0452-0457 0459-0467 0470-0472 0475-0476 0478-0483 0485 0487 0489 0491 0496-0497 0500-0501 0503-0504 0506-0508 0510 0512 0523 0525 0527-0528 0530-0531 0533-0534 0537 0539-0540 0542-0543 0545 0548-0549 0551 0553-0554 0556 0558-0559 0561-0562 0565-0566 0568-0569 0571 0573-0574 0577 0579 0582 0584-0585 0587 0589-0590 0592 0594 0596 0601-0603 0605 0607 0611 0613 0615 0617 0619 0622 0624 0626 0628 0630 0635 0638 0640 0643 0645 0648 0650 0653 0655 0657-0658 0661-0662 0665 0669 0671 0673 0676 0678 0681 0683 0685 0696 0698 0701-0706 0709-0710 0712 0714 0716 0718 0720 0722 0726 0730 0733 0735 0737 0739 0741 0743 0745 0747 0749 0751 0753-0754 0756 0758 0760 0762 0764 0766 0768 0770 0772 0774 0776 0778 0780 0782 0784 0786 0789 0791 0793 0795 0797 0799 0801 0803 0805 0807 0809 0812 0814 0816 0818 0820 0822 0824 0826 0828 0830 0832 0834 0836 0838-0839 0842 0844 0846 0849 0851 0854 0856 0859 0861 0863 0865-0866 0868 0870 0872 0874 0876-0877 0879 0881 0883-0884 0886 0888 0892 0894-0895 0897 0899-0900 0902-0903 0905 0907 0909 0911-0912 0914 0916 0918-0919 0921 0923 0925 0927-0928 0930 0932 0934 0936-0937 0939 0942-0943 0945 0947 0950-0951 0953 0955 0957-0958 0960 0962 0964 0966-0967 0969 0971 0973 0975 0977-0978 0981-0982 0984 0986 0988 0990 0992 0994 0996 0999 1001 1003 1005 1007 1009 1011 1013-1014 1026 1028 1030 1032 1035 1037 1039 1041 1044 1047 1050 1052 1054 1057 1059 1061 1063 1065 1067 1070 1072 1075-1076 1079 1081 1083 1085 1087 1093 1099 1101 1104-1105 1108 1110 1112 1114 1117 1119 1121 1123 1125 1128 1130 1132 1134 1137-1138 1141 1143 1146 1148 1150 1152 1156 1158 1162-1163 1166 1168 1171 1173 1175 1177 1179 1187 1189 1192 1194 1196 1198 1200 1206 1208 1213 1215 1217 1221 1224 1226 1229 1231 1234-1235 1237 1240 1242 1244 1246 1248 1251 1253 1255 1257 1259 1262 1264 1266 1268 1270 1272 1274 1280 1282 1284 1286 1288 1290 1292 1294 1296 1298 1300 1302 1304 1306 1308 1310 1312 1314 1316 1318 1320 1322 1327 1330 1332 1334 1337 1339 1341 1343 1345 1347 1349 1351 1353 1355 1357 1359 1361 1363 1365 1367-1368 1370 1372 1374 1376 1379 1381 1383 1385 1387 1390 1394 1396 1398 1400 1402 1405 1409 1411 1413 1416 1419 1422 1427 1430 1432 1435 1437 1439 1441 1443 1446 1448 1450 1452 1454 1457 1459 1461 1464 1467 1469-1470 1473 1475 1478 1480 1482 1484 1486 1489 1491 1493 1495 1497 1500 1502 1504 1506 1508-1509 1512 1514 1516 1518 1523 1526 1528 1530 1532-1533 1535 1538 1540 1542 1544 1546 1548 1550 1553 1555 1557 1559 1561 1564 1566 1568 1571 1578 1580 1584 1586 1588 1591 1593 1595 1597 1605 1609-1610 1613 1615 1617 1620 1624 1626 1628 1631 1633 1635 1637

MSN 1639 1641 1646 1648 1650 1652 1655 1657 1661 1663 1665 1667 1669 1672
1674 1676 1678 1680 1682 1686-1687 1689 1692 1694 1696-1697 1700 1702 1705 1708
1712 1715 1717 1719 1721 1723 1725 1728 1730 1732 1735-1736 1739 1741 1744
1747 1749 1751 1754-1755 1757 1760 1762 1767 1769 1771 1773 1775 1777 1780
1782 1784-1785 1787 1789 1793 1797 1799 1802 1804 1806 1809 1812-1814 1816 1818
1821-1823 1825 1827 1829 1832 1834-1835 1838 1840 1842 1845 1847 1849 1852
1854 1856-1858 1860-1862 1864-1865 1867-1868 1871 1873-1874 1877 1879 1883 1885
1888-1889 1891-1892 1894-1896 1898-1900 1902-1904 1906-1907 1909-1911 1913-1915
1917-1920 1922 1924 1927 1929-1931 1933 1935 1937 1940 1942 1944-1945 1948-1949
1951 1954 1957-1958 1961 1964-1965 1968-1969 1973 1975 1979 1981 1983 1987 1989
1993 1996 1998 2001 2003 2006 2009 2011 2014 2016 2018 2020 2022 2024 2027
2029 2031 2034 2036 2038 2040 2042 2044 2046 2048-2049 2054 2056 2058 2061 2063
2065 2068 2070 2073 2075 2077 2079 2082 2084-2085 2088 2090 2092 2094 2097 2099
2102 2104 2106 2108 2112 2114 2116 2118 2121 2123 2125 2128 2130 2132-2169 2171
2173 2175 2177-2178 2180 2182-2183 2185 2187 2189 2191 2193 2195 2197 2199 2201
2204 2206-2207 2210 2212 2215 2217 2219 2221 2223 2225 2227 2229 2231 2233 2235
2238-2239 2242 2244 2246 2248 2250 2252 2254 2256-2257 2259 2272 2274-2275 2278
2280 2282 2284 2286 2288 2291-2292 2294 2297 2299 2301 2307 2310 2312 2314 2316
2322 2325 2327 2329 2331 2334 2336 2338 2340 2343 2345 2347 2349 2352 2354 2356
2359 2361 2364 2366 2368 2372 2374 2376 2384 2386 2388 2390-2391 2393 2395 2397
2399 2401 2403 2405 2407 2409 2411 2413 2415 2417 2419 2422-2423 2425 2428 2430
2432 2434 2437 2439 2441 2443 2445 2447 2449 2451 2453 2455 2457 2459 2461
2475 2478-2479 2482 2484 2486 2489 2491 2493 2496 2498 2500 2502 2504 2506 2509
2511 2513 2515 2517 2520 2522 2524 2526 2529 2531 2533 2535 2537 2539-2540 2542
2562 2564 2566 2569 2571 2573 2576-2577 2580 2583-2584 2587 2589 2591 2594 2596
2598 2600 2602 2604 2606 2608-2609 2612-2613 2616 2619-2620 2623 2626-2627 2630
2633 2635 2637 2640 2642 2645 2647 2649 2651 2654 2656 2658 2661 2663 2665
2668 2670-2671 2674 2676 2678 2680 2683 2685 2688-2689 2692 2695-2696 2699 2701
2703 2705 2708 2710 2712 2714 2717 2719 2721 2724-2725 2728 2731-2732 2734 2737
2740 2743 2745 2747 2749 2752-2753 2755 2758 2760-2761 2764 2766 2768 2770 2772
2775-2776 2778 2781 2783 2785 2787 2789 2791-2792 2794 2796 2798 2800 2802 2804
2807-2808 2810 2814 2816-2817 2820 2822 2824 2826 2828 2830 2832 2834-2835 2838
2840 2842 2844 2846 2848 2851 2853 2855-2856 2859 2861 2863 2865 2867 2869 2871
2874-2875 2877 2880-2881 2883 2885 2896 2899-2900 2902 2904 2906 2908-2909 2911
2914-2915 2917 2920 2922 2924 2926 2928 2930 2932 2934 2937 2939 2941 2943-2945
2947 2950 2952-2953 2956 2958 2960 2962 2964 2966 2968 2970 2973 2975 2977 2980
2982 2984 2986-2995 2998 3000 3002 3004 3006 3008 3010 3012 3014 3016 3018 3021
3023 3025 3027 3029 3031 3033 3035 3037 3039-3040 3042 3044 3047-3048 3050
MSN 3052 3055-3056 3058 3060 3063-3064 3066 3068 3071-3072 3074 3076 3079-3080
3083 3086-3087 3089 3091 3093 3095 3097 3099 3101 3103 3105 3107 3109 3111
3113 3115 3117 3119 3121 3123 3125 3127 3129 3131-3132 3135-3136 3138 3140-3143
3145 3147-3162 3164 3166-3167 3170 3173-3174 3177-3178 3180 3182-3183 3185 3187
3189-3190 3192 3194 3196-3197 3199 3201 3203 3205-3206 3208 3210 3213

Should an overweight landing be required, a long straight in approach, or a wide visual pattern, should be flown in order to configure the aircraft for a stabilized approach.

The stabilized approach technique should be used, and VAPP established at the FAF. The speed will be reduced to reach VLS at runway threshold, to minimize the aircraft energy.

The crew will elect the landing configuration according to the "maximum weight for go-around in CONF 3" table provided both in QRH and in FCOM:

. If aircraft weight is below the maximum weight for go-around in CONF 3, landing will be performed CONF full (and go-around CONF 3) as it is the preferred configuration for optimized landing performance

. If aircraft weight is above the maximum weight for go-around in CONF 3, landing will be performed CONF 3 (and go-around CONF 1+F). The CONF 1+F meets the approach climb gradient requirement in all cases (high weights, high altitude and temperature).

If a go-around CONF 1+F is carried out following an approach CONF3, VLS CONF 1+F may be higher than VLS CONF3+5 kt. The recommendation in such a case is to follow SRS orders which will accelerate the aircraft up to the displayed VLS. It should be noted, however, that VLS CONF 1+F equates to 1.23 VS1g whereas the minimum go-around speed required by regulations is 1.13 VS1g. This requirement is always satisfied.

The crew should be aware that the transition from -3° flight path angle to go around climb gradient requires a lot of energy and therefore some altitude loss.

Taking into account the runway landing distance available, the use of brakes should be modulated to avoid very hot brakes and the risk of tire deflation.

When the aircraft weight exceeds the maximum landing weight, structural considerations impose the ability to touch down at 360 ft/mn without damage. This means that no maintenance inspection is required if vertical speed is below 360 ft/mn. If vertical speed exceeds 360 ft/mn at touch down, a maintenance inspection is required.

MSN 0364 0385 0412 0434 0458 0468 0473-0474 0477 0484 0488 0493-0495 0498 0502 0505 0509 0513-0522 0524 0526 0529 0532 0535 0538 0541 0544 0550 0552 0555 0557 0560 0563-0564 0567 0570 0576 0581 0583 0586 0591 0593 0595 0597 0599 0604 0606 0614 0620 0631-0633 0642 0652 0663-0664 0666 0668 0674-0675 0677 0680 0684 0687 0692 0699 0715 0725 0731 0746 0761 0765 0771 0775 0777 0781 0787 0792 0796 0802 0806 0808 0810-0811 0815 0819 0823 0827 0835 0841 0848 0852 0855 0864 0878 0887 0891 0901 0908 0915 0920 0926 0935 0940-0941 0954 0956 0959 0961 0963 0968 0970 0974 0983 0987 0991 0993 0995 1004 1006 1008 1012 1015 1017 1021 1023-1024 1027 1042 1045 1060 1080 1094 1133 1144 1153 1161 1174 1185 1188 1195 1199 1202 1204 1207 1214 1218-1220 1227 1233 1238 1241 1250 1260 1273 1276 1293 1299 1307 1333 1356 1366 1399 1403 1408 1412 1417 1421 1425 1428 1431 1433 1436 1438 1442 1447 1451 1455 1458 1462 1465 1472 1476 1481 1487 1492 1496 1499 1503 1511 1517 1519 1521 1525 1531 1536 1539 1554 1572 1587 1596 1602 1607 1611 1614 1619 1623 1629 1632 1636 1638 1642 1651 1658 1666 1670 1675 1681 1690-1691 1695 1701 1704 1707 1711 1713 1716 1720 1724 1726 1734 1748 1763 1772 1776 1783 1788 1794 1798 1807 1811 1817 1836 1843 1848 1850 1859 1869 1878 1881 1887 1905 1921 1926 1928 1932 1941 1946 1950 1953 1956 1960 1966-1967 1970 1972 1974 1977-1978 1984 1988 1994-1995 2005 2021 2041 2045 2055 2060 2064 2067 2076 2080 2105 2107 2110 2115 2117 2190 2208 2211 2216 2220 2226 2234 2247 2255 2261 2267 2270 2290 2303 2305 2309 2315 2320 2323-2324 2330 2337 2342 2351 2357 2363 2381 2410 2462 2472 2476 2480 2488 2521 2530 2536 2543 2549 2553 2563 2590 2599 2610 2653 2682 2687 2707 2713 2726 2730 2736 2741 2756 2759 2767 2793 2799 2809 2823 2862 2868 2882 2895 2903 2912 2916 2919 2927 2933 2936 2957 2965 2971 2974 2996 2999 3005 3013 3015 3022 3034 3051 3067 3070 3075 3081 3098 3106 3112 3120 3126 3130 3146 3191 3198 3207 3212 3217 3222 3229 3233-3235 3241

Should an overweight landing be required, a long straight in approach, or a wide visual pattern, should be flown in order to configure the aircraft for a stabilized approach.

At very high weights, VFE CONF1 is close to VLS clean. To select CONF1, deselect A/THR, decelerate to (or slightly below) VLS and select CONF1 when below VFE. When established at CONF1, the crew can reengage A/THR and use managed speed again.

The stabilized approach technique should be used, and VAPP established at the FAF. The speed will be reduced to reach VLS at runway threshold, to minimize the aircraft energy.

The crew will elect the landing configuration according to the "maximum weight for go-around in CONF 3" table provided both in QRH and in FCOM:

. If aircraft weight is below the maximum weight for go-around in CONF 3, landing will be performed CONF full (and go-around CONF 3) as it is the preferred configuration for optimized landing performance

. If aircraft weight is above the maximum weight for go-around in CONF 3, landing will be performed CONF 3 (and go-around CONF 1+F). The CONF 1+F meets the approach climb gradient requirement in all cases (high weights, high altitude and temperature).

If a go-around CONF 1+F is carried out following an approach CONF3, VLS CONF 1+F may be higher than VLS CONF3+5 kt. The recommendation in such a case is to follow SRS orders which will accelerate the aircraft up to the displayed VLS. It should be noted, however, that VLS CONF 1+F equates to 1.23 VS1g whereas the minimum go-around speed required by regulations is 1.13 VS1g. This requirement is always satisfied.

The crew should be aware that the transition from -3° flight path angle to go around climb gradient requires a lot of energy and therefore some altitude loss.

Taking into account the runway landing distance available, the use of brakes should be modulated to avoid very hot brakes and the risk of tire deflation.

When the aircraft weight exceeds the maximum landing weight, structural considerations impose the ability to touch down at 360 ft/mn without damage. This means that no maintenance inspection is required if vertical speed is below 360 ft/mn. If vertical speed exceeds 360 ft/mn at touch down, a maintenance inspection is required.

## CREW INCAPACITATION

ALL

### GENERAL

Crew incapacitation is a real safety hazard which occurs most frequently than many of the other emergencies. Incapacitation can occur in many form varying from obvious sudden death to subtle, partial loss of function. It may not be preceded by any warning.

### RECOGNITION

The keys to early recognition of the incapacitation are

- Routine monitoring and cross checking of flight instruments
- Crew members should have a very high index of suspicion of a subtle incapacitation
- If one crew member do not feel well, the other crew must be advised
- Others symptoms e.g. incoherent speech, pale fixed facial expression or irregular breathing could indicate the beginning of an incapacitation.

**ACTION**

The recovery from a detected incapacitation of the fit pilot shall follow the sequence below:

First phase

. Assume control, return the aircraft to a safe flight path, announce "I have control", use the take-over pb and engage the on side AP as required.

. Declare an emergency to ATC

. Take whatever steps are possible to ensure the incapacitated pilot cannot interfere with the handling of the aircraft. This may include involving cabin crew to restrain the incapacitated pilot

. Request assistance from any medically qualified passenger

. Check is a type qualified company pilot is on board to replace the incapacitated crew member

. Land as soon as practicable after considering all pertinent factors

. Arrange medical assistance after landing giving many details about the condition of the affected crewmember

Second phase

. Prepare the approach and read the checklist earlier than usual

. Request radar vectoring and prefer a long approach to reduce workload

. Perform the landing from the fit pilot usual place

TABLE OF CONTENTS

## GENERAL

ALL

The adverse weather operation take into account the following topics:

. Cold weather operations and icing conditions

. Turbulence

. Windshear

. Volcanic ashes

## COLD WEATHER OPERATIONS AND ICING CONDITIONS

ALL

### PREFACE

Aircraft performance is certified on the basis of a clean wing. Ice accretion affects wing performance. When the wing is clean, the airflow smoothly follows the shape of the wing. When the wing is covered with ice, the airflow separates from the wing when the Angle-Of-Attack (AOA) increases. Therefore, the maximum lift-coefficient is reduced. As a result, the aircraft may stall at a lower AOA, and the drag may increase.

The flight crew must keep in mind that the wing temperature of the aircraft may be significantly lower than 0 °C, after a flight at high altitude and low temperature, even if the Outside Air Temperature (OAT) is higher than 0 °C. In such cases, humidity or rain will cause ice accretion on the upper wing, and light frost under the wing. (Only 3mm of frost on the under-surface of the wing is acceptable.)

### EXTERIOR INSPECTION

When ground-icing conditions are encountered, and/or when ice accretion is suspected, the Captain should determine, on the basis of the exterior inspection, whether the aircraft requires ground deicing/anti-icing treatment. This visual inspection must take into account all vital parts of the aircraft, and must be performed from locations that offer a clear view of these parts.

### COCKPIT PREPARATION

The following systems may be affected in very cold weather:

. The EFIS/ECAM (when the cockpit temperature is very low)

. The IRS alignment (may take longer than usual, up to 15 minutes)

The probe and window heating may be used on ground. Heating automatically operates at low power.

## AIRCRAFT GROUND DE-ICING/ANTI-ICING

### DE-ICING/ANTI-ICING FLUID

Deicing/anti-icing fluids must be able to remove ice and to prevent its accumulation on aircraft surfaces until the beginning of the takeoff. In addition, the fluids must flow off the surfaces of the aircraft during takeoff, in order not to degrade takeoff performance.

Several types of fluids can be used. These fluids have different characteristics:

| **type 1** | **type 2, 3, 4** |
|---|---|
| Low viscosity | High viscosity |
| Limited hold-over time | Longer hold-over time |
| Used mainly for de-icing | Used for de-icing and anti-icing |

The holdover time starts from the beginning of the application of the fluid, and depends on the type of fluid, and on the nature and severity of precipitation. The flight crew should refer to applicable tables as guidelines. These tables must be used in conjunction with the pre-takeoff check.

Depending upon the severity of the weather, de-icing/anti-icing procedure must be applied either:

. In one step, via the single application of heated and diluted deicing/anti-icing fluid: This procedure provides a short holdover time, and should be used in low moisture conditions only. The holdover time starts from the beginning of the application of the fluid.

. In two steps, by first applying the heated deicing fluid, then by applying a protective anti-icing fluid: These two sprays must be applied consecutively. The holdover time starts from the beginning of the application of the second fluid.

### PROCEDURES

The following outlines the various procedures to be applied before and after spraying:

- All ENG and APU BLEED pushbutton must be set to OFF and the DITCHING pushbutton must be set to ON, to prevent any engine ingestion of deicing/anti-icing fluid.
- The aircraft can be deiced/anti-iced, with the engine and/or the APU running or off. However, the APU or the engine should not be started during spraying.
- The aircraft must be deiced/anti-iced symmetrically on both sides.
- Keep bleeds off after spraying for a few minutes.
- After spraying, keep bleeds off for a few minutes, and perform a visual inspection of the aircraft surfaces.
- A deicing/anti-icing report must be filled out to indicate the type of fluid and when the spraying began.

## AFTER START

- Keep the engine bleeds off, with the engines running at higher N1.
- Keep the APU running with the bleed off for a few minutes after spraying.
- The slats/flaps and flight controls can be moved, because they no longer have ice.

## TAXI OUT

On contaminated runways, the taxiing speed should be limited to 10 knots, and any action that could distract the flight crew during taxiing should be delayed until the aircraft is stopped.

The following factors should be taken into account:

- At speeds below 10 kts, anti-skid de-activates.
- Engine anti-ice increases ground idle thrust.
- To minimize the risk of skidding during turns: Avoid large tiller inputs.
- On slippery taxiways: It may be more effective to use differential braking and/or thrust, instead of nosewheel steering.
- On slush-covered, or snow-covered, taxiways: Flap selection should be delayed until reaching the holding point, in order to avoid contaminating the flap/slat actuation mechanism.
- When reaching the holding point: The "Before Takeoff down to the line" checklist must be performed.
- The flight crew must maintain the aircraft at an appropriate distance from the aircraft in front.

. In icing conditions: When holding on ground for extended periods of time, or if engine vibration occurs, thrust should be increased periodically, and immediately before takeoff, to shed any ice from the fan blades.

For more details about this procedure, refer to the FCOM 3.03. 09.

## TAKE-OFF

### TAKE-OFF PERFORMANCES

The use of FLEX thrust for take-off on contaminated runways is prohibited.

If anti-ice is used at take-off, the crew will apply the related performance penalty.

Slush, standing water, or deep snow reduces the aircraft take-off performance because of increased rolling resistance and the reduction in tire-to-ground friction. A higher flap setting will increase the runway limited take-off weight, but will reduce second segment limited take-off weight.

### TAKE-OFF ROLL

Before the aircraft lines up on the runway for takeoff, the flight crew must ensure that the airframe has no ice or snow.

Then, before applying thrust, the Captain should ensure that the nosewheel is straight. If there is a tendency to deviate from the runway centerline, this tendency must be neutralized immediately, via rudder pedal steering, not via the tiller.

On contaminated runways, the flight crew should ensure that engine thrust advances symmetrically to help minimize potential problems with directional control.

### MAXIMUM CROSS WIND

The following table provides the maximum crosswind that corresponds to the reported runway-friction coefficient:

| **Reported Braking Action** | **Reported Runway-Friction Coefficient** | **Equivalent Runway Condition** | **Maximum Crosswind** (knots) |
|---|---|---|---|
| Good/Medium | 0.39 to 0.36 | 1 | 29 |
| Medium | 0.35 to 0.3 | 2/3 | 25 |
| Medium/Poor | 0.29 to 0.26 | 2/3 | 20 |
| Poor | $\leq$0.25 | 3/4 | 15 |
| Unreliable | - | 4/5 | 5 |

The runway condition numbers, in the above table, correspond to the runway conditions:

1. Dry, damp, or wet runway (less than 3 MM depth of water )
2. Runway covered with slush
3. Runway covered with dry snow
4. Runway covered with standing water with risk of aquaplaning or wet snow
5. Icy runway or high risk of aquaplaning

## CLIMB/ DESCENT

Whenever icing conditions are encountered or expected, the engine anti-ice should be turned on. Although the TAT before entering clouds may not require engine anti-ice, flight crews should be aware that the TAT often decreases significantly, when entering clouds.

In climb or cruise, when the SAT decreases to lower than -40 °C, engine anti-ice should be turned off, unless flying near CBs.

If the recommended anti-ice procedures are not performed, engine stall, over-temperature, or engine damage may occur,

If it is necessary to turn on the engine anti-ice, and if ice accretion is visible because engine anti-ice was turned on late, then apply the following procedure:

. Set the ENGINE START selector to IGN

. Retard one engine, and set the ENG ANTI-ICE pushbutton to ON

. Smoothly adjust thrust, and wait for stabilization

. Set the ENGINE START selector to NORM

. Repeat this procedure for the other engine

Wing anti-ice should be turned on, if either severe ice accretion is expected, or if there is any indication of icing on the airframe.

## HOLDING

If holding is performed in icing conditions, the flight crew should maintain clean configuration. This is because prolonged flight in icing conditions with the slats extended should be avoided.

## APPROACH

If significant ice accretion develops on parts of the wing that have not been deiced, the aircraft speed must be increased (Ref. FCOM 3.04.30).

When the temperature is lower than ISA-10, the target altitudes (provided by the ATC) must be corrected, by adding the values that are indicated in the table below:

| Corrections to be Added | | | |
|---|---|---|---|
| Height | ISA - 10 | ISA - 20 | ISA 30 |
| 500 | 20 | 40 | 60 |
| 1000 | 40 | 80 | 120 |
| 2000 | 80 | 160 | 240 |
| 3000 | 140 | 260 | 380 |
| 4000 | 180 | 340 | 500 |
| 5000 | 220 | 420 | 620 |

These corrections corresponds approximately to 4 x Delta ISA x Height (ft)/1000

## LANDING

Obviously, landings should be avoided on very slippery runways. However, if it is not possible to avoid such landings, the following factors (linked to operations on contaminated runways) should be considered:

. Braking action

. Directional control

## BRAKING ACTION

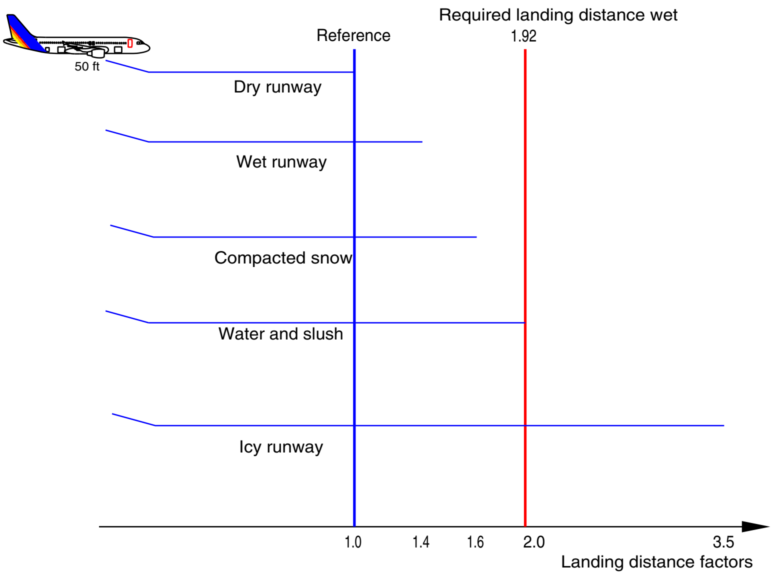
The presence of fluid contaminants on the runway has an adverse effect on braking performance, because it reduces the friction between the tires and the surface of the runway. It also creates a layer of fluid between the tires and the runway surface, and reduces the contact area. The landing distances, indicated in the QRH, provide a good assessment of the real landing distances for specific levels of contamination.

A firm touchdown should be made and MAX reverse should be selected, as soon as the main landing gear is on ground. Using reversers on a runway that is contaminated with dry snow may reduce visibility, particularly at low speeds. In such cases, reverse thrust should be reduced to idle, if necessary.

The use of MED auto-brake is recommended, when landing on an evenly contaminated runway. It is possible that the DECEL light on the AUTO BRK panel will not come on, as the predetermined deceleration may not be achieved. This does not mean that the auto-brake is not working.

In the case of uneven contamination on a wet or contaminated runway, the autobrake may laterally destabilize the aircraft. If this occurs, consider deselecting the autobrake.

TYPICAL LANDING DISTANCE FACTORS VERSUS RUNWAY CONDITION

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## DIRECTIONAL CONTROL

During rollout, the sidestick must be centered. This prevents asymmetric wheel loading, that results in asymmetric braking and increases the weathercock tendency of the aircraft.

The rudder should be used for directional control after touchdown, in the same way as for a normal landing. Use of the tiller must be avoided above taxi speed, because it may result in nosewheel skidding, and lead to a loss of directional control.

When required, differential braking must be applied by completely releasing the pedal on the side that is opposite to the expected direction of the turn. This is because, on a slippery runway, the same braking effect may be produced by a full or half-deflection of the pedal.

Landing on a contaminated runway in crosswind requires careful consideration. In such a case, directional control problems are caused by two different factors:

. If the aircraft touches down with some crab and the reverse thrust is selected, the side force component of reverse adds to the crosswind component and causes the aircraft to drift to the downwind side of the runway.

. As the braking efficiency increases, the cornering force of the main wheels decreases. This adds to any problems there may be with directional control.

If there is a problem with directional control:

- Reverse thrust should be set to idle, in order to reduce the reverse thrust side-force component.
- The brakes should be released, in order to increase the cornering force.
- The pilot should return to the runway centerline, reselect reverse thrust, and resume braking (Ref. FCTM 02.160).

The concept of equivalent runway condition is used to determine the maximum crosswind limitation. The following table indicates the maximum recommended crosswinds related to the reported braking actions:

| **Reported Braking Action** | **Reported Runway Friction Coefficient** | **Equivalent Runway Condition** | **Maximum Crosswind** (knots) |
|---|---|---|---|
| Good/Medium | 0.39 to 0.36 | 1 | 29 |
| Medium | 0.35 to 0.3 | 2/3 | 25 |
| Medium/Poor | 0.29 to 0.26 | 2/3 | 20 |
| Poor | $\leq$0.25 | 3/4 | 15 |
| Unreliable | - | 4/5 | 5 |

## TAXI IN

During taxi-in, after landing, the flaps/slats should not be retracted. This is because retraction could cause damage, by crushing any ice that is in the slots of the slats. When the aircraft arrives at the gate, and the engines are stopped, a visual inspection should be performed to check that the slats/flaps areas are free of contamination. They may then be retracted, with the electric pumps.

## PARKING

At the end of the flight, in extreme cold conditions, cold soak protection is requested when a longer stop over is expected.

# TURBULENCE

ALL

## PREFACE

The flight crew must use weather reports and charts to determine the location and altitude of possible CBS, storms, and Clear Air Turbulence (CAT). If turbulence is expected, the flight crew must turn on the seatbelt signs, in order to prepare passengers and prevent injury.

## TAKE-OFF

For takeoff in high turbulence, the flight crew must wait for the target speed + 20 knots (limited to VFE-5) before retracting the slats/flaps (e.g. the flight crew must wait for F+20 knots before setting Flaps 1).

## IN FLIGHT

### USE OF RADAR

Areas of known turbulence, associated with CBS, must be avoided. Good management of the radar tilt is essential, in order to accurately assess and evaluate the vertical development of CBS. Usually, the gain should be left in AUTO. However, selective use of manual gain may help to assess the general weather conditions. Manual gain is particularly useful, when operating in heavy rain, if the radar picture is saturated. In this case, reduced gain will help the flight crew to identify the areas of heaviest rainfall, that are usually associated with active CB cells. After using manual gain, it should be reset to AUTO, in order to recover optimum radar sensitivity. A weak echo should not be a reason for the flight crew to underestimate a CB, because only the wet parts of the CB are detected. The decision to avoid a CB must be taken as early as possible, and lateral avoidance should, ideally, be at 20 nautical miles upwind.

### USE OF AP AND A/THR

If moderate turbulence is encountered, the flight crew should set the AP and A/THR to ON with managed speed.

If severe turbulence is encountered, the flight crew should keep the AP engaged. Thrust levers should be set to turbulence N1 (Refer to QRH), and the A/THR should then be disconnected. Use of the A/THR is, however, recommended during approach, in order to benefit from the GS mini.

If the aircraft is flown manually, the flight crew should be aware of the fact that flight control laws are designed to cope with turbulence. Therefore, they should avoid the temptation to fight turbulence, and should not over-control the sidestick.

## VMO/MMO EXCEEDANCE

In turbulence, during climb, cruise or descent, the aircraft may slightly exceed VMO/MMO with the autopilot (AP) engaged.

To prevent such an exceedance, adapt speed or Mach target.

If severe turbulence is known or forecasted, consider the use of turbulence speed.

If the current speed is close to the VMO (maximum operating speed), monitor the speed trend symbol on the PFD.

If the speed trend reaches, or slightly exceeds, the VMO limit:

. Use the FCU immediately to select a lower speed target.

If the speed trend significantly exceeds the VMO red band, without high speed protection activation:

. Select a lower target speed on the FCU and, if the aircraft continues to accelerate, consider disconnecting the AP.

. Before re-engaging the AP, smoothly establish a shallower pitch attitude.

If the aircraft accelerates above VMO with the AP engaged, the AP will disengage on reaching the high speed protection. The high speed protection will apply a nose-up order up to 1.75 g, in addition to pilot input during VMO recovery. Therefore, make a smooth pitch correction in order to recover proper speed.

Speedbrakes may be used in case of high speed exceedance, but the flight crew should be aware of pitch influence. In addition, speedbrakes will be used with caution, close to the ceiling.

High Speed Protection may also result in activation of the angle of attack protection. Depending on the ELAC standard, the crew may have to push on the stick to get out of this protection law.

In all events, check the AP engagement status, and re-engage it when appropriate. It may have tripped and the associated aural warning may have been superseded by the overspeed aural warning.

## CONSIDERATIONS ON CAT

Clear Air Turbulence (CAT) can be expected by referring to weather charts and pilot reports. However, the radar cannot detect CAT, because it is "dry turbulence".

If CAT is encountered, the flight crew may consider avoiding it vertically, keeping in mind that the buffet margin reduces as the altitude increases.

**MISCELLANEOUS**

. The flight crew must set the harness to on, check that the seat belts signs are on and use all white lights in thunderstorms.

. Turbulence speeds are indicated in the QRH.

. It is not necessary to set the ENG START selector to IGN. In the case of an engine flameout, the igniters will trigger automatically.

## WINDSHEAR

ALL

### BACKGROUND INFORMATION

**WINSHEAR PHENOMENON**

The windshear is mostly due to cool shaft of air, like a cylinder between 0.5 NM and 1.5 NM width that is moving downward. When the air encounters the ground:

. Mushrooms horizontally, causing horizontal wind gradient

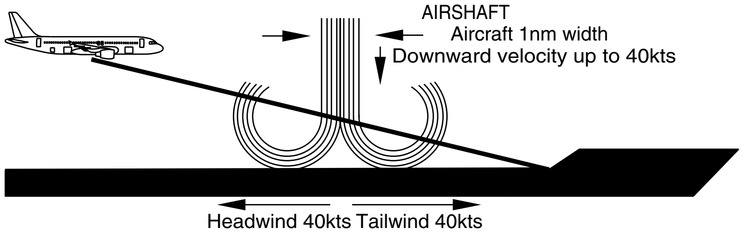
. Curls inward at the edges, causing vertical air mass movement.

Flight safety is affected, because:

. Horizontal wind gradient significantly affects lift, causing the aircraft to descend or to reach very high AOA.

. Vertical air mass movement severely affect the aircraft flight path.

WINDSHEAR PHENOMENON

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## AWARENESS AND AVOIDANCE

Awareness of the weather conditions that causewindshear will reduce the risk of an encounter. Studying meteorological reports and listening to tower reports will help the flight crew to assess the weather conditions that are to be expected during takeoff or landing.

If a windshear encounter is likely, the takeoff or landing should be delayed until the conditions improve, e.g. until a thunderstorm has cleared the airport.

## STRATEGY TO COPE WITH WINDSHEAR

The windshear and microburst are hazardous phenomena for an aircraft at take-off or landing. The strategy to cope with windshear is:

. **Increasing flight crew awareness** through the Predictive Windshear System (if available)

. **Informing the flight crew** of unexpected air mass variations through FPV and approach speed variations

. **Warning the flight crew** of significant loss of energy through "SPEED, SPEED" and "WINDSHEAR" aural warnings (if available).

. **Providing effective tools** to escape the shear through ALPHA FLOOR protection, SRS pitch order, high AOA protection and Ground Speed mini protection.

Increasing flight crew awareness (if available)

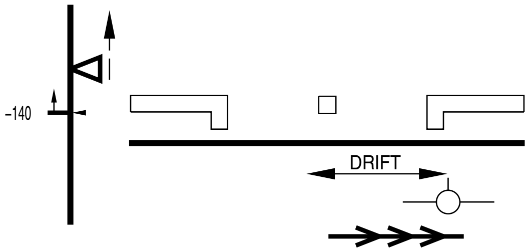
When the airshaft of a microburst reaches the ground, it mushrooms outward carrying with it a large number of falling rain droplets. The radar can measure speed variations of the droplets, and as a result, assess wind variations. This redictive capability to assess wind variations is performed by the Predictive Windshear System (PWS). The PWS operates automatically below 2300 ft AGL, regardless of whether the radar is turned on or off. OFF.

Informing flight crew

The FPV associated with the approach speed variations (GS mini protection) is an effective means for informing the flight crew of unexpected air mass variations:

Approach speed variations and lateral FPV displacement reflect horizontal wind gradient. Vertical FPV displacement reflects the vertical air mass movement.

BIRD AND TARGET SPEED - WIND INTERPRETATION

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Warning the flight crew

The "SPEED, SPEED" low energy warning (if available) is based on the aircraft speed, acceleration and flight path angle. This warning attracts the PF eyes to the speed scale, and request rapid thrust adjustment. In windshear conditions, it is the first warning to appear, before the activation of the alpha floor. The following table provides some typical values of the speed at which the warning could occur in two different circumstances.

| Deceleration Rate | Flight Path Angle | Warning |
|---|---|---|
| -1 knots/second | -3 ° | VLS - 7 knots |
| -1 knots/second | -4 ° | VLS - 1 knots |

In addition, the aircraft has a reactive windshear warning system. This system triggers if the aircraft encounters windshear. In such a case, there is a "WINDSHEAR WINDSHEAR WINDSHEAR" aural warning.

Providing effictive tools

There are three efficient tools to assist the flight crew to escape:

. The alpha floor protection

. THE SRS AP/FD pitch law

. The high angle of attack protection

When the alpha floor protection is triggered, the A/THR triggers TOGA on all engines. The FMA displays A.FLOOR, that changes to TOGA LK, when the aircraft angle-of-attack has decreased. TOGA/LK can only be deselected by turning the A/THR off.

The SRS pitch mode ensures the best aircraft climb performance. Therefore, the procedure requests following the SRS pitch bar and possibly full aft stick, in order to follow the SRS orders and minimize the loss of height.

The high angle-of-attack protection enables the PF to safely pull full aft stick, if needed, in order to follow the SRS pitch order, or to rapidly counteract a down movement. This provides maximum lift and minimum drag, by automatically retracting the speed brakes, if they are extended.

## OPERATIONAL RECOMMENDATIONS

### TAKE-OFF

Predictive windshear ("WINDSHEAR AHEAD" aural warning), if available

If predictive windshear aural warning is generated on the runway before take-off, take-off must be delayed.

If a predictive windshear aural warning is generated during the takeoff roll, the Captain must reject the takeoff (the aural warning is inhibited at speeds greater than 100 knots).

If the predictive windshear aural warning is generated during initial climb, the flight crew must:

- Set TOGA
- Closely monitor the speed and the speed trend
- Ensure that the flight path does not include areas with suspected shear
- Change the aircraft configuration, provided that the aircraft does not enter windshear.

Reactive windshear (WINSHEAR, WINSHEAR, WINSHEAR aural warning) or windshear detected by pilot observation

If the windshear starts before V1 with significant speed and speed trend variations and the captain decides that there is sufficient runway to stop the airplane, the captain must initiate a rejected take-off.

If the windshear starts after V1, the crew will set TOGA and will apply the QRH checklist actions from memory. The following points should be stressed:

- The configuration should not be changed until definitely out of the shear, because operating the landing gear doors causes additional drag.

. The PF must fly SRS pitch orders rapidly and smoothly, but not aggressively, and must consider the use of full backstick, if necessary, to minimize height loss.

. The PNF should call wind variation from the ND and V/S and, when clear of the shear, report the encounter to ATC.

**APPROACH**

Predictive windshear (if available)

In case the "MONITOR RADAR DISPLAY" is displayed or the ADVISORY ICON appears, the flight crew should either delay the approach or divert to another airport. However, if the approach is continued, the flight crew should consider the following:

. The weather severity must be assessed with the radar display.

. A more appropriate runway must be considered.

. A Conf 3 landing should be considered.

. The flight crew should increase VAPP displayed on MCDU PERF APP page up to a maximum VLS +15 kts.

. Using the TRK/FPA or ILS, for an earlier detection of vertical path deviation should be considered.

. In very difficult weather conditions, the A/THR response time may not be sufficient to manage the instantaneous loss of airspeed. The applicable technique is described in FCTM 02.100 - USE OF A/THR.

. In case the "GO AROUND WINDSHEAR AHEAD" message is triggered, the PF must set TOGA for go-around. The aircraft configuration can be changed, provided that the windshear is not entered. Full back stick should be applied, if required, to follow the SRS or minimize loss of height.

Reactive windshear (if available)

In case of the "WINDSHEAR WINDSHEAR WINDSHEAR" aural warning, the PF must set TOGA for go-around. However, the configuration (slats/flaps, gear) must not be changed until out of the shear. The flight crew must closely monitor the flight path and speed.

## VOLCANIC ASH

ALL

## PREFACE

Volcanic ash or dust consists of very abrasive particles, that may cause engine surge and severe damage to aircraft surfaces that are exposed to the airflow. For this reason, operations in volcanic ash must be avoided. However, if such operations cannot be avoided, the operators should apply the following recommendations.

## GROUND OPERATIONS

### PRELIMINARY COCKPIT PREPARATION

The use of APU should be avoided whenever possible and the use of the Ground Power Unit (GPU) should be preferred.

The wipers will not be used for any reason.

### EXTERIOR INSPECTION

Maintenance personnel must remove ash that has settled on exposed lubricated surfaces that can penetrate seals or enter the engine gas path, air conditioning system, air data probes and other orifices on the aircraft. They must clean the engines air inlet of any volcanic ash. In addition, they must clean the 25-feet area around the engine inlet.

### ENGINE START

The use of an external pneumatic supply should be preferred when possible. If not possible, the APU may be used to start the engines.

Before starting the engines, the crew must use dry cranking. This will blow out any ash that may have entered the booster area.

### TAXI

The flight crew must move forward the thrust levers smoothly to the minimum required thrust to taxi, and must avoid any sharp or high-speed turns. The bleeds must be kept OFF.

### TAKE-OFF

It is advisable to use the rolling takeoff technique, and apply smooth thrust.

## IN FLIGHT

### CRUISE

The flight crew must avoid flying into areas of known volcanic ash. If a volcanic eruption is reported, while the aircraft is in flight, the flight must be rerouted to remain clear of the affected area. The volcanic dust may spread over several hundred miles. Whenever possible, the flight crew should stay on the upwind side of the volcano.

Depending on outside conditions (night flight, clouds), volcanic dust might not be visible. However, several phenomena can indicate that the aircraft is flying through ash cloud, for example:

- Smoke or dust in the cockpit
- Acrid odour similar to electrical smoke
- Engine malfunction, e.g. a rising EGT
- At night, the appearance of St Elmo fire, bright white or orange glow appearing in engine inlets or sharp and distinct beams from the landing lights.

If an ash cloud is encountered, the applicable procedure is described in the QRH. The essential actions to be taken are:

- 180° turn if possible. This is the quickest way to escape, because the ash cloud lateral dimension is not known
- Protecting the engines:
  - Set A/THR to OFF
  - Decrease engines thrust if possible and maximize engine bleed to increase the engine surge margin
  - Start the APU for further engine restart, if required
- Protecting the flight crew and passengers:
  - Don the oxygen mask
  - Consider oxygen for the passengers.
- Monitoring the flight parameters:
  - Monitor the EGT and fuel flow, because an engine part may be eroded
  - Monitor and cross-check the IAS because an IAS indication may be corrupted

A diversion to the nearest appropriate airport should be considered.

### LANDING

The use of reverse should be avoided, unless necessary.

## GENERAL

ALL

Two flying references may be used on the PFD:

. The attitude

. The Flight Path Vector (FPV), called the "bird".

The pilot selects the flight reference with the HDG/VS TRK/FPA p/b on the FCU.

## THE ATTITUDE

ALL

When HDG/VS is selected on the FCU, "bird" is off, and the attitude is the flight reference with HDG and VS as basic guidance parameters.

The attitude flight reference should be used for dynamic manoeuvres, for example, take-off or go-around. An action on the sidestick has an immediate effect on the aircraft attitude. The flight crew can monitor this flight reference directly and accurately during these maneuvers.

## THE FLIGHT PATH VECTOR

ALL

When TRK/FPA is selected on the FCU, the "bird" (the FPV) is the flight reference with the TRK and FPA as basic guidance parameters.

In dynamic manoeuvres, the "bird" is directly affected by the aircraft inertia and had a delayed reaction. As a result, the "bird" should not be used as a flight reference in dynamic manoeuvres.

The "bird" is the flying reference that should be used when flying a stabilized segment of trajectory, e.g. a non Precision Approach or visual circuit.

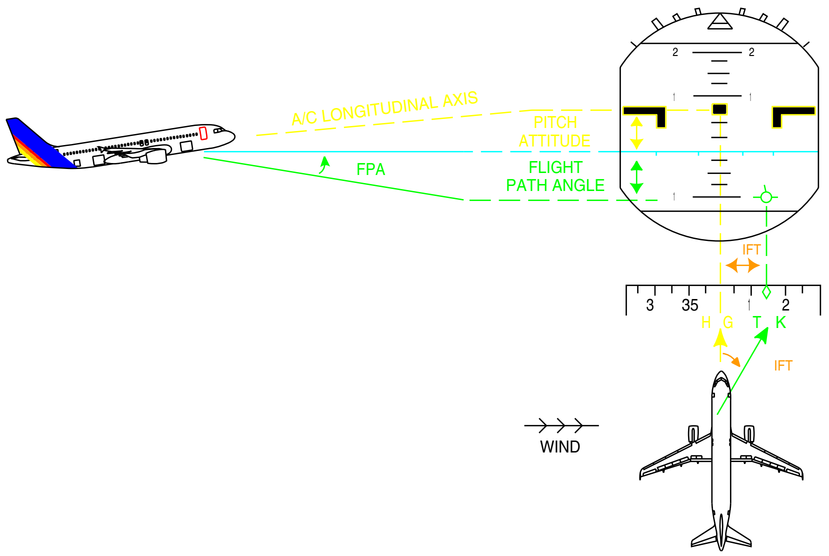
## INFORMATION PRESENTATION

The FPV appears on the PFD as a symbol, known as "the bird". The bird indicates the track and flight path angle in relation to the ground.

The track is indicated on the PFD by a green diamond on the compass, in addition to the lateral movement of the bird in relation to the fixed aircraft symbol. On the ND, the track is indicated by a green diamond on the compass scale. The difference in angle between track and heading indicates the drift.

The flight path angle is indicated on the PFD by the vertical movement of the bird in relation to the pitch scale.

USE OF FPV

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With the flight directors (FDs) selected ON, the Flight Path Director (FPD) replaces the HDG-VS Flight Director (FD). With both FDs pb set to off, the blue track index appears on the PFD horizon.

## PRACTICAL USES OF THE FPV

As a general rule, when using the bird, the pilot should first change attitude, and then check the result with reference to the bird.

## NON-PRECISION APPROACH

The FPV is particularly useful for non-precision approaches. The pilot can select values for the inbound track and final descent path angle on the FCU. Once established inbound, only minor corrections should be required to maintain an accurate approach path. The pilot can monitor the tracking and descent flight path, with reference to the track indicator and the bird.

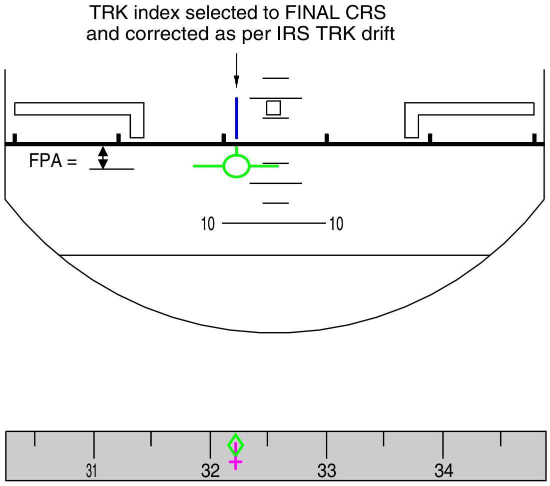
However, pilots should understand that the bird only indicates a flight path angle and track, and does not provide guidance to a ground-based radio facility. Therefore, even if the bird indicates that the aircraft is flying with the correct flight path angle and track, this does not necessarily mean that the aircraft is on the correct final approach path.

## VISUAL CIRCUITS

The FPV can be used as a cross-reference, when flying visual circuits. On the downwind leg, the pilot should position the wings of the bird on the horizon, in order to maintain level flight. The downwind track should be set on the FCU. The pilot should position the tail of the bird on the blue track index on the PFD , in order to maintain the desired track downwind.

On the final inbound approach, the track index should be set to the final approach course of the runway. A standard 3° approach path is indicated, when the top of the bird's tail is immediately below the horizon, and the bottom of the bird is immediately above the 5° nose down marker.

<u>USE OF FPV IN FINAL APPROACH</u>

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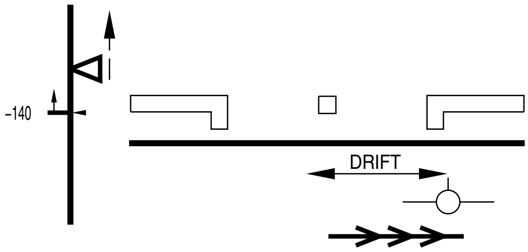
**FINAL APPROACH**

The bird is a very useful flight reference, because it provides the trajectory parameters, and quickly warns the pilot of downburst. In addition, together with the GS MINI protection, it is an excellent indicator of shears or wind variations. If nothing else, the position of the "bird" in relation to the fixed aircraft symbol provides an immediate indication of the wind direction. Therefore, when approaching the minima, the pilot knows in which direction to search for the runway.

The target approach speed symbol moves upward, indicating that there is headwind gust. The bird drifts to the right, indicating that there is wind from the left.

BIRD AND TARGET SPEED- WIND INTERPRETATION

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## RELIABILITY

The FPV is computed from IRS data, therefore, it is affected by ADIRS errors. An error may be indicated by a small track error, usually of up to ± 2°. This can be easily determined during the approach.

The FPV is also computed from static pressure information. Therefore, the bird must be considered as not reliable, if altitude information is not reliable.

## GO-AROUND

MSN 0022-0032 0034-0035 0037-0038 0040-0041 0043 0045-0051 0056-0058 0069-0072 0074-0075 0078-0080 0083 0085-0086 0088-0090 0093-0097 0104 0110-0111 0113-0114 0116-0119 0121 0123-0125 0132 0135 0137-0140 0142 0147-0148 0151-0153 0157 0160-0164 0167-0172 0179-0180 0189-0190 0192-0193 0196-0197 0200-0202 0205-0206 0208-0209 0212-0213 0216-0219 0221-0222 0225 0229-0230 0245 0247 0252 0256-0263 0267-0269 0272-0273 0275-0276 0280-0282 0288 0291-0301 0304 0306-0308 0313-0314 0316 0318-0322 0326-0329 0331-0332 0336 0338-0340 0343-0349 0353-0355 0357-0358 0360-0365 0367-0373 0376 0379-0383 0385-0394 0396-0402 0405-0406 0408 0410-0418 0420 0422-0425 0428-0432 0435-0437 0439 0441-0444 0446-0447 0449-0452 0454 0456-0458 0460-0465 0467-0470 0472-0476 0478-0479 0482-0487 0489-0490 0492-0493 0496 0499-0508 0510-0512 0518 0523 0525 0528 0530-0531 0534 0538-0539 0542 0549 0554 0558 0560-0561 0563-0564 0567-0569 0571 0575 0579-0580 0587 0589-0590 0592 0594-0595 0597 0601 0604-0605 0607 0609-0611 0613-0617 0619 0622-0624 0626-0628 0630 0634 0636 0638-0639 0641 0645 0648-0652 0655 0658-0659 0662 0665-0667 0669 0671 0677-0679 0683 0685-0686 0689-0690 0692 0694 0696 0698-0700 0702 0704-0706 0709-0710 0712 0717-0718 0720 0722-0724 0726 0729 0731 0737-0739 0743-0745 0748-0749 0751 0753-0754 0759 0766-0767 0772 0775 0778 0780 0783 0786-0789 0792 0798-0799 0801-0802 0804 0807 0811 0814 0818 0820 0824-0826 0828 0830 0832-0834 0836 0838 0842-0843 0846-0847 0849-0854 0857-0860 0862 0865 0867 0869 0871 0873-0876 0879-0883 0886-0888 0893 0895 0897-0898 0900-0901 0903 0907 0909 0911 0913-0914 0916 0918 0921 0923 0925 0939 0944 0948 0950 0952 0954-0955 0958 0962-0967 0975 0980-0981 0984 0986 0988-0990 0996 1001 1004-1006 1008-1009 1011 1017 1022 1029 1031-1032 1035 1037 1039 1041-1042 1057-1058 1062 1071-1072 1076 1078 1085 1090-1091 1093 1108 1117 1126 1129 1131 1149 1164-1165 1167 1187 1191 1194-1196 1199 1204 1218 1227 1230 1249 1316 1324-1325 1345-1346 1392 1408 1414 1421 1434 1438 1453 1456 1459 1479 1483 1487 1498 1501 1520 1535 1543 1549 1567 1570 1582 1633 1641 1646 1659 1662 1683 1685 1693 1700 1709 1714 1738 1746 1752 1766 1774 1789 1796 1800 1810 1812 1815 1819-1820 1824 1828 1833 1839 1870 1875 1897 1923 1959 1976 1982 1990 2002 2013 2026 2028 2039 2047 2082 2087 2092 2095 2369 2373 2464 2474 2618 2641

For the go-around, the appropriate flight reference is the attitude, because go-around is a dynamic maneuver. Therefore, if the "bird" is on, the PF will ask the PNF to select HDG/VS, in order to recover the FD bars.

MSN 0002-0021 0033 0036 0039 0042 0044 0052-0055 0059-0068 0073 0076-0077 0081-0082 0084 0087 0091 0098-0103 0108-0109 0112 0115 0120 0122 0126-0131 0133-0134 0136 0141 0143-0146 0149-0150 0154-0156 0158-0159 0165-0166 0173-0178 0181-0188 0191 0194-0195 0198-0199 0203-0204 0207 0210-0211 0214-0215 0220 0223-0224 0226-0228 0231-0244 0246 0248-0251 0253-0255 0264-0266 0270 0274 0277-0279 0283-0287 0289-0290 0302-0303 0305 0309-0312 0315 0317 0323-0325 0330 0333-0335 0337 0341-0342 0350-0352 0356 0359 0366 0375 0377-0378 0384 0395 0403-0404 0407 0409 0419 0421 0426-0427 0434 0438 0440 0445 0448 0453 0455 0459 0466 0471 0477 0480 0488 0491 0494-0495 0497-0498 0509 0513-0517 0519-0522 0524 0526-0527 0529 0532-0533 0535-0537 0540-0541 0543-0548 0550-0553 0555-0557 0559 0562 0565-0566 0570 0572-0574 0576-0578 0581-0586 0588 0591 0593 0596 0598-0600 0603 0606 0608 0612 0618 0620-0621 0625 0629 0631-0633 0635 0637 0640 0642-0644 0646-0647 0653-0654 0656-0657 0660-0661 0663-0664 0668 0670 0672-0676 0680-0682 0684 0687-0688 0691 0693 0695 0697 0701 0703 0707 0711 0713-0716 0719 0721 0725 0727-0728 0730 0732-0736 0740-0742 0746-0747 0750 0752 0755-0758 0760-0765 0768-0771 0773-0774 0776-0777 0779 0781-0782 0784-0785 0790-0791 0793-0797 0800 0803 0805-0806 0808-0810 0812-0813 0815-0817 0819 0821-0823 0827 0829 0831 0835 0837 0839-0841 0844-0845 0848 0855-0856 0861 0863-0864 0866 0868 0870 0872 0877-0878 0884-0885 0889-0892 0894 0896 0899 0902 0904-0906 0908 0910 0912 0915 0917 0919-0920 0922 0924 0926-0938 0940-0943 0945-0947 0949 0951 0953 0956-0957 0959-0961 0968-0974 0976-0979 0982-0983 0985 0987 0991-0995 0997-1000 1002-1003 1007 1010 1012-1016 1018-1021 1023-1028 1030 1033-1034 1036 1038 1040 1043-1056 1059-1061 1063-1070 1073-1075 1077 1079-1084 1086-1089 1092 1094-1107 1109-1116 1118-1125 1127-1128 1130 1132-1148 1150-1163 1166 1168-1185 1188-1190 1192-1193 1197-1198 1200-1203 1205-1217 1219-1226 1228-1229 1231-1248 1250-1315 1317-1323 1326-1344 1347-1391 1393-1407 1409-1413 1415-1420 1422-1433 1435-1437 1439-1452 1454-1455 1457-1458 1460-1478 1480-1482 1484-1486 1488-1497 1499-1500 1502-1519 1521-1534 1536-1542 1544-1548 1550-1566 1568-1569 1571-1581 1583-1632 1634-1640 1642-1645 1647-1658 1660-1661 1663-1682 1684 1686-1692 1694-1699 1701-1708 1710-1713 1715-1737 1739-1745 1747-1751 1753-1765 1767-1773 1775-1788 1790-1795 1797-1799 1801-1809 1811 1814 1816-1818 1821-1823 1825-1827 1829-1832 1834-1838 1840-1869 1871-1874 1876-1896 1898-1922 1924-1958 1960-1975 1977-1981 1983-1989 1991-2001 2003-2012 2014-2024 2027 2029-2038 2040-2046 2048-2081 2083-2086 2088-2091 2093-2094 2096-2368 2370-2372 2374-2463 2465-2473 2475-2617 2619-2640 2642-3260

For the go-around, the appropriate flight reference is the attitude, because go-around is a dynamic maneuver. Therefore, when performing a go-around, regardless of the previously-selected flight reference, upon selection of TOGA, the FD bars are automatically restored in SRS/GA TRK modes, and the "bird" is automatically removed.

## GENERAL

ALL

The primary function of the FMS is navigation i.e. to compute the aircraft's position as accurately as possible. The validity of all the others functions depends upon the accuracy of the FMS position.

The accuracy of the FMS navigation determines the flight crew's strategy for using the AP/FD modes, in addition to the ND display.

## AIRCRAFT POSITION COMPUTATION

ALL

### WITHOUT GPS PRIMARY

#### PRINCIPLE

The FMS position is computed from the three IRS positions, that are combined to provide a MIX IRS position. The radio position is also combined, if two DMEs, a VOR/DME or a GPS supplemental are available. The GPS supplemental is considered to be an additional form of NAVAID, and can be accepted, if it falls within the radio position or the MIX IRS position.

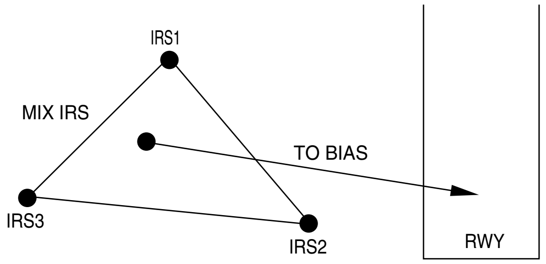
#### INITIALISATION

See FCTM 02.010

#### TAKE-OFF

Each FMGC uses the MIX IRS position as its position, until the thrust levers are pushed forward to TOGA. The FMS position is then updated to the runway threshold coordinates. The difference between the MIX IRS position and the FMS position is referred to as the TO BIAS. The TO BIAS is added to the MIX IRS position, for the subsequent FMS position.

FMS POSITION UPDATING AT TAKE OFF

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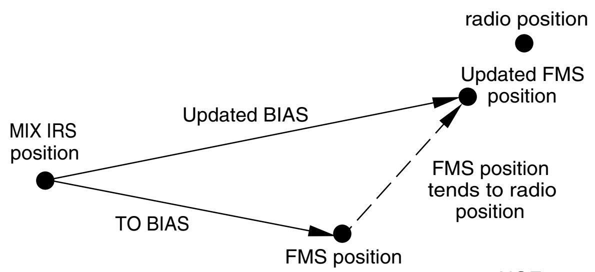
**IN FLIGHT**

The original TO BIAS is continuously updated with the current radio aid.

UPDATING BIAS PRINCIPLE

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If the radio position is lost, the system uses the updated BIAS to determine the FMS position from the MIX IRS position.

**NAVIGATION ACCURACY**

The FMS computes the Estimated Position Error (EPE). The EPE is an estimate. To compute the EPE, the FMS considers the immediately available navigation means in the FMS position computation and applies defined tolerances for each of them. These tolerances assume that the navigation means are working properly. They ignore any possible excessive IRS drift or erroneous locations of navaids. The MCDU PROG page displays the HIGH/LOW indications, according to the EPE. These indications reflect the probable accuracy of the FMS navigation compared to the determined accuracy criteria.

**WITH GPS PRIMARY**

## PRINCIPLE

The GPS interfaces directly with the IRS that outputs a GPIRS position. When a GPIRS position is available, it overrides the RADIO position, if available. Therefore, the FMS position tends toward the GPIRS position.

## INITIALISATION

See FCTM 02.010

## TAKE-OFF

The FM position is automatically updated at the runway threshold. With FMS2, this automatic position update is inhibited.

## IN FLIGHT

The FM position tends to the GPIRS position as long as the GPS satellites are available.

## NAVIGATION ACCURACY

The GPS position is characterized by two parameters:

. integrity

. accuracy

The integrity is a direct function of the number of satellites in view of the aircraft. If five or more satellites are in view, several combinations of the satellite signal may be used to process "several positions" and to carry out reasonableness tests on the satellite signals themselves.

Accuracy functions in direct connection with the satellite constellation in view of the aircraft. If the satellites are low on horizon, or not in appropriate positions, accuracy will be poor. It is provided as a "figure of merit".

If the GPS position fulfils both the integrity and the accuracy criteria, GPS PRIMARY is displayed on the MCDU PROG page and the GPS position is the best raw data position available.

## SUMMARY

| | FM POSITION | |
|---|---|---|
| Flight phase | WITHOUT GPS PRIMARY | WITH GPS PRIMARY |

| | | | |
|---|---|---|---|
| On groundbefore Takeoff | | MIX IRS | GP IRS |
| Takeoff | | Updated at runway threshold (shift) (*) | |
| In flight | With RADIO | Tends to RADIO | GP IRS |
| | WithoutRADIO | MIX IRS + BIAS | GP IRS |

(*) The FMS position update at take-off is inhibited with FMS2 when GPS PRIMARY is active.

## USE OF FMS

ALL

The navigation accuracy is managed through several MCDU pages:

### PROG PAGE

This page indicates GPS PRIMARY.

The PROG displays the estimated navigation accuracy in green. This provides the EPE, if GPS PRIMARY LOST, or is computed by the GPS, if GPS PRIMARY is displayed

The PROG page displays the required navigation accuracy in blue (this can be changed). The required navigation accuracy thresholds are determined, depending on the flight phase, or can be manually entered. These thresholds are used to change from HIGH to LOW accuracy, or vice versa. These indications are used when flying within RNP airspace.

### SELECTED NAVAIDS PAGE

The SELECTED NAVAID page is accessible from DATA/POSITION MONITOR/ FREEZE/SEL NAVAIDS. It has a DESELECT prompt, that enables the flight crew to prevent the FMS from using the GPS data to compute the position, in the case of a major problem. GPS PRIMARY lost is then displayed on MCDU and ND. The GPS can be reselected using the same page.

### PREDICTIVE GPS PAGE (IRS HONEYWELL ONLY)

The PREDICTIVE GPS page is accessible from PROG page. The GPS PRIMARY criteria depend upon the satellite constellation status (position and number) and this is predictable. The crew can assess the GPS PRIMARY status at destination or alternate.

## ND/MCDU

A GPS PRIMARY message is displayed when GPS PRIMARY is again available. This message is clearable.

A GPS PRIMARY LOST message is displayed when GPS PRIMARY is lost. This message is clearable on MCDU but not on ND.

When the class of navigation accuracy is downgraded from HIGH to LOW (LOW to HIGH), a NAV ACCUR DOWNGRADE (UPGRADE) is displayed on ND and MCDU.

# AIRCRAFT POSITION AWARENESS AND OPERATIONAL CONSEQUENCES

ALL

## NAVIGATION ACCURACY INDICATIONS

The navigation accuracy indications are available on the MCDU PROG page. The following guidelines apply:

. If GPS PRIMARY is displayed, no navigation cross-check is required

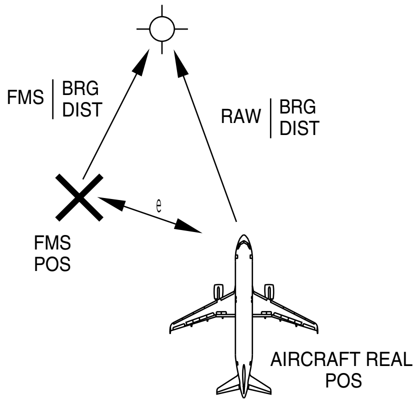
. If GPS PRIMARY LOST, navigation cross-check is required in climb, in cruise, about every 45 mn, before Top Of Descent, reaching TMA and IAF and whenever a navigation doubt occurs.

. The crew will use, IRS only, LOW and NAV ACCY DNGRADED messages as indications to trigger a navigation accuracy check.

## NAVIGATION ACCURACY CROSSCHECK TECHNIQUE

The principle consists in comparing the FMS position with the RADIO position (aircraft real position).

### NAVIGATION ACCURACY CROSS CHECK TECHNIQUE 1

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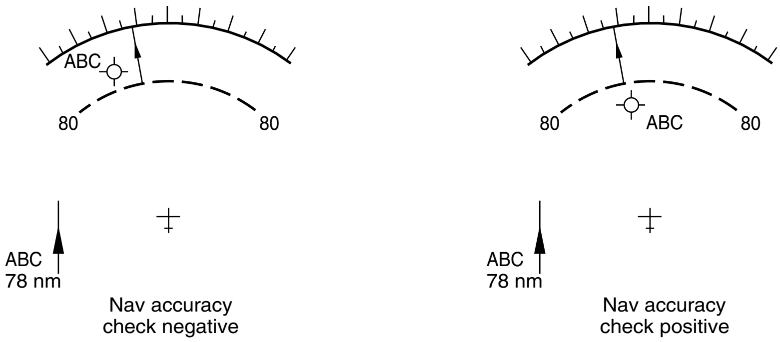
Two different techniques may be used:

. Either the crew will insert a radio ident in MCDU PROG page (which provides a bearing/distance relative to FMS position) and will compare with raw data received from the navaid which materializes the aircraft real position. This allows the error Epsilon to be quantified.

. On the ND, the flight crew compares: The position of the needle and its associated DME distance (the real position of the aircraft) with the position of the navaid symbol and its associated distance, indicated by the range markers (these markers provide a bearing/distance, in relation to the FMS position).

NAVIGATION ACCURACY CROSS CHECK TECHNIQUE 2

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## OPERATIONAL CONSEQUENCES

The result of the navigation accuracy crosscheck dictates the strategy the pilot will apply for the use of the ND display, the AP/FD modes, and EGPWS.

<table>
<tr><th colspan="3" rowspan="2"></th><th colspan="2">ND</th><th rowspan="2">AP/FD mode</th><th rowspan="2">EGPWS</th></tr>
<tr><th>PF</th><th>PNF</th></tr>
<tr><td colspan="2">GPS PRIMARY</td><td>-</td><td colspan="2">Arc or Rose NAV with raw data when required</td><td>Lateral and vertical managed modes</td><td>ON</td></tr>
<tr><td rowspan="4">GPS PRI-MARY LOST Or No GPS</td><td rowspan="2">Cruise</td><td>Navigation accuracy check positive($\leq$ 3 nm)</td><td colspan="2">Arc or Rose NAV with raw data when required</td><td>Lateral and vertical managed modes</td><td>ON</td></tr>
<tr><td>Navigation accuracy check negative(>3 nm)</td><td colspan="2">ARC or ROSE NAV may be used with care and with raw data</td><td>Lateral and vertical managed modes with care with raw data</td><td>OFF</td></tr>
<tr><td rowspan="2">Ap-proach</td><td>Navigation accuracy check positive($\leq$ 1 nm)</td><td colspan="2">Arc or Rose NAV with raw data</td><td>Lateral and vertical managed modes</td><td>ON</td></tr>
<tr><td>Navigation accuracy check negative(>1 nm)</td><td colspan="2">ROSE VOR or ILS as required</td><td>Lateral and vertical selected modes</td><td>OFF</td></tr>
</table>

(1) A GPS defined Non Precision Approach must be interrupted if GPS PRIMARY LOST message is displayed.

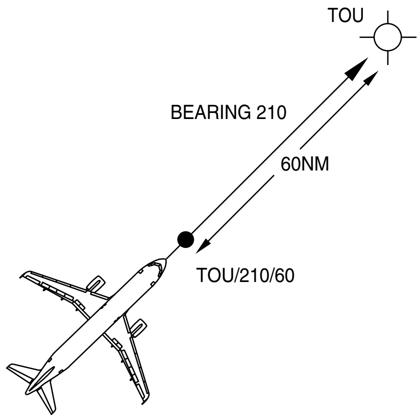
## POSITION UPDATE

In case of an obvious and major map shift noticed by specific messages such as "CHECK A/C POSITION, FM1/FM2 POS MISMATCH", the aircraft position may be updated on the MCDU PROG page. Two techniques are available:

The recommended technique is to carry out a FMS update over a beacon by pressing the UPDATE prompt once estimating that the aircraft overflies the beacon using the associated needle. The potential error induced is approximately 4 to 5 NM. When the position update is achieved, the EPE is automatically set to a higher value and the navigation accuracy is low.

The second technique consists in updating the FM position when flying over a Point/Bearing/Distance (P/B/D) with reference to beacon raw data (Needle + Distance) rather than the beacon itself. The potential for error is far less when the distance is greater than 60 nm. The flight crew will keep in mind the potential 180 degree error on bearing.

FM POSITION UPDATE IN FLIGHT

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## GENERAL

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036-2050 2052-2058 2060-2070 2072-2080 2082-2099 2101-2108 2110-2217 2219-2275 2277-2316 2318-2327 2329-2332 2334-2343 2345-2349 2351-2357 2359-2366 2368-2376 2378-2393 2395-2522 2524-2543 2545-2551 2553-2574 2576-2581 2583-2600 2602-2685 2687-2749 2751-2909 2911-2917 2919-2930 2932-2950 2952-2954 2956-2966 2968-2971 2973-3000 3002-3008 3010-3029 3031-3037 3039-3061 3063-3091 3093-3099 3101-3109 3111-3162 3164-3213 3215 3217 3222 3226-3235 3241-3260

The aircraft Gross Weight (GW) and Centre of Gravity (CG) are computed independently by the FM and FAC:
GW and CG values FM computed are used for:

. FM predictions and speeds

. ECAM (GW)

. MCDU (GW and CG)

GW and CG values FAC computed are used for:

. Flight control laws

. Computation of characteristic speeds (VLS, F, S, GD) for display on PFD

A ZFW or ZFWCG entry error in MCDU INIT B page induces calculation errors that are to be highlighted.

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

The aircraft Gross Weight (GW) and Centre of Gravity (CG) are computed independently by the FM and FAC:
GW and CG values FM computed are used for:

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. ECAM (GW)

. MCDU (GW and CG)

. Computation of characteristic speeds (VLS, F, S, GD) for display on PFD

GW and CG values FAC computed are used for:

. Flight control laws

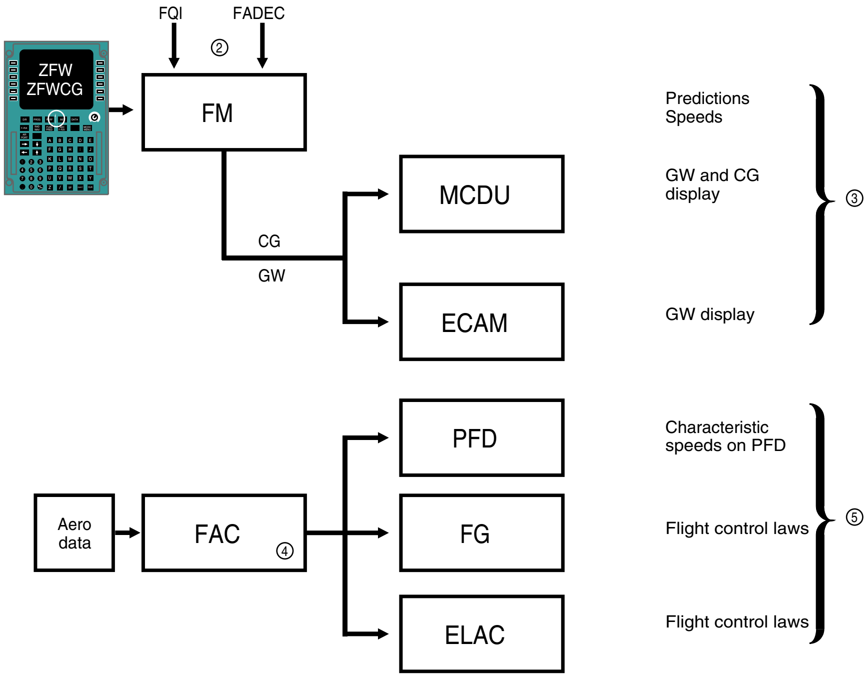
A ZFW or ZFWCG entry error in MCDU INIT B page induces calculation errors that are to be highlighted.

## TECHNICAL BACKGROUND

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036-2050 2052-2058 2060-2070 2072-2080 2082-2099 2101-2108 2110-2217 2219-2275 2277-2316 2318-2327 2329-2332 2334-2343 2345-2349 2351-2357 2359-2366 2368-2376 2378-2393 2395-2522 2524-2543 2545-2551 2553-2574 2576-2581 2583-2600 2602-2685 2687-2749 2751-2909 2911-2917 2919-2930 2932-2950 2952-2954 2956-2966 2968-2971 2973-3000 3002-3008 3010-3029 3031-3037 3039-3061 3063-3091 3093-3099 3101-3109 3111-3162 3164-3213 3215 3217 3222 3226-3235 3241-3260

The GW and CG computation is as follows:

1. The pilot enters the ZFW and ZFWCG in the MCDU INIT B page
2. The FMGC computes the GW and CG from:
   . The ZFW, ZFWCG inserted in the MCDU INIT B page
   . The fuel quantities from the Fuel Quantity Indicator (FQI)
   . The Fuel Flow from the FADEC.
3. This current GW and/or CG is used for:
   . FM predictions and speeds
   . ECAM (GW only)
   . MCDU (GW and CG)
4. The FAC computes its own GW and CG from aerodynamic data.
5. GW and CG FAC computed are used for:
   . Minor adjustments on the flight control laws
   . Characteristic speeds (VLS, F, S, Green dot) display on PFD.

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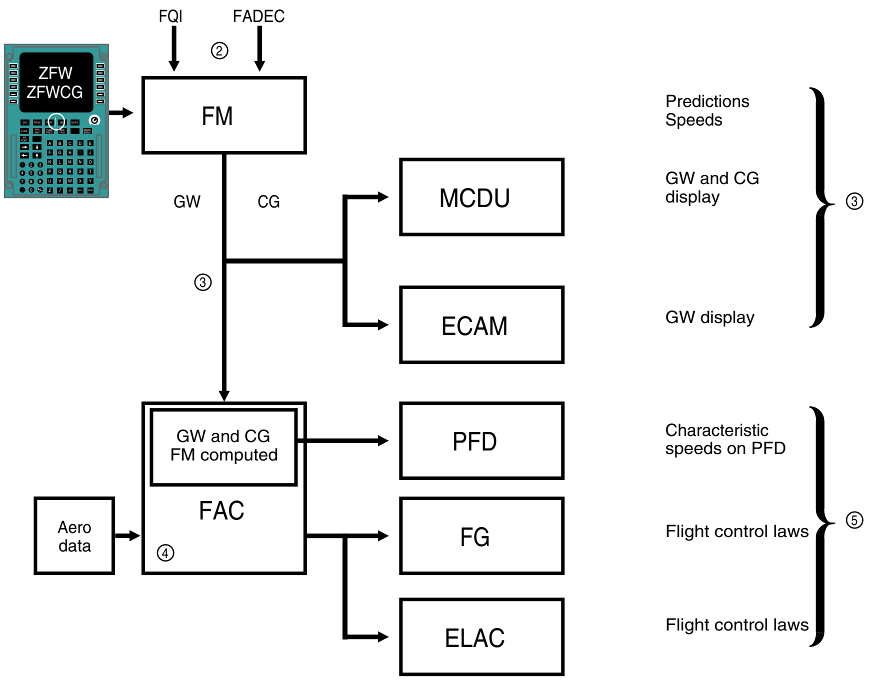
*Note:*

1. *On ground, FAC uses the GW FM computed.*
2. *In flight, at low altitude (below 15000 ft), low speed (below 250 kt) and flight parameters stabilized, GW FAC computed comes from aerodynamic data. If these conditions are not met, GW FAC computed equates to the last memorized GW - fuel used.*
3. *If the GW FM computed and FAC computed differs from a given threshold, a "CHECK GW" message appears on the MCDU scratchpad.*

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

The GW and CG computation is as follows:

1. The pilot enters the ZFW and ZFWCG in the MCDU INIT B page
2. The FMGC computes the GW and CG from:
   . The ZFW, ZFWCG inserted in the MCDU INIT B page
   . The fuel quantities from the Fuel Quantity Indicator (FQI)
   . The Fuel Flow from the FADEC.
3. This current GW and/or CG is used:
   . For FM predictions and speeds
   . For ECAM display (GW only)
   . For MCDU (GW and CG)
   . By FAC for characteristic speed computation for PFD
4. The FAC computes its own GW and CG from aerodynamic data.
5. GW and CG FAC computed are used for:
   . Minor adjustments on the flight control laws

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*Note:*

1. *On ground, FAC takes the GW FM computed*
2. *In flight, at low altitude (below 15000 ft), low speed (below 250 kt) and flight parameters stabilized, GW FAC computed comes from aerodynamic data. If these conditions are not met, GW FAC computed equates to the last memorized GW - fuel used.*
3. *If the GW FM computed and FAC computed differs from a given threshold, a "CHECK GW" message appears on the MCDU scratchpad.*

## ZFW ENTRY ERROR AND OPERATIONAL CONSEQUENCES

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036-2050 2052-2058 2060-2070 2072-2080 2082-2099 2101-2108 2110-2217 2219-2275 2277-2316 2318-2327 2329-2332 2334-2343 2345-2349 2351-2357 2359-2366 2368-2376 2378-2393 2395-2522 2524-2543 2545-2551 2553-2574 2576-2581 2583-2600 2602-2685 2687-2749 2751-2909 2911-2917 2919-2930 2932-2950 2952-2954 2956-2966 2968-2971 2973-3000 3002-3008 3010-3029 3031-3037 3039-3061 3063-3091 3093-3099 3101-3109 3111-3162 3164-3213 3215 3217 3222 3226-3235 3241-3260

If the pilot enters erroneous ZFW on MCDU INIT B page, this will affect as follows:
GW and, to a lesser degree, CG, computed by FM are erroneous. This induces the following consequences:

. The FM predictions and speeds are erroneous

. Incorrect GW and CG on MCDU FUEL PRED page

. Incorrect GW displayed on ECAM
FAC GW, which is based on FM GW on ground, will be updated only once airborne through a specific slow calculation using AOA information. Consequently,

. Characteristic speeds on PFD at take-off are erroneous, but they are correct in flight

. SRS mode guidance is affected if computed VLS is above V2 as inserted in the MCDU PERF TAKE-OFF page.

*Note*:

1. *In flight, if the FM and FAC GW differ from more than several tons, a "CHECK GROSS WEIGHT" message is triggered on the MCDU.*
2. *Valpha prot, Valpha max, Vsw are not affected since based on aerodynamic data.*

## ERRONEOUS FUEL ON BOARD ENTRY

As long as the engines are not started, the FM GW is erroneous and above-mentioned consequences apply. Once the engines are started, the fuel figures are updated and downstream data update accordingly.

It should be noted however, that the FOB on ECAM is correct since it is provided from FQI data.

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

If the pilot enters erroneous ZFW on MCDU INIT B page, this will affect as follows:
GW and, to a lesser degree, CG, computed by FM are erroneous. This induces the following consequences:

. The FM predictions and speeds are erroneous

. Incorrect GW and CG on MCDU FUEL PRED page

. Incorrect GW displayed on ECAM

. Characteristic speeds on PFD are erroneous

. SRS mode guidance is affected if computed VLS is above V2 as inserted in the MCDU PERF TAKE-OFF page.

GW FAC computed, which is based on GW FM computed on ground, will be updated only once airborne through a specific slow calculation using AOA information.

*Note*:

1. *In flight, if the FM and FAC GW differ from more than several tons, a "CHECK GROSS WEIGHT" message is triggered on the MCDU.*
2. *Valpha prot, Vaalpha max, Vsw are not affected since based on aerodynamic data.*

## ERRONEOUS FUEL ON BOARD ENTRY

As long as the engines are not started, the FM GW is erroneous and above-mentioned consequences apply. Once the engines are started, the fuel figures are updated and downstream data update accordingly.

It should be noted however, that the FOB on ECAM is correct since it is provided from FQI data.

## OPERATIONAL RECOMMENDATIONS

MSN 0002-1598 1600-1659 1661-1938 1940-1990 1993-2016 2018-2034 2036-2050 2052-2058 2060-2070 2072-2080 2082-2099 2101-2108 2110-2217 2219-2275 2277-2316 2318-2327 2329-2332 2334-2343 2345-2349 2351-2357 2359-2366 2368-2376 2378-2393 2395-2522 2524-2543 2545-2551 2553-2574 2576-2581 2583-2600 2602-2685 2687-2749 2751-2909 2911-2917 2919-2930 2932-2950 2952-2954 2956-2966 2968-2971 2973-3000 3002-3008 3010-3029 3031-3037 3039-3061 3063-3091 3093-3099 3101-3109 3111-3162 3164-3213 3215 3217 3222 3226-3235 3241-3260

ZFW entries should be cross-checked by both crew members to avoid entry error.

If the "CHECK GW" amber warning is displayed on the MCDU, a significant discrepancy exists between the FM computed GW and the FAC computed GW.

The crew will compare the Load and Trim Sheet (LTS) figures with the FM GW and fuel used:

. If an obvious entry error is detected, FM GW will be updated on the MCDU FUEL PRED page.

. If FM and LTS GW are in accordance and appear to be correct, the FAC computed GW should be suspected. (AOA sensor problem). Consequently, characteristic speeds on PFD are erroneous and should be disregarded. Characteristic speeds should be extracted from QRH.

. If FM and LTS GW are in accordance but LTS GW is suspected, FAC and QRH characteristic speeds should be compared (to validate FAC outputs) and the most appropriate applied.

MSN 1599 1660 1939 1991 2017 2035 2051 2059 2071 2081 2100 2109 2218 2276 2317 2328 2333 2344 2350 2358 2367 2377 2394 2523 2544 2552 2575 2582 2601 2686 2750 2910 2918 2931 2951 2955 2967 2972 3001 3009 3030 3038 3062 3092 3100 3110 3163 3214 3216 3220 3225 3238

ZFW entries should be cross-checked by both crew members to avoid entry error.

If the "CHECK GW" amber warning is displayed on the MCDU, a discrepancy exists between the FM computed GW and the FAC computed GW.

The crew will compare the Load and Trim Sheet (LTS) figures with the FM GW and fuel used:

. If an obvious entry error is detected, FM GW will be updated on the MCDU FUEL PRED page.

. If FM and LTS GW are in accordance and appear to be correct, the FAC computed GW should be suspected. (AOA sensor problem).

. If FM and LTS GW are in accordance but LTS GW is suspected, characteristic speeds should be extracted from QRH.

**NOT APPLICABLE**

## TECHNICAL BACKGROUND

ALL

### GENERAL

A Traffic Alert and Collision Avoidance System (TCAS) provides the flight crew with traffic information and warnings of potential conflicts with vertical avoidance instructions. The TCAS can only detect and indicate other traffic, that is equipped with a transponder.

The ND displays the traffic information, together with:

. The bearing and range to the intruder

. The intruder closure rate

. The relative altitude difference.

If the TCAS considers the intruder to be a potential collision threat, it generates a visual and aural Traffic Advisory (TA). If it considers the intruder to be real collision threat, it generates a visual and aural Resolution Advisory (RA).

### INTRUDER CLASSIFICATION

| Intruder | Display | Type of collision threat | Aural warning | Crew action |
|---|---|---|---|---|
| No threat traffic or others | ◇ ↑ -17(w) | No threat | - | - |
| Proximate | ◆ ↑ -10(w) | Consider as No threat | - | - |
| Traffic Advisory (TA) | ● ↑ -09(a) | Potential threat | "TRAFFIC" | Establish visual contactNo evasive maneuver |

| | | | | | |
|---|---|---|---|---|---|
| Resolution Advisory (RA) | ■ | ↑ | Collision threat | Preventive, e.g."MONITORV/S" | Do not alter your flight path and keep VS out of red sector |
| | -06(r) | | | Corrective, e.g."CLIMB" | Smoothly and firmly (0.25g) follow VSI green sector within 5s. |
| | | | | Corrective, e.g."CLIMB NOW" or "INCREASE CLIMB" | Smoothly and firmly (0.35g) follow VSI green sector within 2.5s |

## OPERATIONAL RECOMMENDATIONS

ALL

### GENERAL

The flight crew must select

. ABV in climb (+ 9 900 feet/ - 2 700 feet)

. ALL in cruise (+ 2 700 feet/ - 2 700 feet)

. BELOW, if the cruise altitude is within 2 000 feet of FL 410, or in descent (+ 2 700feet/ - 9 900 feet)

. THRT in heavy traffic terminal area

. TA, in the case of:
  - Engine failure
  - Flight with landing gear down
  - Known nearby traffic, that is in visual contact
  - Operations at specific airports, and during specific procedures that an operator identifies as having a significant potential for not wanted and not appropriate RAs, e.g. closely spaced parallel runways, converging runways.

If a TA is generated:

. The PF announces: "TCAS, I have controls".

. The PF flies and announces the bearing and distance displayed on his ND.

. The PNF looks outside to get visual contact.

. No evasive maneuver should be initiated, only on the basis of a TA.

If a RA is generated:

. The flight crew must always follow the TCAS RA orders in the correct direction, even:
  - If they contradict the ATC instructions
  - At the maximum ceiling altitude with CLIMB, CLIMB or INCREASE CLIMB, INCREASE CLIMB TCAS RA orders
  - If it results in crossing the altitude of the intruder.

. The PF disconnects the AP, and smoothly and firmly follows the Vertical Speed Indicator (VSI) green sector within 5 seconds, and requests that both FDs be disconnected.

*Note: Both FDs must be disconnected once APs are disconnected:*
  - *To ensure autothrust speed mode*
  - *To avoid possible confusion between FD bar orders and, TCAS aural and VSI orders*

. The PNF disconnects both FDs, but will not try to see intruders.

. The PF will avoid excessive maneuvers, and keep the Vertical Speed outside the red area of the VSI and within the green area. If necessary, the PF must use the full speed range between Valpha max and Vmax.

. The PNF must notify ATC.

. The flight crew should never maneuver in the opposite direction of the RA, because TCAS maneuvers are coordinated.

. In final approach, i.e. "CLIMB", "CLIMB NOW", "INCREASE CLIMB", the flight crew will initiate a go-around.

When clear of conflict:

. The flight crew must resume normal navigation, in accordance with ATC clearance, and using the AP, as required.

## FAA OPERATIONAL RECOMMENDATIONS

The pilots should follow RAs unless they believe it is unsafe to do so or they have definitive visual acquisition of the intruding aircraft. If a pilot makes the decision not to follow a RA, he should be aware that the intruder may be TCAS equipped and may be manoeuvring toward his aircraft in response to a coordinated RA.

Pilots should comply with the vertical speed limitations prescribed in the Airmans information manual during the last 2000 ft of climb or descent. In particular, pilots should limit vertical speeds to 1500 ft/mn during the last 2000 ft of a climb or descent, especially when they are aware of traffic that is converging in altitude and intending to level off 1000 ft above or below the pilots assigned altitude.

## GENERAL

ALL

The weather radar has two main functions:

. Weather detection

. Mapping.

Weather detection is the primary function. For weather detection, the radar detects precipitation droplets. The strength of the echo is in proportion to the droplet size, composition and quantity (e.g. the reflection of water particles is five times greater than ice particles of the same size). Therefore, the weather radar does not detect weather that has small droplets (e.g. clouds or fog), or that does not have droplets (e.g. clear air turbulence).

Mapping is the secondary function. For mapping, the echo takes into account the difference between incoming and outgoing signals. Any significant difference in the signal is easily mapped (e.g. mountains or cities), but a small difference in the signal is not mapped (e.g. calm sea or even ground).

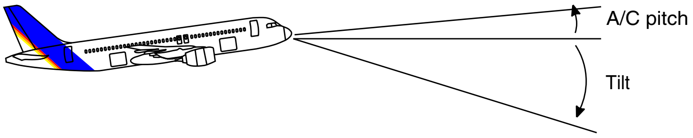
## FUNCTIONS

MSN 0002-2312 2314-2345 2347 2349-2402 2404-2509 2511-2533 2535-2568 2570-2583 2585-2596 2598-2638 2640-2647 2650-2653 2655 2658 2662 2664-2665 2667 2669-2671 2674-2678 2680-2682 2686 2689-2691 2695 2700 2702-2703 2705-2710 2712-2713 2715 2717 2721 2724-2729 2731-2732 2735-2736 2738-2742 2744-2745 2747-2748 2750-2756 2759 2761-2767 2769 2773-2779 2781-2783 2785-2788 2790 2794-2795 2798-2800 2802-2804 2806-2809 2811-2812 2814-2815 2817-2818 2821 2823 2827 2829-2832 2836-2837 2840 2843 2845 2848 2850-2852 2854 2856-2858 2860 2864 2866 2868 2870-2876 2878 2880 2884 2886-2889 2892 2894 2897 2900-2901 2903 2906 2908 2910 2912 2914 2916 2918-2923 2925 2927-2928 2930 2933-2934 2936 2938-2941 2943 2945-2949 2951-2952 2954 2957 2959 2961-2962 2964-2965 2967 2969-2972 2977 2982 2984 2988 2992-2994 2996-2999 3001 3003 3008-3010 3012 3014-3015 3020 3023-3025 3028-3030 3034 3036-3041 3044 3048 3051-3054 3059 3061-3063 3067 3070 3072-3073 3075 3078 3081-3084 3087-3092 3095-3096 3098-3102 3104-3110 3112 3118-3120 3122-3123 3125-3127 3130 3133-3135 3137-3138 3143-3152 3155 3157 3160-3164 3166 3169 3174 3176-3177 3179 3181 3183-3185 3187 3189-3191 3203-3205 3207-3209 3212 3214-3216 3220-3225 3229-3231 3235-3238 3243-3260

The flight crew uses the following controls to operate the radar:

### TILT

"Tilt" is the angle between the antenna radar and the horizon, irrespective of the aircraft's pitch and bank angles. The antenna stabilizes by using IRS data.

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To help avoid weather, it is important to effectively manage the tilt, taking into account the flight phase and the ND range.

Usually, it is the appropriate tilt value that provides ground returns on the top of the ND.

In case of overscanning, a cell may not be detected or may be underestimated, when the radar beam scans the upper part of the cell. This occurs because, at high altitude, this cell may have ice particles, and therefore the reflection of these particles is weak.

If AUTO TILT function is installed, selecting AUTO ensures a proper tilt management along the flight.

## GAIN

Gain control is mostly used in AUTO/CAL mode. The detection or evaluation of cells will always start in AUTO/CAL gain mode.

However, the gain may be manually tuned to detect the strongest part of a cell displayed in red on the ND. If the gain is slowly reduced, the red areas (level 3 return) will slowly become yellow areas (level 2 return), and the yellow areas will become green areas (level 1). The last part of the cell to turn yellow is the strongest area.

The gain must then be reset to AUTO/CAL mode.

## MODE

The operation modes are WX, WX+T, TURB, MAP.

WX+T or TURB modes are used to locate the wet turbulence area. TURB mode detects wet turbulence within 40 nm, and is not affected by the gain. TURB mode should be used to isolate turbulence from precipitation.

**GCS (IF INSTALLED)**

The Ground Clutter Suppression (GCS) operates in WX mode, and inhibits the ground echoes on the ND.

It is sometimes difficult to differentiate between weather and ground returns. A change in tilt rapidly changes the shape and color of ground returns and eventually makes them disappear. This is not the case for weather.

**RCT (IF INSTALLED)**

The React (RCT) function is used temporarily to help detect weather or buildups beyond of the weather already detected.

**PWS**

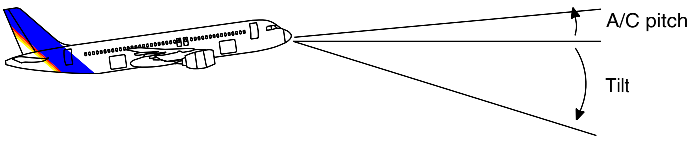
Refer to the FCTM 04.001 on adverse weather.

MSN 2313 2346 2348 2403 2510 2534 2569 2584 2597 2639 2648-2649 2654 2656-2657 2659-2661 2663 2666 2668 2672-2673 2679 2683-2685 2687-2688 2692-2694 2696-2699 2701 2704 2711 2714 2716 2718-2720 2723 2730 2733-2734 2737 2743 2746 2749 2757-2758 2760 2768 2770-2772 2780 2784 2789 2791-2793 2796-2797 2801 2805 2810 2813 2816 2819-2820 2822 2824-2826 2828 2833-2835 2838-2839 2841-2842 2844 2846-2847 2849 2853 2855 2859 2861-2863 2865 2867 2869 2877 2879 2881-2883 2885 2890-2891 2893 2895-2896 2898-2899 2902 2904-2905 2907 2909 2911 2913 2915 2917 2924 2926 2929 2931-2932 2935 2937 2942 2944 2950 2953 2955-2956 2958 2960 2963 2966 2968 2973-2976 2978-2981 2983 2985-2987 2989-2991 2995 3000 3002 3004-3007 3011 3013 3016-3019 3021-3022 3026-3027 3031-3033 3035 3042-3043 3045-3047 3049-3050 3055-3058 3060 3064-3066 3068-3069 3071 3074 3076-3077 3079-3080 3085-3086 3093-3094 3097 3103 3111 3113-3117 3121 3124 3128-3129 3131-3132 3136 3139-3141 3153-3154 3156 3158-3159 3165 3167-3168 3170-3173 3175 3178 3180 3182 3186 3188 3192-3202 3206 3210 3213 3217 3226 3233 3241

The flight crew uses the following controls to operate the radar:

**TILT**

"Tilt" is the angle between the antenna radar and the horizon, irrespective of the aircraft's pitch and bank angles. The antenna stabilizes by using IRS data.

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To help avoid weather, it is important to effectively manage the tilt, taking into account the flight phase and the ND range.

Usually, it is the appropriate tilt value that provides ground returns on the top of the ND.

In case of overscanning, a cell may not be detected or may be underestimated, when the radar beam scans the upper part of the cell. This occurs because, at high altitude, this cell may have ice particles, and therefore the reflection of these particles is weak.

Selecting AUTO ensures a proper tilt management along the flight.

Note: *In cruise, MULTISCAN function provides a large view of the weather ahead, ie display of weather cells located on and below aircraft path. Before envisaging a route change in front of an ambiguous or unexpected weather display, the crew should confirm the potential conflicts with aircraft path, using temporarily manual tilt.*

## GAIN

Manual gain selection (+8) must be used when MULTISCAN selector is set to AUTO.

However, the gain may be tuned to detect the strongest part of a cell displayed in red on the ND. If the gain is slowly reduced, the red areas (level 3 return) will slowly become yellow areas (level 2 return), and the yellow areas will become green areas (level 1). The last part of the cell to turn yellow is the strongest area.

The gain must then be reset to +8.

## MODE

The operation modes are WX, WX+T, TURB, MAP.

WX+T or TURB modes are used to locate the wet turbulence area. TURB mode detects wet turbulence within 40 nm, and is not affected by the gain. TURB mode should be used to isolate turbulence from precipitation.

## GCS (IF INSTALLED)

The Ground Clutter Suppression (GCS) operates in WX mode, and inhibits the ground echoes on the ND.

It is sometimes difficult to differentiate between weather and ground returns. A change in tilt rapidly changes the shape and color of ground returns and eventually makes them disappear. This is not the case for weather.

## RCT (IF INSTALLED)

The React (RCT) function is used temporarily to help detect weather or buildups beyond of the weather already detected.

## PWS

Refer to the FCTM 04.001 on adverse weather.

## OPERATIONAL RECOMMENDATIONS FOR WEATHER DETECTION

MSN 0002-2063 2065-2075 2077-2307 2309-2312 2314-2325 2327-2329 2331-2336 2338-2340 2343-2345 2347 2349-2354 2356-2374 2376-2378 2380-2402 2404-2417 2420 2422-2437 2440 2442-2468 2470-2500 2502-2509 2511-2533 2535-2539 2541-2568 2570-2583 2585-2595 2598-2608 2610-2615 2617-2622 2624-2625 2627-2638 2640-2647 2650-2652 2655 2658 2664-2665 2667 2669-2671 2675-2677 2680-2682 2686 2689-2691 2695 2700 2702-2703 2705-2710 2712-2713 2715 2717 2721 2724-2725 2727-2729 2731-2732 2735 2738-2739 2741-2742 2744-2745 2747 2750-2755 2759 2762-2767 2769 2774-2775 2777 2779 2781-2783 2786-2788 2790 2795 2802-2804 2806 2808-2809 2812 2814-2815 2817-2818 2821 2827 2829 2831-2832 2836-2837 2840 2845 2848 2850 2852 2854 2856-2858 2860 2864 2866 2871-2874 2876 2880 2884 2886-2888 2892 2894 2900-2901 2906 2908 2910 2914 2916 2918-2919 2921-2923 2927 2930 2933 2936 2938-2940 2943 2945-2946 2948-2949 2951-2952 2959 2961 2964 2967 2969-2972 2977 2982 2992 2994 2998 3001 3003 3008-3009 3012 3014 3020 3023 3025 3028-3030 3034 3036 3038-3039 3041 3044 3048 3051 3053 3059 3061-3062 3067 3072-3073 3075 3081-3082 3084 3088-3092 3098-3100 3104-3106 3110 3112 3118-3120 3122-3123 3125 3133-3134 3137 3144 3147-3150 3160 3162-3164 3176 3183-3184 3189-3190 3214 3216 3220-3225 3229-3231 3235-3238 3243-3260

| FLIGHT PHASE | DETECTION AND MONITORING PROCEDURES | COMMENTS |
|---|---|---|
| TAXI | clear on parking area, set ND to lowest range, TILT DOWN then UP;<br>Chek appearance/disappearance of ground returns. | Radar check (away from people). |
| TAKEOFF | If weather is suspected, SLOWLY SCAN up to + 15°, then TILT + 4°. | Scanning along departure path. |
| CLIMB | To avoid OVERSCANNING, TILT DOWNWARD as the A/C climbs, and maintain GND RETURNS ON TOP OF ND. | TILT angle function of altitude and ND RANGE. |
| CRUISE | Use TILT slightly NEGATIVE to maintain ground returns on top of ND:<br>Range 320 TILT≅ 1 DN<br>Range 160 TILT≅ 1,5 DN<br>Range 80 TILT≅ 3,5 DN<br>Range 40 TILT≅ 6 DN<br>In higher altitudes, closing weather:<br>– Decrease ND<br>– TILT down<br>Use TURB to ISOLATE Turbulence – GAIN to AUTO. | No ground returns beyond line of view.<br>Dnm = 1,23√ALT ft<br>FL 370 D 240nm<br>Poor ground returns over calm sea / even ground. |
| DESCENT | During DES, TILT UPWARD approximately + 1° / 10000 ft in higher altitudes, then + 1°/5000 ft below 15000 ft. | |
| APPROACH | TILT + 4°. | To avoid ground returns. |

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*<u>Note</u>: It is difficult to differentiate between weather returns and ground returns: A change in TILT causes the shape and color of ground returns to change rapidly. These ground returns eventually disappear. This is not the case for weather returns.*

MSN 2064 2076 2308 2326 2330 2337 2341-2342 2355 2375 2379 2418-2419 2421 2438-2439 2441 2469 2501 2540 2596 2609 2616 2623 2626 2653 2662 2674 2678 2726 2736 2740 2748 2756 2761 2773 2776 2778 2785 2794 2798-2800 2807 2811 2823 2830 2843 2851 2868 2870 2875 2878 2889 2897 2903 2912 2920 2925 2928 2934 2941 2947 2954 2957 2962 2965 2984 2988 2993 2996-2997 2999 3010 3015 3024 3037 3040 3052 3054 3063 3070 3078 3083 3087 3095-3096 3101-3102 3107-3109 3126-3127 3130 3135 3138 3143 3145-3146 3151-3152 3155 3157 3161 3166 3169 3174 3177 3179 3181 3185 3187 3191 3203-3205 3207-3209 3212 3215

| FLIGHT PHASE | DETECTION AND MONITORING PROCEDURES | COMMENTS |
|---|---|---|
| TAXI | Clear on parking area, set ND to lowest range, TILT DOWN then UP;<br>Check appearance/disappearance of ground returns.<br>Reselect AUTO after scanning. | Radar check (away from people) |
| TAKE OFF | If weather is suspected, SLOWLY SCAN up to + 15°, then reselect AUTO. | Scanning along departure path |
| IN FLIGHT | Use TURB to ISOLATE Turbulence GAIN to AUTO | Poor ground return over calm sea / even ground |

<u>Note</u>: *Weather and ground returns are difficult to differentiate: a change in TILT rapidly changes the shape and color of ground returns and eventually cause them to disappear which is not the case for weather.*

MSN 2313 2346 2348 2403 2510 2534 2569 2584 2597 2639 2648-2649 2654 2656-2657 2659-2661 2663 2666 2668 2672-2673 2679 2683-2685 2687-2688 2692-2694 2696-2699 2701 2704 2711 2714 2716 2718-2720 2723 2730 2733-2734 2737 2743 2746 2749 2757-2758 2760 2768 2770-2772 2780 2784 2789 2791-2793 2796-2797 2801 2805 2810 2813 2816 2819-2820 2822 2824-2826 2828 2833-2835 2838-2839 2841-2842 2844 2846-2847 2849 2853 2855 2859 2861-2863 2865 2867 2869 2877 2879 2881-2883 2885 2890-2891 2893 2895-2896 2898-2899 2902 2904-2905 2907 2909 2911 2913 2915 2917 2924 2926 2929 2931-2932 2935 2937 2942 2944 2950 2953 2955-2956 2958 2960 2963 2966 2968 2973-2976 2978-2981 2983 2985-2987 2989-2991 2995 3000 3002 3004-3007 3011 3013 3016-3019 3021-3022 3026-3027 3031-3033 3035 3042-3043 3045-3047 3049-3050 3055-3058 3060 3064-3066 3068-3069 3071 3074 3076-3077 3079-3080 3085-3086 3093-3094 3097 3103 3111 3113-3117 3121 3124 3128-3129 3131-3132 3136 3139-3141 3153-3154 3156 3158-3159 3165 3167-3168 3170-3173 3175 3178 3180 3182 3186 3188 3192-3202 3206 3210 3213 3217 3226 3233 3241

| FLIGHT PHASE | DETECTION AND MONITORING PROCEDURES | COMMENTS |
|---|---|---|
| TAXI | Clear on parking area, set ND to lowest range, TILT DOWN then UP;<br>Check appearance/disappearance of ground returns.<br>Reselect AUTO after scanning. | Radar check (away from people) |
| TAKE OFF | If weather is suspected, SLOWLY SCAN up to + 15°, then reselect AUTO. | Scanning along departure path |
| IN FLIGHT | Use TURB to ISOLATE Turbulence | Poor ground return over calm sea / even ground |

*Note:*

1. *GAIN must be manually set to +8, when MULTISCAN selector is set to AUTO.*
2. *MULTISCAN AUTO mode provides an efficient ground clutter rejection. During operations in good or non-significant weather, no weather pattern will be displayed on ND's. In such situation, the crew ascertains correct radar operation, using temporarily MANUAL TILT.*
3. *The crew monitors weather radar display in AUTO, and confirms any ambiguous or unexpected weather display using manual tilt according to standard techniques.*

## OTHER OPERATIONAL RECOMMENDATIONS

ALL

## WEATHER AVOIDANCE

- When weather is suspected, scan for it by varying the radar tilt. If AUTOTILT or MULTISCAN function is available, reselect AUTO after scanning.
- Do not underestimate a thunderstorm, even if echo is weak (only wet parts are detected)
- Avoid all red + magenta cells by at least 20 nm
- Deviate upwind instead of downwind (less probability of turbulence or hail)
- Do not attempt to fly below a storm even visual (turbulence, shear, altimetry)
- Use TURB detection to isolate turbulence from precipitation
- There may be severe turbulence, up to 5 000 ft above a cell
- Storms with tops above 35 000 ft are hazardous
- Frequent and vivid lightning indicates a high probability of severe turbulence.

## WEATHER PENETRATION

In the case of storm penetration, the flight crew must take full advantage of the radar. For flight crew guidelines, in the case of turbulence, refer to the FCTM section on ADVERSE WEATHER.

## MAPPING

TILT and GAIN have to be adjusted harmoniously, because the ground returns vary greatly with the angle of the radar beam which illuminates them.

- Use MAP to detect PROMINENT TERRAIN (mountain, city, and coastline)
- Adjust TILT and GAIN - Mapping coverage varies with tilt and aircraft altitude.

| TILT ANGLE | AREA SCANNED AT FL 330 |
|---|---|
| 3° DN | 72 nm to 190 nm |
| 5° DN | 47 nm to 190 nm |
| 7° DN | 36 nm to 70 nm |
| 10° DN | 26 nm to 41 nm |

**However, flight crew should NOT USE the weather radar as a terrain avoidance system.**