# DRAGONAIR

# A320/A321

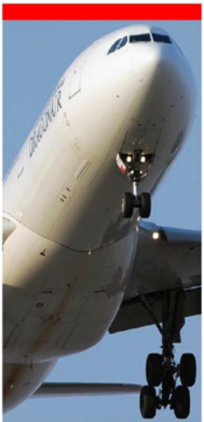
# OPERATIONS MANUAL

# FLIGHT CREW TRAINING MANUAL

This volume forms part of the Operations Manual. It is issued by the Operations Department and is authorised by the General Manager (Operations).

Signed : P. Sanderson.
Peter SANDERSON
General Manager Operations

The holder of this volume is responsible for its revision.




# 安全、質量及保安政策

安全、質量及保安是港龍航空的核心價值。藉著各員工絕不妥協地致力推行各種持續提升質量、保安及安全管理系統計劃，我們務求在這些方面均達到最高的水平。

港龍航空一直以來均十分重視及鼓勵任何有關運作安全及保安事件的報告。我們有既定政策，鼓勵每一位員工向公司匯報任何可能影響航班及地勤營運安全及保安的情況及資料，並積極推動這種文化。我們更製訂了一套程序，適用於航空安全報告、機艙安全報告、地勤安全報告、品質審計報告及保安審查報告所收集紀錄及發放的資訊，確保溝通可以在不受拘束的情況下進行。

我們亦確立機制，以量度及訂立在所有有關安全、質量及保安方面的主要表現水平，並以嚴謹的風險評審，按其重要性訂定改善措施的優先次序。

為建立互信關係，港龍航空推行公平文化的政策，決不會紀律處分任何匯報有關航班安全事件的員工。但如果有關資訊是來自其他來源，或員工刻意漠視既定的政策及程序，此項政策則不適用。我們希望從錯誤中學習，以不斷提升水平。

作為行政總裁，我自然責無旁貸，除致力履行承諾提供安全的運作及工作環境，我務請大家積極負責，讓港龍航空繼續在安全、品質及保安方面均達致最高的水平，讓顧客、員工及商業夥伴均受惠，並保持公司在這方面的業界領導地位。

楊偉添

行政總裁　楊偉添
二〇一一年八月

# SAFETY, QUALITY AND SECURITY POLICY

Safety, quality and security are core values of Dragonair. We are dedicated to achieving the highest standards in these disciplines by the uncompromising efforts and vigilance of every employee in implementing continuous quality improvement, security and safety management system programmes that are in place in Dragonair.

It is imperative that we have uninhibited reporting of all incidents and occurrences which compromise the safe and secure conduct of our operations. We have a policy of an open reporting culture where every employee is encouraged to communicate any information that may affect the integrity of flight and ground safety and security. Such communication is free of reprisal. Our method of collecting, recording and disseminating information obtained from Air Safety Reports, Cabin Safety Reports, Ground Safety Reports, Quality Audits and Security Inspections has been developed to achieve this aim.

We have established methods to measure and set key performance standards in all the safety, quality and security disciplines coupled with a rigorous process of risk assessment in order to prioritise the deployment of corrective actions in a timely and efficient manner.

To engender mutual trust, Dragonair has a just culture policy where it will not take disciplinary action against any employee who discloses an incident or occurrence involving safety. This policy shall not apply to information received by the company from a source other than the employee, or when the employee knowingly disregards established policies and procedures. We constantly improve our standards by learning from our own mistakes and errors as well as those made by others.

As the Chief Executive Officer I am ultimately accountable and fully committed to providing a safe operational and working environment. However I require you all to take responsibility to ensure Dragonair maintain its industry position as a leader in providing our customers, employees and business partners with the highest level of safety, quality and security.

Patrick Yeung
Chief Executive Officer
August 2011

KASQSPDMS-201108-REV2

DRAGONAIR

# POLICY STATEMENTS

### *COMMANDER/PILOT IN COMMAND/PIC*

The term "Commander" throughout the Operations manuals is synonymous with "Pilot in Command (PIC)"

### *CREW RESOURCE MANAGEMENT (CRM)*

Dragonair is committed to the application of modern Crew Resource Management principles in Flight Operations. CRM principles of today are considered by Hong Kong Dragon Airlines to provide the most proven methods of achieving effective leadership and communication, aimed at the promotion of safe and efficient flight. While traditional high standards of technical excellence remain the cornerstone of the airline, it is recognised that effective team management is essential. This must involve the promotion of a comfortable and understanding working environment, especially in multi-cultural crew situations, through clear and unambiguous communication and task sharing. It is Company Policy that CRM principles will be promoted and adopted by all persons in Flight Operations.

### *AUTOMATION*

It is Dragonair policy to regard Automation as a tool to be used, but not blindly relied upon. At all times, flight crew must be aware of what automation is doing, and if not understood , or not requested, reversion to basic modes of operation must be made immediately without analysis or delay. Trainers must ensure that all flight crew are taught with emphasis how to quickly revert to basic modes when necessary. In the man-machine interface, man is still in charge.

### *QUALITY MANAGEMENT*

Dragonair is committed to the application of a Quality Management System in Flight Operations. To this end the management system is defined in OM Part A and shall be complied with for all future policy and procedural development.

### *GENDER*

Masculine terms in all the operations manuals, such as he, him or his also imply the female gender.

### *ELECTRONIC MANUALS*

Electronic manuals are an established means of communicating information and data in support of a wide range of FOP activities.
Access to electronic manuals is available to all approved users via Dragonet. All FOP staff are encouraged to utilise electronic manuals on a routine and ongoing basis. Electronic manuals posted on Dragonet represent the latest revised versions and, where differences exist with physical documentation, are considered to be the master source. In some cases manuals can be downloaded directly onto storage devices for offline use. Persons utilising information and data in this manner must be careful to ensure that it represents the latest in-use version available on Dragonet.

### *STANDARD OPERATING PROCEDURES*

Airbus customized FCOM chapters and QRH as well as Dragonair customized FCOM and QRH chapters are accepted as the Standard operating Procedures for Dragonair. Where there is a difference between Airbus and Dragonair customized material, the latter is the overriding authority.

### *DESIGNATED COMMON LANGUAGE*

It is Dragonair Policy that English shall be the designated common language for Flight Operations. All communications pertaining to Flight Operations, whether oral or written will be conducted in English. This includes all oral communications between Flight Crew within the Cockpit, and between the Flight Crew and all other staff (includes the Cabin Crew, Ground Handling Personnel, Passengers, Air Traffic Control and any other ground station or aircraft). All operational documentation including training materials shall be written in English. All Flight Crew and Cabin Crew training activities and evaluations shall be conducted in English.

Signed: ____________

General Manager Operations

(01 OCT 10)

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# TRANSMITTAL LETTER

## Issue date: 31 MAY 12

This is the FLIGHT CREW TRAINING MANUAL at issue date 31 MAY 12 for the A320/A321 and replacing last issue dated 28 NOV 11

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Please incorporate the revision as follow:

| Localization<br>Subsection Title | Remove | Insert<br>Rev. Date |
|---|---|---|
| OP-030<br>**AP / FD / ATHR** | ALL | 31 MAY 12 |
| NO-020<br>**PRE START** | ALL | 31 MAY 12 |
| NO-030<br>**START** | ALL | 31 MAY 12 |
| NO-040<br>**TAXI** | ALL | 31 MAY 12 |
| NO-050<br>**TAKEOFF** | ALL | 31 MAY 12 |
| NO-060<br>**CLIMB** | ALL | 31 MAY 12 |
| NO-070<br>**CRUISE** | ALL | 31 MAY 12 |
| NO-080<br>**DESCENT PREPARATION** | ALL | 31 MAY 12 |
| NO-090<br>**DESCENT** | ALL | 31 MAY 12 |
| NO-100<br>**HOLDING** | ALL | 31 MAY 12 |
| NO-110<br>**APPROACH GENERAL** | ALL | 31 MAY 12 |
| NO-120<br>**ILS APPROACH** | ALL | 31 MAY 12 |
| NO-130<br>**NON PRECISION APPROACH** | ALL | 31 MAY 12 |
| NO-140<br>**CIRCLING APPROACH** | ALL | 31 MAY 12 |
| NO-150<br>**VISUAL APPROACH** | ALL | 31 MAY 12 |
| NO-160<br>**PRECISION APPROACH** | ALL | 31 MAY 12 |
| NO-170<br>**LANDING** | ALL | 31 MAY 12 |
| NO-180<br>**GO AROUND** | ALL | 31 MAY 12 |
| NO-190<br>**TAXI IN** | ALL | 31 MAY 12 |
| AO-020<br>**OPERATING TECHNIQUES** | ALL | 31 MAY 12 |

# FILING INSTRUCTIONS

| Localization<br>Subsection Title | Remove | Insert<br>Rev. Date |
|---|---|---|
| AO-022<br>**AUTOFLIGHT** | ALL | 31 MAY 12 |
| AO-024<br>**ELECTRICAL** | ALL | 31 MAY 12 |
| AO-026<br>**FIRE PROTECTION** | ALL | 31 MAY 12 |
| AO-027<br>**FLIGHT CONTROLS** | ALL | 31 MAY 12 |
| AO-029<br>**HYDRAULIC** | ALL | 31 MAY 12 |
| AO-034<br>**NAVIGATION** | ALL | 31 MAY 12 |
| AO-070<br>**POWER PLANT** | ALL | 31 MAY 12 |
| AO-090<br>**MISCELLANEOUS** | ALL | 31 MAY 12 |
| SI-010<br>**ADVERSE WEATHER** | ALL | 31 MAY 12 |
| SI-070<br>**USE OF RADAR** | ALL | 31 MAY 12 |
| SI-080<br>**BRIEFING GUIDELINES** | ALL | 31 MAY 12 |
| SI-110<br>**LANDING PERFORMANCE** | ALL | 31 MAY 12 |

# PRELIMINARY PAGES

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| M(1) | Localization | Subsection Title | Rev. Date |
|---|---|---|---|
| | IN-010 | GENERAL INTRODUCTION | 28 NOV 11 |
| | OP-010 | INTRODUCTION | 28 NOV 11 |
| | OP-020 | FLIGHT CONTROLS | 28 NOV 11 |
| R | OP-030 | AP / FD / ATHR | 31 MAY 12 |
| | OP-040 | ECAM | 28 NOV 11 |
| | OP-050 | CRM AND TEM | 28 NOV 11 |
| | OP-060 | OPERATING POLICY | 28 NOV 11 |
| | NO-010 | GENERAL | 28 NOV 11 |
| R | NO-020 | PRE START | 31 MAY 12 |
| R | NO-030 | START | 31 MAY 12 |
| R | NO-040 | TAXI | 31 MAY 12 |
| R | NO-050 | TAKEOFF | 31 MAY 12 |
| R | NO-060 | CLIMB | 31 MAY 12 |
| R | NO-070 | CRUISE | 31 MAY 12 |
| R | NO-080 | DESCENT PREPARATION | 31 MAY 12 |
| R | NO-090 | DESCENT | 31 MAY 12 |
| R | NO-100 | HOLDING | 31 MAY 12 |
| R | NO-110 | APPROACH GENERAL | 31 MAY 12 |
| R | NO-120 | ILS APPROACH | 31 MAY 12 |
| R | NO-130 | NON PRECISION APPROACH | 31 MAY 12 |
| R | NO-140 | CIRCLING APPROACH | 31 MAY 12 |
| R | NO-150 | VISUAL APPROACH | 31 MAY 12 |
| R | NO-160 | PRECISION APPROACH | 31 MAY 12 |
| R | NO-170 | LANDING | 31 MAY 12 |
| R | NO-180 | GO AROUND | 31 MAY 12 |
| R | NO-190 | TAXI IN | 31 MAY 12 |
| | AO-010 | GENERAL | 28 NOV 11 |
| R | AO-020 | OPERATING TECHNIQUES | 31 MAY 12 |
| E | AO-022 | AUTOFLIGHT | 31 MAY 12 |
| R | AO-024 | ELECTRICAL | 31 MAY 12 |
| R | AO-026 | FIRE PROTECTION | 31 MAY 12 |
| R | AO-027 | FLIGHT CONTROLS | 31 MAY 12 |
| | AO-028 | FUEL | 28 NOV 11 |
| R | AO-029 | HYDRAULIC | 31 MAY 12 |
| | AO-032 | LANDING GEAR | 28 NOV 11 |
| R | AO-034 | NAVIGATION | 31 MAY 12 |
| R | AO-070 | POWER PLANT | 31 MAY 12 |
| R | AO-090 | MISCELLANEOUS | 31 MAY 12 |
| R | SI-010 | ADVERSE WEATHER | 31 MAY 12 |
| | SI-020 | FLYING REFERENCE | 28 NOV 11 |
| | SI-030 | NAVIGATION ACCURACY | 28 NOV 11 |

| M(1) | Localization | Subsection Title | Rev. Date |
|---|---|---|---|
| | SI-040 | **ZFW - ZFCG ENTRY ERRORS** | 28 NOV 11 |
| | SI-060 | **TCAS** | 28 NOV 11 |
| R | SI-070 | **USE OF RADAR** | 31 MAY 12 |
| R | SI-080 | **BRIEFING GUIDELINES** | 31 MAY 12 |
| | SI-090 | **PFD/FMA CALLS AND FCU PROCEDURES** | 28 NOV 11 |
| | SI-100 | **TOUCH AND GO-AROUND** | 28 NOV 11 |
| R | SI-110 | **LANDING PERFORMANCE** | 31 MAY 12 |
| | PIR-010 | **PREVENTING IDENTIFIED RISKS** | 28 NOV 11 |

*(1) Evolution code : N=New, R=Revised, E=Effectivity, M=Moved*

This table gives, for each delivered aircraft, the cross reference between:

- The Manufacturing Serial Number (MSN).
- The Fleet Serial Number (FSN) of the aircraft as known by AIRBUS S.A.S.
- The registration number of the aircraft as known by AIRBUS S.A.S.
- The aircraft model.

| M(1) | MSN | FSN | Registration Number | Model |
|---|---|---|---|---|
| | 0633 | HDA 0103 | B-HTF | 321-231 |
| | 0756 | HDA 0051 | B-HSD | 320-232 |
| | 0784 | HDA 0052 | B-HSE | 320-232 |
| | 0812 | HDA 0001 | B-HSG | 320-232 |
| | 0930 | HDA 0055 | B-HSI | 320-232 |
| | 0993 | HDA 0101 | B-HTD | 321-231 |
| | 1024 | HDA 0102 | B-HTE | 321-231 |
| | 1253 | HDA 0002 | B-HSJ | 320-232 |
| | 1695 | HDA 0104 | B-HTG | 321-231 |
| | 1721 | HDA 0056 | B-HSK | 320-232 |
| | 1984 | HDA 0151 | B-HTH | 321-231 |
| | 2021 | HDA 0152 | B-HTI | 321-231 |
| | 2229 | HDA 0003 | B-HSL | 320-232 |
| | 2238 | HDA 0004 | B-HSM | 320-232 |
| | 2428 | HDA 0005 | B-HSN | 320-232 |
| | 4023 | HDA 0057 | B-HSO | 320-232 |
| | 4247 | HDA 0058 | B-HSP | 320-232 |
| N | 5024 | HDA 0060 | B-HSQ | 320-232 |
| N | 5030 | HDA 0059 | B-HSR | 320-232 |
| N | 5362 | HDA 0061 | B-HST | 320-232 |
| N | 5429 | HDA 0062 | B-HSU | 320-232 |

*(1) Evolution code : N=New, R=Revised*

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| M(1) | MODIFICATION | Linked SB | Incorp. Date | Title |
|---|---|---|---|---|
| | J0071 | | 08 JUL 08 | WINGS-WING TIP FENCES-INTRODUCE WING TIPS INCLUDING FENCES- |
| | **Applicable to: ALL** | | | |
| | K2113 | | 08 JUL 08 | FUSELAGE - REAR FUSELAGE SECTION 16A - DEFINE A321 BASIC STRUCTURE |
| | **Applicable to: B-HTD, B-HTE, B-HTF, B-HTG, B-HTH, B-HTI** | | | |
| N | P10383 | 31-1334 04 | 31 MAY 12 | INDICATING/RECORDING SYSTEMS - FLIGHT WARNING COMPUTER (FWC) - INSTALL FWC STANDARD H2-F5 |
| | **Applicable to: ALL** | | | |
| R | P10694 | | 15 JUN 10 | AUTO-FLIGHT - FMGC - ACTIVATE "MOD NAV GO AROUND" ON FMGC |
| | **Applicable to: B-HSP, B-HSQ, B-HSR, B-HST, B-HSU** | | | |
| R | P2316 | | 08 JUL 08 | AUTO FLIGHT - ACTIVATE WINDSHEAR FUNCTION |
| | **Applicable to: ALL** | | | |
| R | P3341 | | 08 JUL 08 | LANDING GEAR - WHEELS AND BRAKES - INSTALL MESSIER GOODRICH WHEELS AND BRAKES ON A321 |
| | **Applicable to: B-HTD, B-HTE, B-HTF, B-HTG, B-HTH, B-HTI** | | | |
| | P3379 | | 08 JUL 08 | INDICATING/RECORDING SYSTEMS - GENERAL- DEFINE CPIP3 |
| | **Applicable to: ALL** | | | |
| | P3511 | | 08 JUL 08 | AUTO FLIGHT - FAC - INSTALL TWO FACS P/N BAM 0509 |
| | **Applicable to: ALL** | | | |
| R | P3560 | | 08 JUL 08 | AUTO FLIGHT - FMGC - PROVIDE TIME CONSTRAINT AND TEN CHARACTERS RTE IDENT FUNCTIONS |
| | **Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI** | | | |
| | P3686 | | 08 JUL 08 | AUTO FLIGHT-FAC-INTRODUCE FAC P/N BAM 510 |
| | **Applicable to: ALL** | | | |
| N | P3924 | | 28 NOV 11 | LANDING GEAR - MLG - MESSIER - INTRODUCE BRAKES P/N C202253 |
| | **Applicable to: B-HSQ, B-HSR** | | | |
| R | P4319 | 22-1058 48 | 08 JUL 08 | AUTO FLIGHT - FCU - DEFINE FLIGHT DIRECTOR ENGAGEMENT IN CROSSED BARS AT GO AROUND |
| | **Applicable to: ALL** | | | |
| R | P4320 | | 08 JUL 08 | AUTO FLIGHT-GENERAL-ACTIVATE GLOBAL SPEED PROTECTION AND F/D DISENGAGEMENT UPON SPEED CONSTRAINTS |
| | **Applicable to: B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTD, B-HTE, B-HTG, B-HTH, B-HTI** | | | |

| M(1) | MODIFICATION | Linked SB | Incorp. Date | Title |
|---|---|---|---|---|
| R | P4576 | | 24 JUN 09 | LANDING GEAR-ALTERNATE BRAKING- INTRODUCE MODIFIED ALTERNATE BRAKING SYSTEM |
| | **Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU** | | | |
| R | P4808 | | 08 JUL 08 | LANDING GEAR-WHEELS AND BRAKES- INTRODUCE BSCU COMMON STD |
| | **Applicable to: B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU** | | | |
| | P5168 | 34-1162 08 | 08 JUL 08 | NAVIGATION - MMR - INSTALL COLLINS MMR PROVIDING ILS AND GPS FUNCTION |
| | **Applicable to: ALL** | | | |
| | P5518 | 32-1232 01<br>32-1336 01 | 08 JUL 08 | LANDING GEAR-NORMAL BRAKING- INTRODUCE STD 8 BSCU (TWIN VERSION) |
| | **Applicable to: ALL** | | | |
| R | P5768 | | 08 JUL 08 | ELEC PWR-AC EMERGENCY GENERATION- ACTIVATE A319/A321 ELECTRICAL EMERGENCY CONFIGURATION ON A320 A/C |
| | **Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU** | | | |
| | P6375 | 32-1201 04 | 08 JUL 08 | LANDING GEAR-PARKING/ULTIMATE EMERGENCY BRAKING-INTRODUCE A PRESSURE SWITCH |
| | **Applicable to: ALL** | | | |
| R | P7520 | 22-1090 11 | 08 JUL 08 | AUTOFLIGHT-FMGC-INSTALL FMGC IAE C13042BA01 (EQUIPPED WITH FMS2 HONEYWELL) |
| | **Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI** | | | |
| R | P7721 | 32-1247 02 | 08 JUL 08 | LANDING GEAR-WHEELS AND BRAKES-CANCEL MIXABILITY BETWEEN GOODRICH BRAKES 2-1600-2 AND -3 AUTHOR. WITH MOD 31803 |
| | **Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HST, B-HSU** | | | |
| R | P7790 | | 08 JUL 08 | AUTO FLIGHT - FLIGHT MANAGEMENT AND GUIDANCE SYSTEM - ACTIVATE FMA ENHANCEMENT FUNCTION |
| | **Applicable to: B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTI** | | | |
| | P7876 | 73-1075 01 | 08 JUL 08 | ENGINE FUEL AND CONTROL - CONTROLLING - INTRODUCE EEC SOFTWARE STANDARD "SCN17" ON V2500-A5 ENGINES |
| | **Applicable to: ALL** | | | |
| R | P7929 | | 28 NOV 11 | NAVIGATION-WEATHER RADAR SYSTEM-INSTALL COLLINS DUAL CONTROL PANEL TO ACTIVATE MULTISCAN FUNCTION |
| | **Applicable to: B-HSQ, B-HSR, B-HST, B-HSU** | | | |
| R | P8194 | | 24 JUN 09 | NAVIGATION - ADIRS ACTIVATE ALIGNMENT IMPROVEMENT FUNCTION ON ADIRU |
| | **Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU** | | | |

| M(1) | MODIFICATION | Linked SB | Incorp. Date | Title |
|---|---|---|---|---|
| R | P8440 | 32-1291 01 | 24 JUN 09 | LANDING GEAR - WHEELS AND BRAKES INTRODUCE GOODRICH DURACARB CARBON BRAKES WITH ANTI - OXYDAN "M1" |
| | **Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HST, B-HSU** | | | |
| R | P9171 | | 24 JUN 09 | NAVIGATION-AIR DATA/INERTIAL REFERENCE SYSTEM (ADIRS) - INTRODUCE AIR DATA MONITORING FUNCTION |
| | **Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU** | | | |
| | P9907 | | 29 JUL 11 | INDICATING RECORDING SYSTEM - FLIGHT WARNING COMPUTER (FWC)- INSTALL FWC STANDARD H2-F4 |
| | **Applicable to: B-HSO, B-HSP** | | | |
| | 34-1119 02 | | 08 JUL 08 | NAVIGATION - SATELLITE NAVIGATION - INSTALL DUAL LITTON GPS AS A SUPPLEMENTARY MEANS OF NAVIGATION. |
| | **Applicable to: B-HTF** | | | |
| | 34-1143 08 | | 08 JUL 08 | NAVIGATION - GLOBAL POSITIONING SYSTEM - ACTIVATE A PRIMARY GPS MEANS OF NAVIGATION USING LITTON GPS (CLASS C1 - HYBRID ARCHITECTURE). |
| | **Applicable to: B-HTF** | | | |
| | 34-1167 01 | | 08 JUL 08 | NAVIGATION - INSTALL LITTON ADIRS (4MCU) INSTEAD OF HONEYWELL ADIRS (4MCU) - FOR RETROFIT ONLY. |
| | **Applicable to: B-HSD, B-HSE** | | | |

*(1) Evolution code : N=New, R=Revised, E=Effectivity*

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# INTRODUCTION

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## IN-PLP PRELIMINARY PAGES



## IN-010 GENERAL INTRODUCTION

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## FOREWORD

**Applicable to: 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 A320/1. It should be read in conjunction with the FCOM. If there is any conflicting information, the FCOM and other Company publications are the overriding authorities.
Dragonair Policy is contained in FCOM PRO-NOR, and where applicable, the Operations Manual Part A.

## COMMENT - QUESTIONS - SUGGESTIONS

**Applicable to: ALL**

FCTM holders and users are encouraged to submit any questions and suggestions about this manual through Dragonet via Company email to CP(A).

## MANUAL STRUCTURE

**Applicable to: ALL**

The contents of the FCOM are organised as following:
- GEN contains general information and abbreviations.
- DSC provides technical system information. It is organised in accordance with the Air Transport Association (ATA) numbering format.
- PER provides loading information and performance organized by phase of flight.
- PRO contains Normal Procedures (NOR), Abnormal Procedures (ABN), Supplementary Procedures (SUP) and Special Operations (SPO).
- LIM contains limitations.
- OEB contains Operations Engineering Bulletins.
- FCB contains Flight Crew Bulletins.

The NOR section sets out the policy and philosophy for the Airbus operation; it ensures a standard operation based on common phraseology and techniques. The SUP section cover situations that do not occur on a regular basis, e.g. manual engine start. The SPO section covers special operations such as flight with gear down, RVSM, etc.
The QRH contains Abnormal Checklists, Non-Normal manoeuvres and OEB required procedures.
The Minimum Equipment List (MEL) details which aircraft systems may be unserviceable prior to flight and must be consulted if a reference is specified in the Aircraft Maintenance Log.
The MEL is a Company document that uses the Airbus Master Minimum Equipment List (MMEL) as its source. Regulatory requirements dictate that the MEL must be at least as restrictive as the MMEL.

## LEGACY FM VS PEGASUS FM

**Applicable to: ALL**

Airbus FBW aircraft employ Honeywell FMGEC systems (FM's) to perform flight management functions during all phases of flight. The flight crew access and control these functions through the MCDU and FCU, which are the hardware elements, while the software elements consist of the flight envelope, guidance, performance and navigation databases. The FM systems have developed and expanded in their capabilities since inception and, as a result, later model aircraft are equipped with FM’s that are different to those fitted on earlier models.
The FM’s are divided into two broad categories, namely 'Legacy' (FM1) and 'Pegasus' (FM2), with Legacy defining those on the early model aircraft. Pegasus defines those on later models and are further divided into two categories; Pegasus 1 and Pegasus 2, which are transparent to the crew.
Most functions are identical between Legacy and Pegasus FM’s, however there are some differences embedded in the software and on specific page layouts. It is necessary to make reference to the different FM’s from time to time, for example, when defining operating procedures, or when highlighting a restriction or anomaly by means of an Operations Notice.

A320-200:
- Legacy FM equipped aircraft: HSD-HSI.
- Pegasus FM equipped aircraft: HSJ and subsequent.

A321-200:
- Legacy FM equipped aircraft: HTD-HTF.
- Pegasus FM equipped aircraft: HTG and subsequent.

# OPERATIONAL PHILOSOPHY

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## OP-PLP PRELIMINARY PAGES



## OP-010 INTRODUCTION



## OP-020 FLIGHT CONTROLS



## OP-030 AP / FD / ATHR



## OP-040 ECAM



## OP-050 CRM AND TEM



## OP-060 OPERATING POLICY

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| Localization<br>Title | Toc Index | ID | Reason |
|---|---|---|---|
| OP-030<br>AUTOTHRUST (A/THR) — Description | B | 1 | Update of the illustration<br>Update the "A/THR use in flight" illustration, to be in line with the FCB 24. |
| OP-030<br>AUTOTHRUST (A/THR) — Caution | B | 2 | Effectivity update: The information no longer applies to MSN 1253, 1695, 1721, 1984, 2021, 2229, 2238, 2428, 4023, 4247, 5024, 5030, 5362, 5429. |
| OP-030<br>AUTOTHRUST (A/THR) — Caution | B | 3 | Documentation update: Addition of "AUTOTHRUST (A/THR) — Caution" documentary unit |

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## INTRODUCTION

**Applicable to: ALL**

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

**Applicable to: ALL**

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 don't go as expected - take over
7. Use the proper level of automation for the task
8. Practice task sharing and back-up each other

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## INTRODUCTION

Applicable to: ALL

The relationship between the Pilot Flying's (PF's) input on the sidestick, and the aircraft's 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

Applicable to: 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

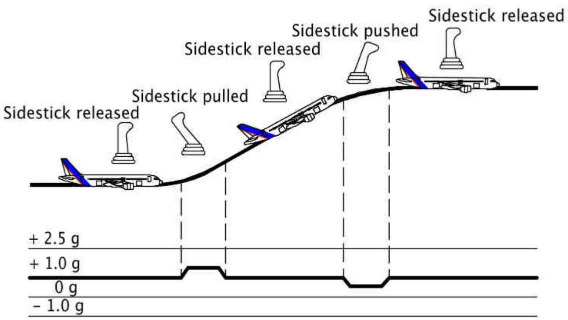
#### IN FLIGHT

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 PF's 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




Operational Recommendation:

From the moment 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 force the sidestick, or overcontrol it. If the PF suspects an overcontrol, they should release the sidestick.

## 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 nose gear down, by applying slight aft pressure on the sidestick.

## LATERAL CHARACTERISTICS

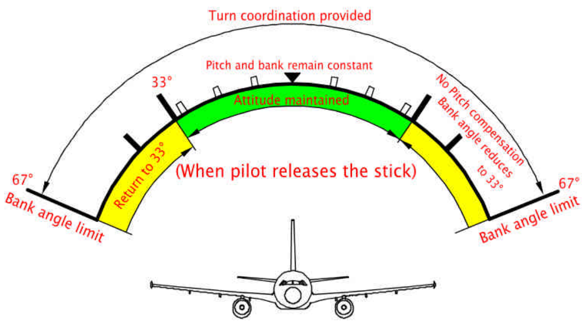
### NORMAL CONDITIONS

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 °, 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 °, pitch compensation is provided.
If the bank angle is greater than 33 °, 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




Operational Recommendation:

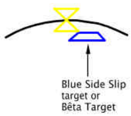
During a normal turn (bank angle less than 33 °), in level flight:
- The PF moves the sidestick laterally (the more the sidestick is moved laterally, the greater the resulting roll rate - e.g. 15 °/s at max deflection)
- It is not necessary to make a pitch correction
- It is not necessary to use the rudder.

In the case of steep turns (bank angle greater than 33 °), 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 ° 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




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

Applicable to: 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 (at a speed threshold that is below VLS), the automatic pitch trim stops 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 α FLOOR is inhibited. (On A318, MMO setting is also reduced to M 0.77.)

**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. The flight crew should consider descending to a lower altitude to increase the margin to buffet. Descending by approximately 4 000 ft below REC MAX ALT reduces significantly the occurrence of stall warning in turbulence.

## DIRECT LAW

Applicable to: 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.
The Flight crew should consider descending to a lower altitude to increase the margin to buffet. Descending by approximately 4 000 ft below the REC MAX ALT reduces significantly the occurrence of stall warning in turbulence.

## INDICATIONS

**Applicable to: ALL**

The ECAM and PFD indicate any control law degradation.

**ON THE ECAM**

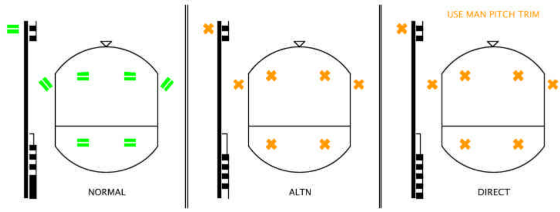
- **In ALTN Law:**
  FLT CTL ALTN LAW (PROT LOST)
  MAX SPEED 320 kt(320 kt/M 0.77 on A318)
- **In Direct Law:**
  FLT CTL DIRECT LAW (PROT LOST)
  MAX SPEED 320 kt/M 0.77
  MAN PITCH TRIM USE

**ON THE PFD**

The PFD enhances the PF's 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




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

**Applicable to: ALL**

### 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 exceed deliberately 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 °, within the Normal Flight envelope (2.5 g level flight)
- 40 °, in high Speed protection (to prevent spiral dive)
- 45 °, in high Angle-Of-Attack protection

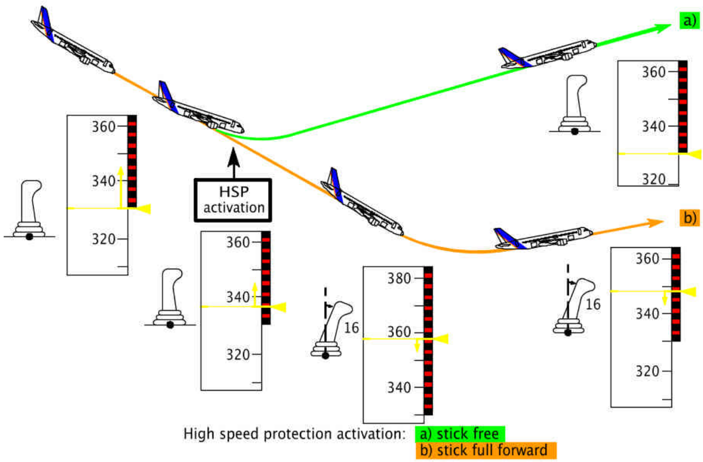
## HIGH SPEED PROTECTION

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



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

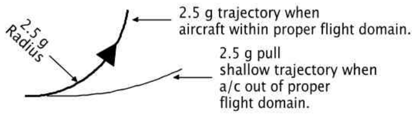
Note: *1. An OVERSPEED warning is provided.*
*2. At high altitude, this may result in activation of the angle of attack protection. Depending on the ELAC standard, the crew may have to push on the stick to get out of this protection law.*

## 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




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 pilots 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 °/minus 15 °.
Pitch attitude protection enhances high speed protection, high load factor protection, and high AOA protection.

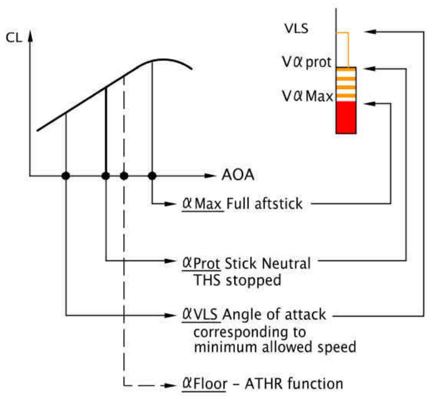
## HIGH ANGLE-OF-ATTACK (AOA) PROTECTION

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



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
- An aural low-energy "SPEED SPEED SPEED" warning, warms the flight crew that the energy of the aircraft is below a threshold under which they will have to increase thrust, in order to regain a positive flight path angle through pitch control. It is available in CONF 2, CONF 3, and CONF FULL.

  The FAC computes the energy level with the following inputs:
  - Aircraft configuration
  - Horizontal deceleration rate
  - Flight path angle

  For example, if the aircraft decelerates at 1 kt/sec, and:
  - The FPA is -3 °, the alert will trigger at approximately VLS -8,
  - The FPA is -4 °, the alert will trigger at approximately VLS -2.

  This alert draws the PF's attention to the SPEED scale, and indicates the need to adjust thrust. It comes immediately before the ALPHA Floor.
- 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 warning "SPEED, SPEED, SPEED": Enhances PF awareness
- ALPHA FLOOR: Provides TOGA thrust
- HIGH AOA protection: Provides maximum aerodynamic lift
- Automatic speedbrake retraction: Minimizes drag.

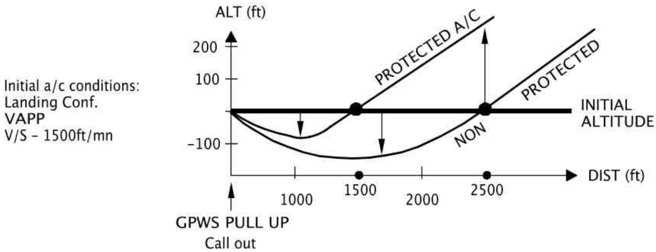
**OPERATIONAL RECOMMENDATIONS:**

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 floor has been triggered, it must be cancelled with the instinctive 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




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 % lower, a bucket-distance that is 50 % 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.

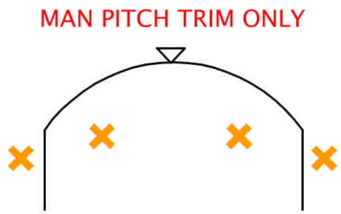
## MECHANICAL BACKUP

**Applicable to: 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 that 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




## ABNORMAL ATTITUDES

**Applicable to: 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 the avoidance of 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 ° up, 30 ° down)
- Bank (125 °)
- AOA (30 °, -10 °)
- 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 TAKEOVER P/B

**Applicable to: 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 Monitoring (PM) also acts on the stick, then both signals/orders are added.
Therefore, as on any other aircraft type, PF and PM must not act on their sidesticks at the same time.
If the PM (or Instructor) needs to take over, the PM must press the sidestick takeover 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 takeover pushbutton for at least 40 s, in order to deactivate the "failed" sidestick.
A pilot can at any time reactivate a deactivated stick by momentarily pressing the takeover pushbutton 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 this warning.

# AUTOPILOT/FLIGHT DIRECTOR

Applicable to: 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.

| Managed | Selected |
|---|---|
| To fly along the pre-planned F-PLN, entered in the MCDU | For specific ATC requests, or when there is not sufficient time to modify the MCDU F-PLN |

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

## MAIN INTERFACES WITH THE AP/FD

| MCDU<br>Long-term* interface | FCU<br>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") |

*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 directly affecting navigation are directed by the PF actioned but not executed by the PM until receiving comfirmation from the PF.

A crosscheck must be performed.

Time-consuming entries should be avoided below 10000 feet.
Entries should be restricted to those that have an operational benefit.

(PERF APPR, DIR TO, DIR TO INTERCEPT, RAD NAV, LATE CHANGE OF RUNWAY, ACTIVATE SEC F-PLN, ENABLE ALTN)

FCU entries are performed by:
- The PF, with the AP on.
- The PM (upon PF request), with the AP off.

FCU entries must be announced.

Upon FCU entries:

The PF must check and announce the corresponding PFD/FMA target and mode.

The PM must crosscheck and announce "CHECKED".

## 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

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

## AUTOPILOT (AP) OPERATION

The AP can be engaged within the normal flight envelope, 5 s after liftoff and at least 100 ft. 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
  - The DA for straight in LNAV/VNAV 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 autoland
- Abnormal configuration (e.g. slats/flaps failure): Down to 500 ft 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 also disengages the AP.It consists in pushing or pulling the sidestick beyond a given threshold.. The flight crew should use the FCU AP pushbutton when they perform an AP switching (changeover from AP1(2) to AP2(1)).

## RECOMMENDED PRACTICE FOR AUTOPILOT ENGAGEMENT

Before engaging the Autopilot (AP), the Flight Crew should:

- Fly the aircraft on the intended path
- Check on FMA that Flight Director (FD) is engaged with the appropriate guidance modes for the intended flight path; if not, select FD ON, and the appropriate guidance mode(s) as required
- Center the FD bars with the aircraft symbol on the PFD

<u>Note:</u> *Engaging the AP while large orders are required to achieve the intended flight path may result in the AP overshooting the intended vertical and/or lateral target. This situation may surprise the pilot due to the resulting large pitch / roll changes and thrust variations.*

## 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)

**Applicable to: ALL**

## 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.

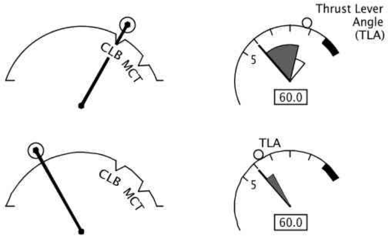
## INTERFACE

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 crew's 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).

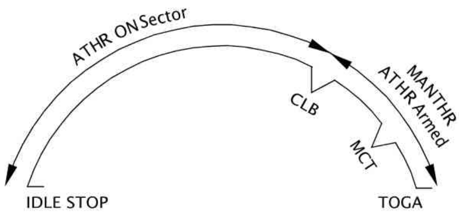
The TLP determines MAX Thrust for the A/THR




## 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 Angle, 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




### 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.

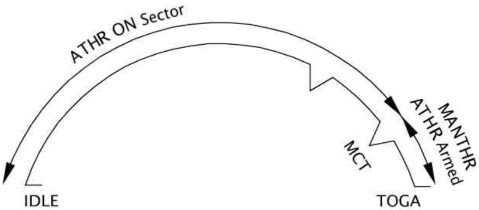
### THRUST LEVER(S) BELOW THE CLB DETENT

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 engine's 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 A/THR 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.

## 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 thrust levers are set between IDLE and MCT.

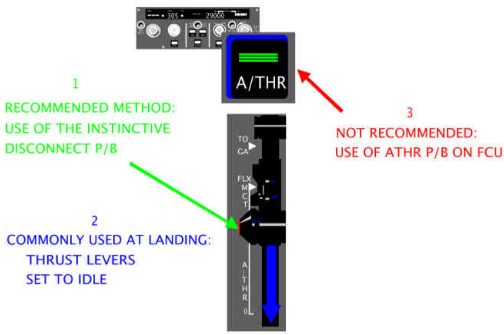
A/THR operating sectors - one engine inoperative




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




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

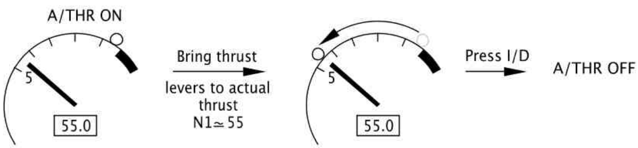
If the I/D pushbutton is pressed when the thrust levers are in CL detent, thrust will increase to MAX CL. This will cause an unwanted thrust increase and may destabilize the approach.

**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




## 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 rapidly 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 ft, except in the case of autoland, where it occurs at 10 ft.
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 "AUTO FLT A/THR 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

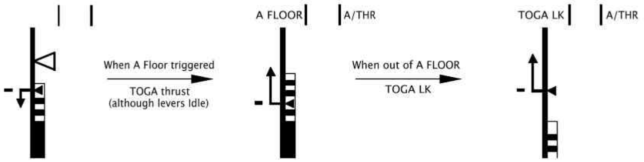
In this case, when the flight crew moves the thrust levers out of detent, full manual control is recovered, and the THRUST LOCKED message disappears from the FMA.
This feature should not be used, unless the instinctive disconnect pushbuttons are inoperative.

## 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



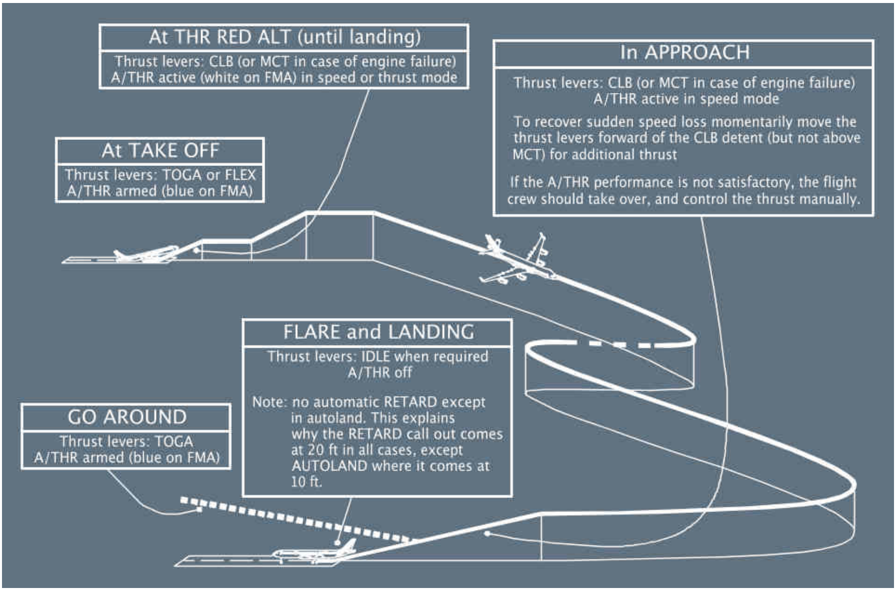

When the speed decreases, so that the angle-of-attack reaches the ALPHA FLOOR threshold, A/THR activates and orders TOGA thrust, despite the fact that the thrust levers are at IDLE. When the aircraft accelerates again, the angle-of-attack drops below the ALPHA FLOOR threshold. TOGA thrust is maintained 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 RA at landing. It is inhibited in some cases of engine failure.

## 1 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




A/THR should be monitored via the:
- FMA –SPEED / SPEED TREND on the PFD
- N1/N1 command (EPR) on the ECAM E/WD.

2 **Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

3

| | |
|---|---|
| **CAUTION** | Below 100 ft radio altitude if the thrust levers are moved forward of the CLB detent and then back into the CLB detent the autothrust will disconnect. As a result the thrust will increase up to CLIMB thrust and must then be manually set by the crew. |

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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HTF**

### 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 aircraft's 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.*

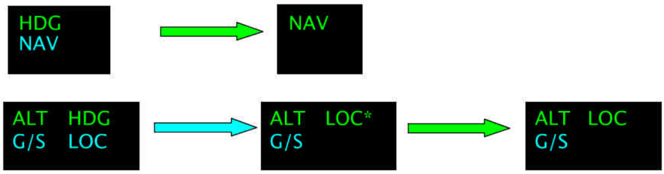
## THE LOGICAL SEQUENCE OF MODES

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)


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)




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

## MODE REVERSIONS

### GENERAL

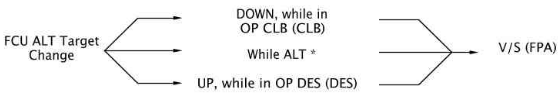
Mode reversions are automatic mode changes that unexpectedly occur, but are designed to ensure coherent AP, FD, and A/THR operations, in conjunction with flight crew input (or when entering a F-PLN discontinuity).

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

FCU change resulting reversion to VS mode




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

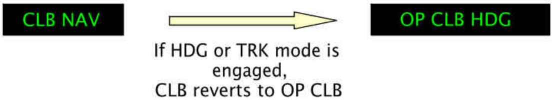
This reversion is due to the integration of the AP, FD, and A/THR with the FMS.

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).

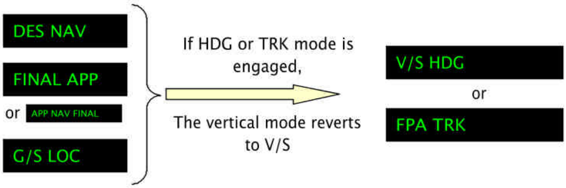
Vertical managed modes can only be used, if the lateral managed NAV mode is used. If the flight crew decides to divert from the lateral F-PLN, the autopilot will no longer guide the aircraft along the vertical F-PLN.
Therefore, in climb:

Lateral mode change and vertical mode reversion




In descent:

Lateral mode change and vertical mode reversion




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 crew's responsibility to adapt pitch, if necessary.

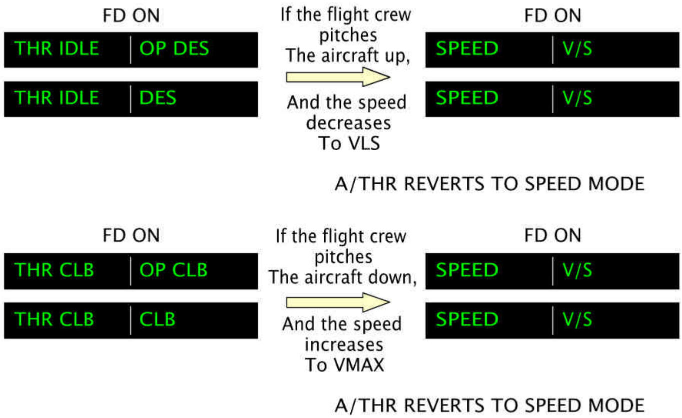
## THE AIRCRAFT ENTERS A F-PLN DISCONTINUITY

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




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

Criteria: P4320, SA
**Applicable to: B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTD, B-HTE, B-HTG, B-HTH, B-HTI**

### INTRODUCTION

The flight crew manually engages the modes.

However, they may change automatically, depending on the:
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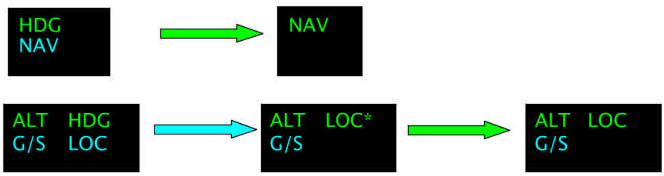



These logical mode changes occur, when the modes are armed. They appear in blue on the FMA.

## MODE REVERSIONS

### GENERAL

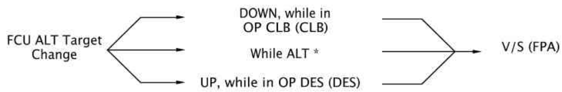
Mode reversions are automatic mode changes that unexpectedly occur, but are designed to ensure coherent AP, FD, and A/THR operations, in conjunction with flight crew input (or when entering a F-PLN discontinuity).

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




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).

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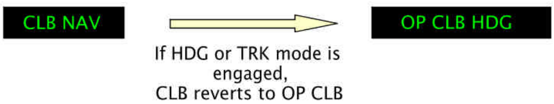
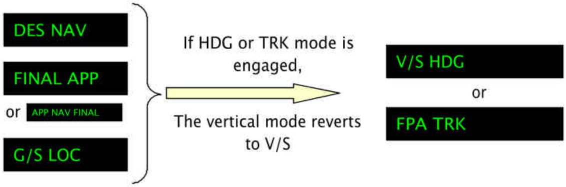



In descent:

Lateral mode change and vertical mode reversion

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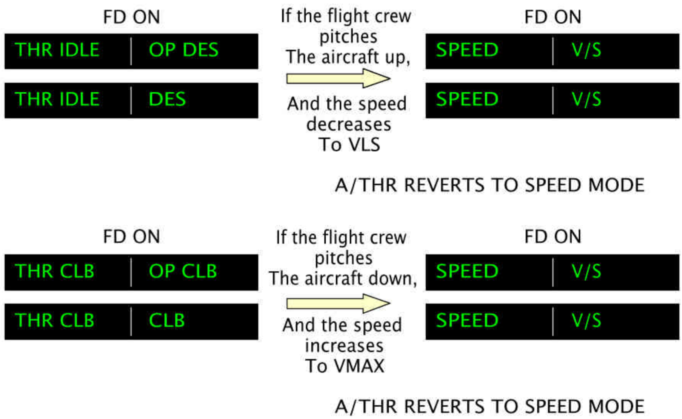
If the flight crew does not follow the FD pitch orders, an A/THR mode reversion occurs. This reversion is effective, when the A/THR is in THRUST MODE (THR IDLE, THR CLB), and the aircraft reaches the limits of the speed envelope (VLS, VMAX):

Reversion to speed mode




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

**Applicable to: B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTI**

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.

*Note:* *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.*

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## PURPOSE OF THE ECAM

**Applicable to: 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 reduction of memory items.

## MAIN PRINCIPLES

**Applicable to: ALL**

### 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 ECAM's 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 aircraft's 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 a 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

**Applicable to: ALL**

## GENERAL

When carrying out ECAM procedures, both pilots must be aware of the present display. Before any "clear" action, both pilots shall cross-check the ECAM display to confirm that no blue action lines remain that can be eliminated by direct action, other than those actions that are not sensed by ECAM, e.g. thrust lever at idle when the FADEC is not powered.

## ADVISORIES

The crew should review the drifting parameter on the corresponding SYSTEM page. If time permits, the PM may refer to QRH ABN-80, which contains the recommended actions for the various advisory indications.

## CAUTIONS AND WARNINGS

| WARNING/CAUTION LEVELS | SIGNIFICANCE | ACTION |
|---|---|---|
| • Red Master Warning Light<br>• Continuous Repetitive Chime (CRC)<br>• Red ECAM Warning on EW/D | • System Failure affecting flight safety (e.g. ENG FIRE).<br>• Aircraft configuration warning | Reset the Master Warning.<br>This warning requires immediate action by the crew. In the case of a system failure, before commencing ECAM actions, the flight path must be stable and the aircraft should be above 400 ft AAL. |
| • Master Caution Light<br>• Single chime<br>• Amber ECAM Caution on EW/D | • A System failure that has no direct consequence to flight safety (e.g. B SYS LO PR) | Reset the Master Caution.<br>No immediate action is necessary. When workload permits and it is safe to do so, commence ECAM actions in the normal manner. |
| • Amber ECAM Caution on EW/D | • A simple failure leading to a loss of system redundancy. | There are no actions associated with this level of caution. It may be cleared when workload permits and requires awareness and monitoring by crew only. |

When the ECAM displays a warning or caution the first priority is to maintain a safe flight path. The successful outcome of any ECAM procedure is dependent on the precise reading and actioning of the procedure, maintenance of correct task sharing and deliberate monitoring and cross-checking. It is important to remember the following:

- In case of a failure during takeoff, approach or go-around, ECAM actions should be delayed until the aircraft reaches at least 400 ft AAL and is stabilised on a safe trajectory. However, any aural warning should be cancelled using the MASTER WARN pb.
- The PF is to fly the aircraft, navigate and communicate. The use of the AP is strongly recommended.
- The PM is to deal with the failure on command of the PF. He is responsible for reading aloud and executing the ECAM or checklist actions, which includes manipulation of thrust levers and engine master switches when directed by ECAM or checklist.
- Notwithstanding the above, during an engine start/shutdown malfunction on the ground the PF is responsible for executing the ECAM or checklist actions, including the manipulation of the engine master switches.
- Monitoring cross-checking remain primary tasks for both PF and PM.
- Prior to taking any action the PM should review the overhead panel and/or System Display (SD) to analyze and confirm the failure (bear in mind the sensors for the SD indications may be different to those that triggered the failure).

- ECAM actions may be stopped by the PF at any time by ordering, "Stop ECAM," if other specific actions must be performed; e.g. normal checklist, application of an OEB, computer reset. When the action is completed, the PF shall direct to, "Continue ECAM."
- At any time, the Captain may take control of the aircraft or order, "ECAM actions," if he considers it necessary.

## TASK SHARING

<table>
<tr><th></th><th>PF</th><th>PM</th></tr>
<tr><td rowspan="2">ECAM WARNING/CAUTION in manual flight.<br>Master Warning/Caution light and repetitive/single chime.</td><td>AUTOPILOT....................ENGAGE<br>Make maximum use of the Autopilot.<br><u>Note:</u> In the case of an engine failure while in manual flight, centre the beta target and use rudder trim to equalize rudder pressure before engaging the AP.</td><td></td></tr>
<tr><td colspan="2">• Either pilot may press the Master Warning/Caution to reset the warning and cancel any audio.<br>First pilot who notices:<br>Master Warning/Caution .........Reset<br>Announce ............"Master Warning/Caution, ECAM title."<br>Second pilot re-reads the ECAM title.</td></tr>
</table>

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| | PF | PM |
|---|---|---|
| **When the flight path is stabilized.**<br>(Minimum 400 ft AAL in the case of ECAM checklist displayed during the takeoff phase.)<br><u>*Note:*</u> *When appropriate, consider performance and navigation requirements, EOSID, deceleration to Green Dot, descent to lower level, etc.* | • Re-read the failure title.<br>e.g. "Engine 1 Fail." | • Read the failure title.<br>e.g. "Master Caution, Engine 1 Fail." |
| | • After both pilots have read the ECAM title, the PF initiates the ECAM actions.<br>ANNOUNCE........“I have control, ECAM actions,”<br>OR<br>ANNOUNCE........“Standby." | • Commence reading ECAM only when the necessary criteria have been met.<br>• If the PM wishes to delay commencement of ECAM actions, “Standby” should be used.<br>ECAM Actions.........Read and do. |
| **Evaluation of Damage after an Engine Failure.** | | • PM analyses engine indications and verbalizes his conclusion.<br>e.g. “Damage confirmed – EGT overtemp.”<br>e.g. “No damage – engine rundown only.” |
| | • PF provides own evaluation considering ECAM and aircraft handling characteristics.<br>e.g. “Agreed – engine damaged.”<br>e.g. "Agreed – no damage.” | |

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| | PF | PM |
|---|---|---|
| **Monitoring an Engine Fire.** | ANNOUNCE........"Check." | • If the ENG FIRE pb-sw remains illuminated 30 s after the second squib has been fired.<br>ANNOUNCE........"Fire not out." |
| | • Confirm the fire is out.<br>ANNOUNCE........"Check." | • When the ENG FIRE pb-sw is no longer illuminated.<br>ANNOUNCE........"Fire out." |
| **When the PF needs to interrupt the ECAM checklist procedure.** | • State required action or confirm selection, as appropriate, after stopping ECAM.<br>e.g. "Stop ECAM ......Activate the Secondary."<br>e.g. "Stop ECAM .......Direct To...."<br>• When the PF is ready for the ECAM to continue.<br>ANNOUNCE......"Continue ECAM." | |

## CROSS-CONFIRMATION

During ECAM procedures, some selectors must be positively cross-checked by both pilots before movement or selection to prevent the crew from carrying out inadvertent or irreversible actions. These are:

- Thrust lever
- Engine master switch
- Engine or APU fire pb-sw
- ADIRS panel controls
- All guarded pbs and switches
- All hydraulic pump switches (electric and engine driven) and PTU.

| | PF | PM |
|---|---|---|
| **Where the ECAM action requires cross-confirmation by the PF.** | | • Read the entire line as displayed by ECAM.<br>e.g. “Thrust Lever 1..............Idle.” |
| | | • Place hand/finger on the control to be moved/selected, while nominating the control.<br>e.g. “Number 1, Confirm?” |
| | • Visually confirm the correct control or (guarded) switch.<br>e.g. “Number 1, Confirm.” | |
| | | • Move the control or select the switch while stating the action.<br>e.g. “Idle.” |

The PF shall monitor all ECAM/checklist actions. Actions associated with memory items shall be confirmed by the PF when all memory items are complete and the aircraft is stabilized on the desired flight path. This can normally be done by reference to the ECAM MEMO.

## OVERHEAD PANEL

If overhead panel pbs or switch selections are to be made, identification of the correct panel is aided by reference to the system name, written in white at the side of each system panel.
The PM uses the terminology of "System, Procedure/Selector, Action," e.g. "Air, Cross Bleed, shut." By using this method and announcing the intended selection prior to execution, the PM keeps the PF aware of the progress of the procedure. Following a system failure, the associated amberfault light in the system pb on the overhead panel will be illuminated to aid proper identification. When carrying out system switch or pb selection, verify on the SD that the required action has occurred, e.g. closing the Cross Bleed valve changes the indications on the SD.

| | PF | PM |
|---|---|---|
| **Where the ECAM action requires action on the overhead panel.** | | • Read the entire line as displayed by ECAM.<br>e.g. "Crossbleed............Shut."<br>• State the name of the panel (if applicable), nominate the switch/control and state the action while carrying it out.<br>e.g. "Air > Crossbleed > Shut." |

## CLEARING TITLES

| | PF | PM |
|---|---|---|
| **Clearing ECAM titles.**<br>Note:<br>1. ECAM titles for independent failures are not boxed, for example:<br>**HYD B RSVR OVHT**<br>2. ECAM titles for primary failures are boxed, for example:<br>**B SYS LO PR**<br>3. An ECAM title may include both an independant failure and a primary failure, for example:<br>**HYD B RSVR OVHT**<br>**B SYS LO PR**<br>4. Secondary failures associated with a primary failure have a star infront of the title, for example: *F/CTL. | • Review ECAM before confirming the request.<br>ANNOUNCE....."Clear Hydraulics." | • Before clearing an ECAM title, review the SD page of the failed system (if displayed), for example: "We have lost the blue hydraulic system. Blue level is zero. The blue electric pump is off."<br>• When all the actions under an ECAM title are complete, request permission to clear the title.<br>ANNOUNCE....."Clear Hydraulics?"<br>• Press the CLR pb. The current ECAM title and any remaining action/boxed items will be cleared down to the next title (if any). |
| | • There is no requirement to repeat "I have control, ECAM actions." Re-read the ECAM title.<br>e.g. "Flight Controls, SEC 1 Fault." | • If futher ECAM titles are displayed, read the title.<br>e.g. "Flight Controls, SEC 1 Fault."<br>• Continue the ECAM actions associated with the title. |
| **Single line ECAM titles with no blue action lines.**<br>For example: **ENG 1 FUEL FILTER CLOG.** | • First pilot who notices calls the title, for example:<br>ANNOUNCE....."Engine 1, fuel filter clog."<br>ANNOUNCE....."I have control, ECAM actions."<br>ANNOUNCE....."Clear Engine 1." | ANNOUNCE....."Engine 1 fuel filter clog."<br>ANNOUNCE....."No actions required, clear Engine 1?"<br>ANNOUNCE....."ECAM actions complete." |

When reviewing secondary failures follow the same dIscipline of request and confirmation before action on the CLR pb.

| | PF | PM |
|---|---|---|
| **Viewing and clearing Secondary Failure pages on the SD.**<br>If **LAND ASAP** is displayed, use this prompt and it's colour to confirm or define what action is required to achieve a landing in an appropriate time. | ANNOUNCE....."Check." | • If **LAND ASAP** is displayed on the lower right of the E/WD.<br>ANNOUNCE....."Land ASAP, Amber/Red." |
| | | • Review the SD page associated with the secondary failure(s) (if applicable). For example, if *** F/CTL** is displayed on the lower right of the E/WD: "Secondary failure, flight controls. In addition to spoilers 1 and 5 you have lost the green hydraulic flight control actuators."<br>ANNOUNCE....."Clear flight controls?" |
| | • Review the SD page.<br>ANNOUNCE....."Clear flight controls." | |

## STATUS PAGE

When all ECAM checklist actions have been completed, the STATUS page is automatically displayed and should be reviewed by both pilots.

| | PF | PM |
|---|---|---|
| **When the STATUS Page is displayed**<br>In the case where an ECAM Warning or Caution is displayed before the After Takeoff Checklist is actioned, complete the After Takeoff Checklist before reading the STATUS page.<br>A green overflow arrow indicate further pages of status messages. To acess the remaining lines, press the STS key on the ECP. | ANNOUNCE....."Stop ECAM , After Takeoff Checklist,"<br>OR<br>ANNOUNCE....."Read Status."<br><br>ANNOUNCE....."Clear Status." | ANNOUNCE....."Status."<br><br>• Read Status line by line ensuring both pilots understand each line. Note items of specific relevance to the Approach and Landing.<br>ANNOUNCE....."Clear Status?" |
| **When ECAM actions are complete, the SD page returns to the flight phase related page.** | | ANNOUNCE....."ECAM actions complete." |

Following certain failures, or after multiple failures, the STATUS page may contain an excess of information. In order to extract the information essential for landing the aircraft safely, use the following guide:

- CONFIG – flap/slat setting, approach speed increment, landing distance factor and control law for landing.
- GEAR – when to lower the gear and whether normal or gravity lowering.
- BRAKES – normal, alternate or alternate without anti-skid.
- REVERSE – availability.
- LANDING WEIGHT – Overweight landing?

When carrying out such ECAM procedures, it is important both crew members cross-check the applicable landing configuration, approach speed increment and landing distance. These may be extracted from the QRH after the ECAM actions have been completed.
Having completed the ECAM procedures and prior to reviewing the STATUS, ensure that any relevant normal checklists have been actioned. After reviewing the STATUS, refer to OEBs and consider any applicable computer resets. Refer to the QRH ABN-80 for landing distance and VAPP calculations. If an applicable QRH Summary exists, review the Summary once the ECAM actions have been completed (Summaries include VAPP and landing distance tables).

ECAM procedures and the STATUS, supplemented by a check on the PFD/ND are sufficient for handling the fault. If time permits, and when ECAM actions have been completed, refer to the appropriate FCOM PRO-ABN procedure for supplementary information. However in critical situations, do not prolong the flight for the sole purpose of consulting the FCOM .

- When reviewing the STATUS prior to descent, aircraft configuration for landing should be emphasised. During the descent and approach, the PM should advise the PF of the next abnormal event at a time that will keep crew workload to a minimum. This sequence should be repeated until all items have been reviewed and/or completed. The STATUS page is automatically recalled during descent when the slats are extended (Flaps 1 selected).

If the ECAM warning (or caution) disappears while applying the procedure, it can be assumed the warning is no longer relevant and the applicable procedure can be stopped. An example of this would be during an engine fire procedure and the fire was extinguished successfully with the first fire bottle. The Engine Fire warning would go out and the procedure can be stopped. Any remaining ECAM procedures should be handled in the normal manner.
If an ECAM caution disappears during the completion of a procedure, the CLR lights extinguish on the ECP and the STATUS page will not be displayed automatically. If the STS reminder prompt is displayed at the bottom of the E/WD, the STATUS page will need to be manually selected to check the status items.

## MULTIPLE CAUTIONS AND WARNINGS

Most failures are straightforward and should not present any difficulty when handling the related ECAM procedure. Some failures, however, can produce multiple ECAM procedures and in these cases the following points should be considered.

- Complete all required actions (blue) associated with the first red or amber ECAM title (e.g. **HYD G RSVR LO LVL**).
- Clear the title of the first failure before dealing with next failure. The first ECAM title and any remaining action/boxed items will be cleared from the display down to the next title.
- Subsequent ECAM Failure Titles must be announced by PM and repeated by PF. This ensures that PF is aware of multiple failures.
- Carry out the second drill until its red/amber title can be cleared, before starting on the third etc.
- Do not leave red/amber titles on the E/WD when all actions associated with that failure have been completed. Clear the title when the applicable actions have been completed.
- When all necessary actions have been completed there will be no red/amber titles displayed on the lower part of the E/WD.

## ECAM HANDLING - EXAMPLE OF CREW COORDINATION DURING ECAM ACTIONS

**Applicable to: ALL**

| WARNING DISPLAY | PF DUTIES | PM DUTIES |
|---|---|---|
| **Master Caution & Single Chime.** | First pilot who notices:<br>Master Warning/Caution....................Reset<br>Announce............."Master Warning/Caution, ECAM title."<br>Second pilot re-reads the ECAM title. | |
| **HYD B RSVR OVHT**<br>• **BLUE ELEC PUMP......OFF** | | ANNOUNCE.....“Master Caution, Hydraulic, Blue Reservoir Overheat.” |
| | Confirm the failure. Repeat the failure title; "Hydraulic, Blue Reservoir Overheat."<br>• If it is necessary to delay the ECAM the procedure to a more appropriate time; "Standby."<br>• When ready to initiate the ECAM procedure; "I have control, ECAM actions." | |
| | | ANNOUNCE......"Blue Electric pump, off."<br>ANNOUNCE and ACTION......<br>"Hydraulics > Blue Electric Pump > Off." |

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| WARNING DISPLAY | | PF DUTIES | PM DUTIES |
| --- | --- | --- | --- |
| **Master Caution & Single Chime.** | | • If ECAM actions trigger further Master Warning/Cautions there is no requirement to repeat "I have control, ECAM actions." | • Press the Master Caution to reset the caution. |
| **HYD B RSVR OVHT**<br>**B SYS LO PR** | ***F/CTL** | | ANNOUNCE......"Blue System Low Pressure. No actions required. Clear Hydraulics?" |
| | | • Check the ECAM.<br>ANNOUNCE......"Clear hydraulics." | |
| | | | • Press the CLR pb. The hydraulic ECAM title will be cleared. (Note: LAND ASAP is not displayed for this failure.)<br>ANNOUNCE......"Secondary Failure, flight controls." (Give a concise summary of the SD page.)<br>ANNOUNCE......"Clear flight controls?" |
| | | • Check the ECAM.<br>ANNOUNCE......"Clear flight controls." | |
| | | | • Press the CLR pb. The flight control secondary failure title will be cleared and the STATUS page will then be displayed. |

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| WARNING DISPLAY | | PF DUTIES | PM DUTIES |
|---|---|---|---|
| **STATUS**<br>APPR PROC<br><br>**IF BLUE OVHT OUT:**<br>• **BLUE ELEC PUMP.....AUTO**<br><br>**IF HYD NOT RECOVD:**<br>• **LDG DIST PROC.....APPLY**<br><br>**SLATS SLOW CAT 3 SINGLE ONLY** | **STATUS**<br>INOP SYS<br>B HYD<br>SPLR 3<br>CAT 3<br>DUAL<br>B ELEC<br>PUMP | ANNOUNCE......"Read Status."<br><br>ANNOUNCE......"Clear Status." | ANNOUNCE......"Status."<br><br>• Read the STATUS page line by line and ensure both pilots understand each item. Landing distance and VAPP calculations should be done after the ECAM actions are complete.<br><br>ANNOUNCE......"Clear Status?"<br><br>• Press the CLR pb. |
| System display returns to the flight phase related page. STS prompt remains displayed near the bottom of the E/WD as a reminder that items are listed on the Status page. | | | ANNOUNCE......"ECAM actions complete." |

## SOME ADDITIONAL REMARKS

- There are very few memory items:
  - Immediate actions of EMER DESCENT
  - Immediate actions, in case of an unreliable speed indication
  - Loss of braking
  - Windshear (reactive and predictive)
  - EGPWS and GPWS
  - TCAS
  - Stall recovery and stall warning at lift-off
  - Crew incapacitation
- In some cases, the ECAM displays: "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.

  Note: *The CLOSEST AIRPORTS MCDU page may help the flight crew to determine the nearest suitable airport: This page displays the four airports that are the nearest to the aircraft's current position. These airports are found in the navigation database, and are displayed regardless of their suitability.The flight crew should keep in mind that the four closest airports are sorted according to distance, and should refer to the EstimatedTime of Arrival (ETA).*

- 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 /OEB 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.

## ECAM HANDLING - IN CASE OF AN ECAM FAULT

**Applicable to: ALL**

## DISPLAY UNIT FAILURE

All screens are identical, providing redundancy either automatically or by switching. The various options to allow switching of screens in the event of screen failure are detailed in FCOM DSC-31-05-60. In the case of single ECAM display the remaining screen displays the E/WD.

There is no automatic display of the SD page associated with a failure or an advisory and so further analysis of the failure requires the relevant system page pb to be pressed and held. The SD page will temporarily replace the E/WD. This also applies when reviewing secondary failures.
The STATUS page is only displayed when the STS pb is pressed and held. The STATUS page will temporarily replace the E/WD. In order to view more pages of status messages the STS pb must be released for less than 2 seconds and then pressed and held again.
If the STS pb or system page pb is held for longer than 3 minutes, the display automatically reverts back to the E/WD. Alternatively, the SD and STATUS pages may be transferred to either pilot’s ND using the ECAM/ND Transfer Selector. With dual screen mode established once again, ECAM operation is normal.
In the case of failure of both ECAM displays, the E/WD may be transferred to either pilots ND using the ECAM/ND Transfer Selector to establish single screen mode.

## 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).

## SPURIOUS CAUTION

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

## RCL PUSHBUTTON

The RCL pushbutton allows to call up all ECAM alerts and the STATUS page that may have been suppressed by the CLR pushbutton or by flight-phase-related inhibition.
Any alerts that have been inhibited by the EMER CANCEL pushbutton are displayed when the flight crew holds the RCL pushbuttom down for more than three seconds.

# USE OF SUMMARIES

Applicable to: ALL

## GENERAL

SUMMARIES consist of QRH procedures, and are designed to assist the flight crew to manage applicable actions, in the event of an ELEC EMER CONFIG ECAM warning or a dual hydraulic failure.
In any case, **ECAM actions should be applied first** (actions and STATUS review). The PM should refer to the applicable QRH SUMMARIES, only after announcing: "ECAM ACTIONS COMPLETED".

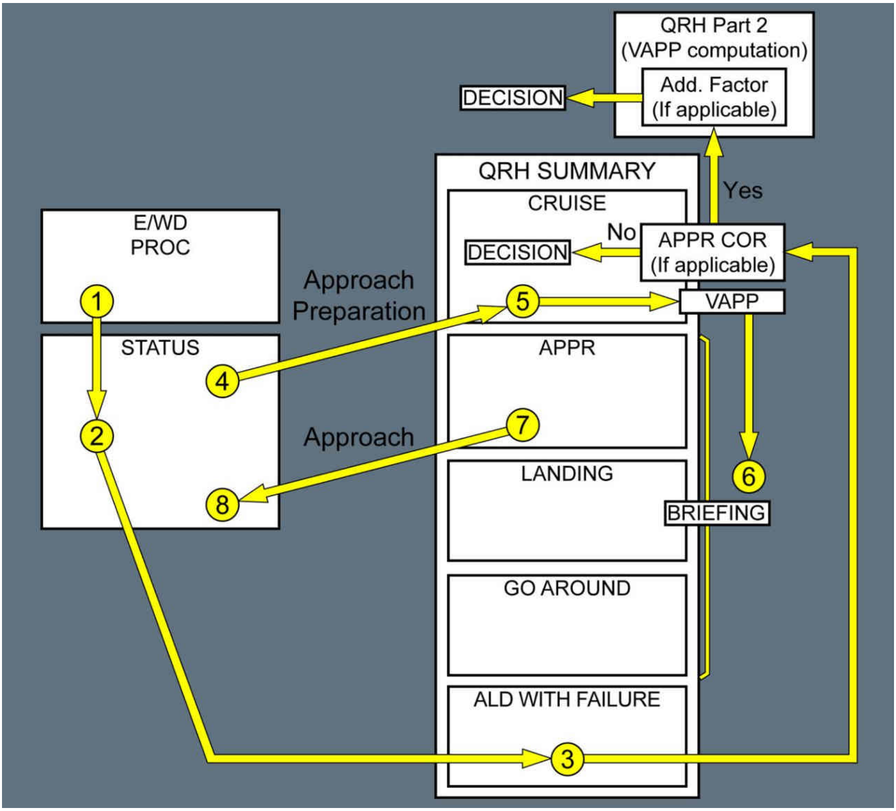
## APPROACH PREPARATION

As usual, approach preparation includes a review of the ECAM STATUS.
After reviewing the STATUS, the PM should refer to the "CRUISE" section of the SUMMARIES, to determine the VREF correction, and compute the VAPP.
This assumes that the PM is aware of the computation method, and uses the VREF displayed on the MCDU (with the updated destination). The SUMMARIES provides a VREF table, in the event that failure results in the loss of the MCDU.
The LANDING and GO-AROUND sections of the SUMMARIES should be used for the **approach briefing**.

## APPROACH

To perform the APPR PROC, the APPROACH section of the SUMMARIES 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 SUMMARIES 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 PM should then review the ECAM STATUS**, and check that all the APPR PROC actions have been completed.

sequence


QRH Part 2
(VAPP computation)
Add. Factor
(If applicable)
DECISION
QRH SUMMARY
CRUISE
Yes
No
APPR COR
(If applicable)
DECISION
E/WD
PROC
1
Approach
Preparation
5
VAPP
STATUS
APPR
4
2
Approach
7
LANDING
6
8
BRIEFING
GO AROUND
ALD WITH FAILURE
3

# CREW RESOURCE MANAGEMENT (CRM)

Applicable to: ALL

Crew resource management is the application of team management concepts and the effective use of all available resources to operate a flight safely. In addition to the aircrew, it involves all other groups who are involved in the decisions required to operate a flight. These groups include, but are not limited to; aircraft dispatchers, flight attendants, maintenance personnel and air traffic controllers.
Throughout this manual, techniques that help build good CRM habit patterns on the flight deck are discussed. Situational awareness and communications are stressed. Situational awareness, or the ability to accurately perceive what is going on in the flight deck and outside the aircraft, requires on-going questioning, cross-checking, communication and refinement of perception.
It is important that all flight deck crew identify and communicate any situation that appears unsafe or out of the ordinary. Experience has proven that the most effective way to maintain safety of flight and resolve these situations is to combine the skills and experience of all crew members in the decision making process to determine the safest course of action.

# THREAT AND ERROR MANAGEMENT (TEM)

Applicable to: ALL

## GENERAL

Threat and error management is the process that effective crews follow to manage the safe and efficient operation of their aircraft. This is the first time the industry has been able to define airmanship in a practical and simple manner and has now become the governing philosophy that helps guide everything we do in flight operations.
Threats are those contingencies that add additional complexity to the operation and increase the potential for error. They can be obvious ones such as a thunderstorm off the end of the runway or can be seemingly insignificant, such as an ACARS printer failure. All, however, increase the potential for error and all have to be properly managed. Good threat management requires good anticipation, sharing the threat with the other crew and the development of a strategy.
Error management (Resolve Phase) is the tool that the crew use to minimise the consequence of an error. This involves the use of a combination of non-technical (CRM) and technical (operational) skills. At its very core is the importance of monitoring and the ability to challenge once an unsafe situation is detected.

## MONITORING

Effective monitoring requires sensible workload management to ensure that the PM is not overloaded at a critical phase of flight. This may involve delaying certain tasks to a more appropriate time (Aviate, Navigate, Communicate). Effective monitoring also involves the sharing of a mental model with the PM. This principle is known as communication of intent. In its simplest form, communications of intent is achieved through the C-TWO plus departure and arrival briefing.

## CHALLENGE

All crew members have the responsibility to advise the Commander any time that an unsafe or potentially unsafe condition exists. The following strategy is recommended:

- Supportive statement: express personal concern, using standard calls if possible.
- Question: determine the PF's plan, e.g. "Will you be fully stabilised by 1 000 ft?"
- Solution: offer an alternative, e.g. "Would you like some extra track miles?"
- Action: "Captain you MUST LISTEN" or, if circumstances require, take over.

However, we must never become over assertive to the extent that we challenge routine decisions. The strategy recommended above is for dealing with unsafe situations only.

## CALLOUTS

**Applicable to: ALL**

Avoid casual and non-essential conversation during critical phases of flight, particularly during taxi, takeoff, approach and landing. The PM makes callouts based on FMA changes appropriate to the flight mode. The PM verifies the condition from the FMA and acknowledges. If the PF does not make the required callout, the PM should make it. There is no competition to see who can be the first to call these changes; the PM should allow reasonable time for the PF to call and not pre-empt him with every change. The PF should alert the PM prior to disconnecting the autopilot.
One of the basic fundamentals of CRM is that each crew member must be able to supplement or act as a back-up for the other crew member. Correct adherence to standard callouts is an essential element of a well-managed flight deck. These callouts provide both crew members with the required information about aircraft systems and confirmation of the other crew member's involvement. The absence of a standard callout at the appropriate time may indicate a system malfunction or the possibility of pilot incapacitation.

## STANDARD FMA CALLOUTS

**Applicable to: ALL**

Refer to SI-090.

## STANDARD PHRASEOLOGY

**Applicable to: ALL**

Refer to FCOM PRO-NOR-SOP-90 and Part A 8.3.13.

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# NORMAL OPERATIONS

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## NO-PLP PRELIMINARY PAGES



## NO-010 GENERAL



## NO-020 PRE START



## NO-030 START



## NO-040 TAXI

TABLE OF CONTENTS

## NO-050 TAKEOFF



## NO-060 CLIMB



## NO-070 CRUISE

## NO-080 DESCENT PREPARATION



## NO-090 DESCENT



## NO-100 HOLDING



## NO-110 APPROACH GENERAL



## NO-120 ILS APPROACH



## NO-130 NON PRECISION APPROACH

## NO-180 GO AROUND



## NO-190 TAXI IN

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# SUMMARY OF HIGHLIGHTS

| Localization Title | Toc Index | ID | Reason |
|---|---|---|---|
| NO-020<br>COCKPIT PREPARATION | E | 1 | Update of the illustration |
| NO-020<br>COCKPIT PREPARATION | E | 2 | Update of the illustration |
| NO-030<br>After Start Flow Pattern | G | 1 | Documentation update: Addition of "After Start Flow Pattern" documentary unit |
| NO-040<br>Taxi Flow Pattern | O | 1 | Documentation update: Addition of "Taxi Flow Pattern" documentary unit |
| NO-060<br>AP/FD CLIMB MODES | B | 1 | Update of the technical content<br>New highlightUpdate of the technical content |
| NO-060<br>AP/FD CLIMB MODES | B | 2 | Update of the technical content |
| NO-060<br>AP/FD CLIMB MODES | B | 3 | Update of the technical content |
| NO-070<br>PREFACE | A | 1 | DU revised to insert space between "ALT CRZ" and "is" |
| NO-080<br>LANDING PERFORMANCE | A | 1 | Documentation update: Addition of "LANDING PERFORMANCE" documentary unit |
| NO-090<br>DESCENT CONSTRAINTS | E | 1 | DU revised to insert space between "DIR TO" and "clearance" |
| NO-090<br>DESCENT CONSTRAINTS | E | 2 | - DU revised to insert space between "DIR TO" and "clearance"<br>- DU revised to insert space between "DIR TO" and "with" |
| NO-110<br>INTERMEDIATE APPROACH | C | 1 | **Update of the technical wording** |
| NO-110<br>INTERMEDIATE APPROACH | C | 2 | Revision in order to highlight the fact that the flight crew should sequence the F-PLN before the flight crew presses APPR p/b. |
| NO-110<br>INTERMEDIATE APPROACH | C | 3 | **Revision in order to highlight the fact that the flight crew should<br>sequence the F-PLN before the flight crew presses APPR p/b.** |
| NO-110<br>FINAL APPROACH | D | 4 | **Replace MDA/DH by minima** |
| NO-120<br>FINAL APPROACH | D | 1 | Update of the technical wording |
| NO-130<br>REACHING THE MINIMA | G | 1 | Effectivity update: The information no longer applies to MSN 5024, 5030, 5362, 5429. |
| NO-130<br>REACHING THE MINIMA | G | 2 | Effectivity update: The information no longer applies to MSN 0633, 0756, 0784, 0812, 0930, 0993, 1024, 1253, 1695, 1721, 1984, 2021, 2229, 2238, 2428, 4023, 4247. |
| NO-130<br>REACHING THE MINIMA | G | 3 | Documentation update: Addition of "REACHING THE MINIMA" documentary unit |
| NO-140<br>Circling Approach pattern | B | 1 | Update of the illustration |

| Localization Title | Toc Index | ID | Reason |
|---|---|---|---|
| NO-150 VISUAL APPROACH DIAGRAM | C | 1 | Update of the illustration |
| NO-170 LANDING PERFORMANCE | B | 1 | Update of the technical wording |
| NO-170 ROLL OUT | H | 2 | Deletion of “differential drag due to spoiler retraction” because it is not applicable to this aircraft. |
| NO-170 BRAKING | I | 3 | Enhancement of the landing procedure. The flight crew may now maintain REV IDLE on dry runway only and if landing performance permits. For any other case, they should immediately select REV MAX on all reverser levers after the main landing gear touches down. |
| NO-170 TAIL STRIKE AVOIDANCE | K | 4 | **Addition of HSQ and HSR** |
| NO-180 AP/FD GO-AROUND PHASE ACTIVATION | C | 1 | Revision in order to clarify the FMGS behavior in case of Go-Around with the thrust levers not set to the TOGA detent. |
| NO-180 AP/FD GO-AROUND PHASE ACTIVATION | C | 2 | Revision in order to clarify the FMGS behavior in case of Go-Around with the thrust levers not set to the TOGA detent. |
| NO-190 AFTER LANDING FLOW PATTERN | E | 1 | Update of the illustration |

## INTRODUCTION

Applicable to: 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 can be found in SI-010 General.

## USE OF CHECKLISTS

Applicable to: ALL

The FCOM PRO-NOR is set out in a logical sequence and provides the structure around which crew base their operation in order to provide a common standard. Flow patterns are designed to allocate actions to each crew member to share the workload. By following the flow patterns, each crew member ensures that all actions necessary for any particular phase of flight have been accomplished prior to the completion of the relevant checklist. Normal checklists are of the 'non-action' type, i.e. all actions should be completed from memory prior to the checklist being called for. The response to a checklist item confirms that the correct action has already been carried out. FCOM PRO-SUP is used only when required, and where present the checklists are of the 'action' type, i.e. 'read and do'. Abnormal checklists are provided to deal with and resolve abnormal situations on the ground or in flight and are located in FCOM PRO-ABN. By contrast to Normal Checklists, Abnormal Checklists are of the 'action' type, i.e. the 'read and do' philosophy applies.

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# MMEL/MEL

Applicable to: ALL

## INTRODUCTION TO THE MMEL

The Master Minimum Equipment List (MMEL) is developed to improve the aircraft use and thereby to provide more convenient and economic air transportation for the public.
The MMEL is a document that lists the system, function, or equipment which may be temporarily inoperative, subject to certain conditions, while maintaining an acceptable level of safety. It does not contain obviously required items such as wings, flaps, and rudders.
ALL ITEMS RELATED TO THE AIRWORTHINESS OF THE AIRCRAFT AND NOT INCLUDED IN THE MMEL ARE AUTOMATICALLY REQUIRED TO BE OPERATIVE FOR DISPATCH.
Non-safety related equipment such as galley equipment and passenger convenience items do not need to be listed.
The MMEL is the basis for the development of individual Operator's MEL which takes into consideration the Operator's particular aircraft equipment configuration and operational conditions.
In order to maintain an acceptable level of safety and reliability, the MMEL establishes limitations on the duration and on conditions for operation with inoperative item.

## INTRODUCTION TO THE MEL

The Minimum Equipment List (MEL) is based on the MMEL.
An Operator's MEL may differ in format from the MMEL, but cannot be less restrictive than the MMEL.
The MEL shall not deviate from any applicable Airworthiness Directive or any other Mandatory Requirement.
The MEL is intended to permit operation with inoperative system, function, or equipment for a period of time until repairs can be accomplished. It is important that repairs be accomplished at the earliest opportunity.
Suitable conditions and limitations in the form of placards, maintenance procedures, crew operational procedures, and other restrictions are necessary in the MEL to ensure that an acceptable level of safety is maintained.
The MEL takes into consideration the Operator's particular aircraft equipment, configuration and operational conditions, routes being flown, and requirements set by the appropriate Authority.
When an item is discovered to be inoperative, it is reported by making an entry in the technical logbook. The item is then either rectified or may be deferred per the MEL before further operation.
MEL conditions and limitations do not relieve the Operator from determining that the aircraft is in a correct condition for safe operation with items inoperative.
The provisions of the MEL are applicable until the aircraft starts the flight. Any decision to continue a flight following a failure or unserviceability must be subject to flight crew judgment and

good airmanship. The Commander may continue to make reference to the MEL and use it as appropriate.

By approval of the MEL, the Authority permits dispatch of the aircraft for revenue, ferry, or training flights with certain items inoperative provided an acceptable level of safety is maintained:
- By use of appropriate operational or maintenance procedures or
- By transfer of the function to another operating system or
- By reference to other instruments or systems providing the required information.

## MEL ITEM NUMBERING

A code of three or four pairs of digits identifies each MEL item.
The three first digits of this numbering system follow the ATA Spec 2200.

For practical reasons, the second pair of digit also follows the below Airbus organization:
- 01 refers to items located on the overhead panels
- 05 refers to indications on the PFD
- 06 refers to indications on the ND
- 07 refers to indications on the SD pages
- 08 refers to indications on the EWD
- 09 refers to ECAM alerts
- 10 to 95 follow the ATA Spec 2200

For more information on the MEL, refer to MEL/HOW TO USE section.

## MEL CONTENTS

The MEL has four sections:
- How to Use (HOW): This section contains general information and describes the organization of the manual.
- MEL Entries (ME): This section lists all the ECAM alerts and gives a link to the associated MEL item (if any) to be applied for the dispatch. This section is a user-friendly entry point for the flight crew and the maintenance personnel when an ECAM alert reports a system failure.
- MEL Items (MI):This section is approved by the EASA and lists all the MEL items with the associated dispatch conditions.
- MEL Operational Procedures (MO): This section gives the operational procedures that are associated with the MEL items.

*Note:* *The MEL Maintenance Procedures are published in the Aircraft Maintenance Manual (AMM).*

## OPERATIONAL USE OF THE MEL

The provisions of the MEL are applicable until the aircraft starts the flight. Any decision to continue a flight following a failure or unserviceability must be subject to flight crew judgment and good airmanship. The Commander may continue to make reference to the MEL and use it as appropriate.

Airbus recommends that the Operator establishes guidelines in their own MEL, on how the flight crew should handle failures occurring during taxi out, depending on:
- Departure and destination airports: e.g. main base, outstation
- The type of flight: e.g. livestock transportation, maximum altitude, airspace, flight time, weather
- The operational impacts: flight crew workload, navigation, communication, landing capability.

During the preliminary cockpit preparation, the flight crew should press the RCL pb for at least 3 s, in order to recall any previous alerts that were cleared or cancelled. The flight crew must also consult the technical logbook to confirm that the alerts are compatible with the MEL.
The purpose of the MEL Entries section is to help the flight crew to determine the MEL entry point. It provides the relationship between the failure symptom (i.e. ECAM alerts), and the MEL items, if applicable.
If a failed item does not appear in the MEL, it is not possible to dispatch the aircraft, except if the item is not related to airworthiness or to operating requirements (e.g. galley equipment, entertainment systems, or passenger convenience items). The dispatch applicability of these items is not relevant to the MEL.

If the failed item appears in the MEL, the dispatch of the aircraft is permitted, provided that all of the dispatch conditions are satisfied:
- Check on the technical logbook that the repair interval time did not expire. For more information on the repair interval, refer to MEL/MI-PRE-RI Repair interval.
- Consider location and when the repair is possible
- Placard means that an INOP placard is required
- (o) means that a specific operational procedure or limitation is required
- (m) means that a specific maintenance procedure is required.

The dispatch of an aircraft is also possible with some secondary airframe part or parts missing. In such a case, refer to the Configuration Deviation List (CDL) at the rear of the MEL.

When the aircraft performs several flights with the same inoperative MEL item:
- The operational procedure (if any) should be repeated before each flight, unless differently specified. The flight crew usually applies the operational procedure during the cockpit preparation, but some actions can be applicable during other flight phases
- The maintenance procedure (if any) is normally a one-time action that must be applied before the first MEL dispatch. However the dispatch condition may specify a periodicity for repetitive actions. In this case the maintenance procedure must be applied before the first MEL dispatch and must be repeated at the defined periodicity.

In the case of failures occurring during flight, the MEL is not applicable. For in-flight failures, the flight crew should follow the ECAM alerts. The only exception to this rule is when an operational procedure in the MEL requires flight crew action during the flight, since it can deviate from usual flight crew action.
However, the flight crew can consult the MEL, in flight, following a failure, to plan effectively the end of the flight. Are there maintenance personnel available at destination for deactivation? Is there a need for a spare part to be ordered?
Refer to Part A 8.6.2 for company policy regarding the use of the MEL and CDL.

## SAFETY EXTERIOR INSPECTION

**Applicable to: ALL**

An assessment should be made of the aircraft external environment before applying pneumatic or hydraulic power. Items to check include:
- Wheel chocks (the Park Brake must be applied if chocks are not in place),
- Landing gear door positions,
- APU inlet and exhaust areas,
- Connection of external electrics,
- Connection of external air-conditioning or HP air.

This visual assessment is normally made when approaching the aircraft from ground level. However, where such an assessment is not feasible, co-ordination with the ground engineer must be established before starting the APU or activating aircraft pneumatic, electric or hydraulic systems.
Double chocks should be positioned approx 2 inches forward and aft of the nose wheel. Main wheels must also be chocked if wind or ramp slope conditions require, and/or if single type chocks only are used on the nose wheel. Be aware that the parking brake efficiency is significantly reduced if ACCU PRESS falls below 1 500 psi (amber sector).

## EXTERIOR INSPECTION

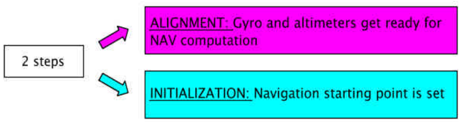
**Applicable to: ALL**

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 to 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

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN**




### 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 min, 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 s). 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 5 nm. 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 airport pair on the INIT A page, and does not re-align the ADIRS.

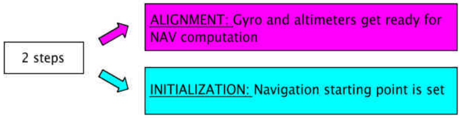
In this case, check the coordinates on the INITA page and compare them with:

- 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.

# ADIRS INITIALIZATION

Criteria: P8194, SA
**Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**




## 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 min, 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 s). 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 airport 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

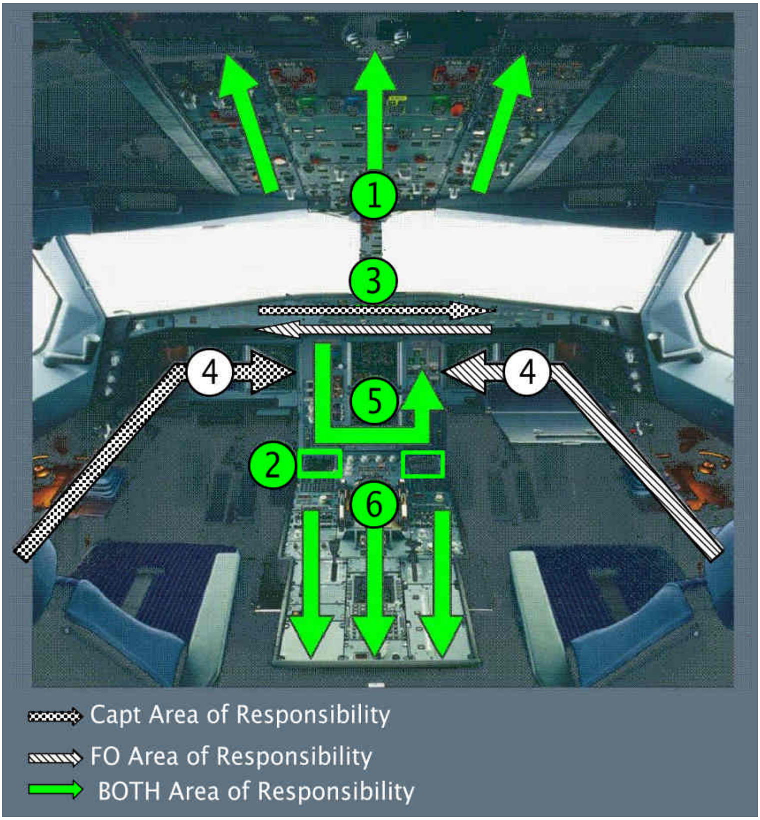
When the ADIRS are in NAV mode, and new origin airport coordinates are inserted, the RESET IRS TO NAV message triggers.
This occurs, in transit, when the crew performs a fast alignment, since this fast alignment is usually completed before the crew enters the FROM-TO airport pair.
Check the validity of the IRS initialization, before clearing this message.

## COCKPIT PREPARATION

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

1 **FLOW PATTERN**

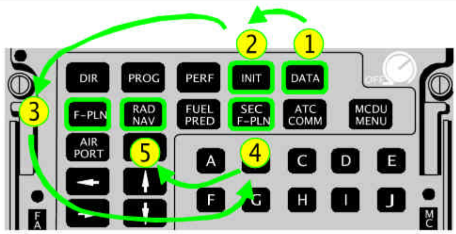
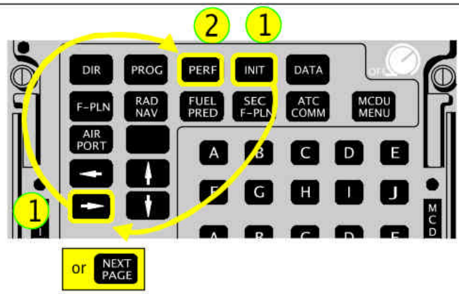
The scan pattern will normally be completed in the following sequence:
1. Overhead panel: Turn off any white lights
2. FMGS preparation
3. Glareshield
4. Lateral consoles and PF/PM panels
5. Center instrument panel
6. Pedestal



## 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 |  |

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 NO-020 ADIRS INITIALIZATION*).
  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 1 500 ft. 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 1 500 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 PM should then cross check the information prior to the take-off briefing.
When the predictions are available, the crew may print the PREFLIGHT DATA ⊲* . This listing provides all the predictions which may be used during the initial part of the flight.

## TAKE-OFF BRIEFING

Refer to SI-080.

COCKPIT PREPARATION

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

2 **FLOW PATTERN**

The scan pattern will normally be completed in the following sequence:
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3. Glareshield
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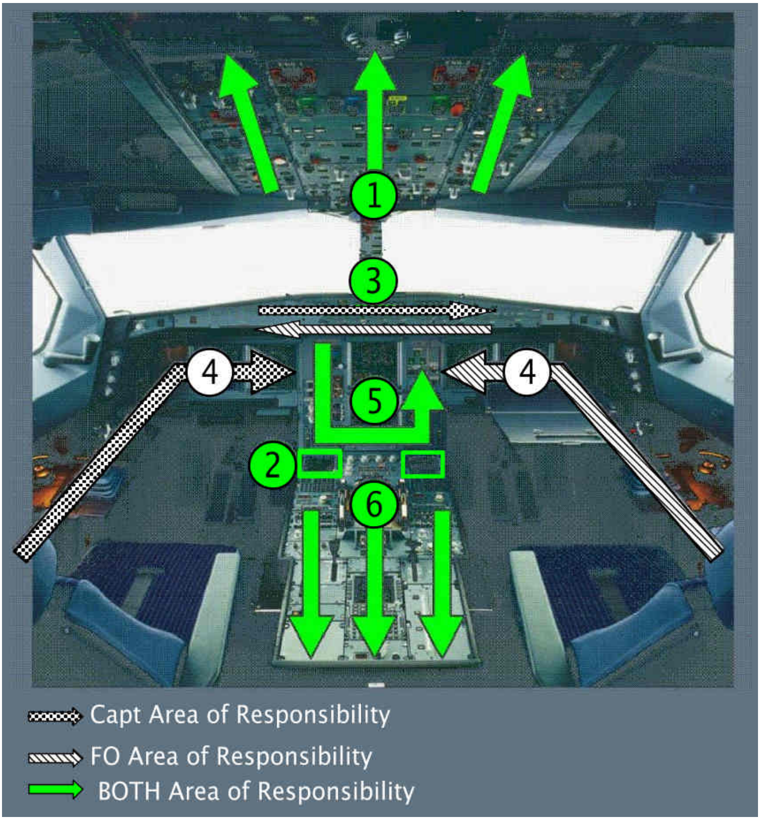

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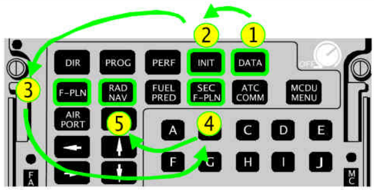
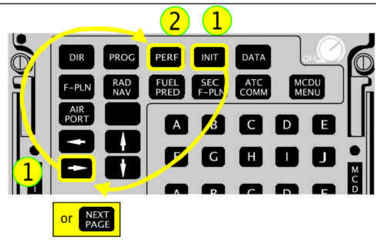
| Navigation | Status<br>Init A<br>F-PLN<br>(SEC F-PLN)<br>RAD NAV |  |
| Performance | Init B<br>PERF |  |

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  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.
  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 1 500 ft.
  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 1 500 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 PM should then cross check the information prior to the take-off briefing.
When the predictions are available, the crew may print the PREFLIGHT DATA ⊲* . This listing provides all the predictions which may be used during the initial part of the flight.

**TAKE-OFF BRIEFING**

Refer to SI-080.

# MISCELLANEOUS

Applicable to: 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 appropriate 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 PM will display the MCDU F-PLN page.

## ENGINE AUTO START

Applicable to: 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
- IGN indication off (*Refer to FCOM/PRO-NOR-SOP-08 Automatic Engine Start*)
- Start valve closes

When the engine is at idle, (grey background on the N2 indication disappears), 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).

## AVERAGE IDLE ENGINE PARAMETERS

**Applicable to: ALL**

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 21.4 %
N2 about 57.8 %
EGT about 414 °C
FF about 350 kg/h - 775 lb/h

## ENGINE START MALFUNCTION

**Applicable to: 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, *Refer to FCOM/LIM-70 Starter*, must be observed.

## MANUAL ENGINE START

**Applicable to: 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 FCOM/PRO SUP 70 A.Manual Engine Start* 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

**Applicable to: 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 of the 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 be used as last resort: Chemical or dry chemical powder causes serious corrosive damage to the engine.

## ENGINES WARM UP PERIOD

**Applicable to: ALL**

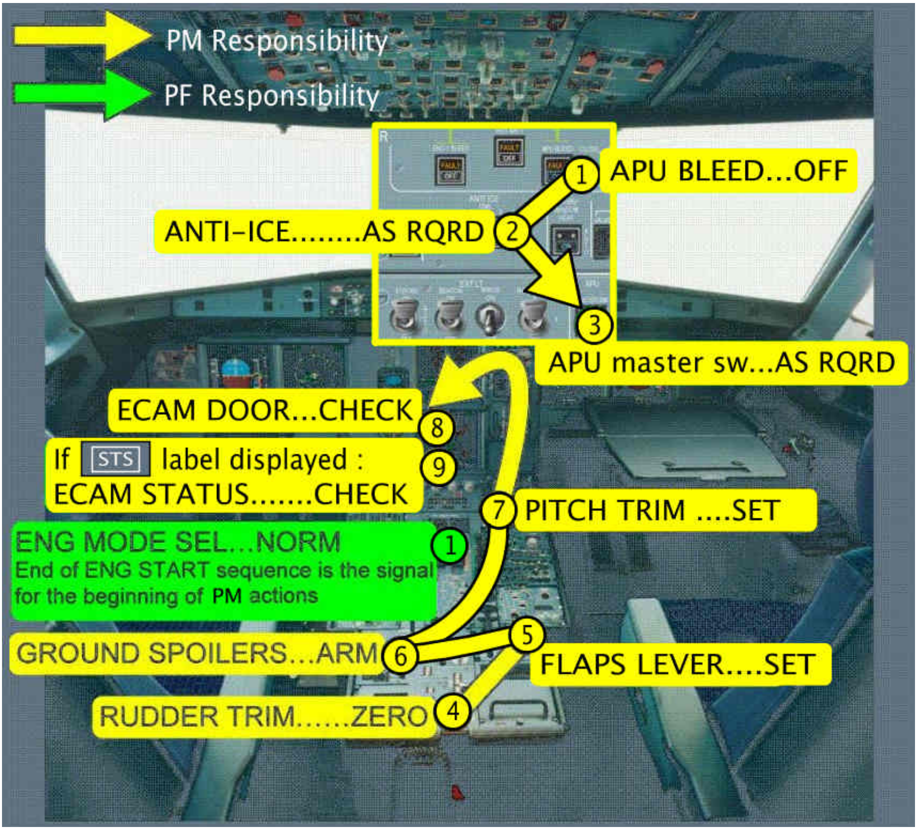
After engine-start, and in order to avoid thermal shock of the engine, the engine should be operated at idle or near idle (*Refer to FCOM/PRO-NOR-SOP-09 After Start - ENG Start Selector*) before setting the thrust lever to high power. The warm-up can include any taxi time at idle.

## AFTER START FLOW PATTERN

**Applicable to: ALL**

1

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


PM Responsibility
PF Responsibility
1 APU BLEED...OFF
ANTI-ICE........AS RQRD 2
3
APU master sw...AS RQRD
ECAM DOOR...CHECK 8
If STS label displayed : 9
ECAM STATUS.......CHECK
7 PITCH TRIM ....SET
ENG MODE SEL...NORM 1
End of ENG START sequence is the signal for the beginning of PM actions
GROUND SPOILERS...ARM 6
5
FLAPS LEVER....SET
RUDDER TRIM......ZERO 4

## POWERPUSH

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN**

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.

## POWERPUSH

Criteria: P4576, SA
**Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

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.

## PREREQUISITES TO COMMENCE TAXI

**Applicable to: ALL**

The Park Brake shall not be released until:
- The nose wheel steering pin has been sighted (following a pushback).
- Ground crew 'thumbs up' signal has been received indicating all personnel and equipment are clear,
- The After Start Checklist has been completed,

- ATC taxi clearance has been received, confirmed and understood by both pilots,
- The NOSE light is set to TAXI,
- Both pilots have visually confirmed and cross-checked there are no obstructions in the taxi path.

## TAXI ROLL AND STEERING

**Applicable to: ALL**

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

### THRUST USE

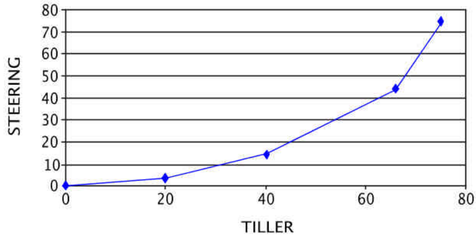
Only a little power is needed above thrust idle, in order to get the aircraft moving (N1 40 %). Excessive thrust application can result in exhaust-blast damage or Foreign Object Damage (FOD). Thrust should normally be used symmetrically.

### TILLER AND RUDDER PEDALS USE

Pedals control nosewheel steering at low speed (± 6 ° 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.

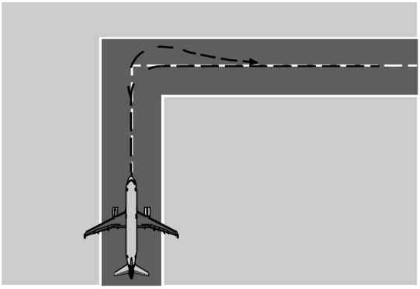



Therefore, the PF should move the tiller smoothly and maintain the tiller's position. Any correction should be small and smooth, and maintained for enough time to enable the pilot to assess the outcome. Being over-active on the tiller will cause uncomfortable oscillations.
On straight taxiways, the aircraft is correctly aligned on the centerline, when the centerline is lined-up between the PFD and ND.

Proper centerline following

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 °, and the visual ground geometry provides an obscured segment of 42 ft (12.5 m). 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 m behind the pilot.

Oversteering technique



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 kt and nosewheel steering can be used. With two tires deflated, the aircraft speed is limited to 3 ktand nosewheel steering angle should be limited to 30 °.
For turns of 90 ° or more, the aircraft speed should be less than 10 kt.

## 180 ° TURN

For turn of 180°, the following procedure is recommended for making a turn in the most efficient way.

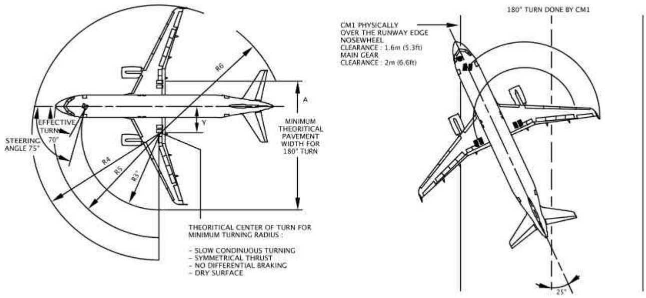
For the LHS

- 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 ground speed between 5 kt and 8 kt
- When the LHS assesses to be physically over the runway edge, smoothly initiate a full deflection turn to the right
- Asymmetric thrust will be used during the turn. Anticipation is required to ensure that asymmetric thrust is established before the turn is commenced, between 30 % and 35 % (or 1.02 and 1.03 EPR), to maintain a continuous speed of approximately 5 to 8 kt throughout the manoeuvre
- It is essential to keep minimum ground speed during the turn in order not to need to increase the thrust too significantly so as not to get stuck. It is a good practice that the RHS calls the GS from ND while in turn

- Differential braking is allowed, but a braked pivot turn is not recommended as a general rule (i.e. braking to fully stop the wheels on one main gear), to avoid stress on the landing gear assembly
- On wet or contaminated runway, more specifically when turning on the runway white or yellow painted marking, tight turn lead to jerky rides of the nose wheel which are noisy and uncomfortable.

For the RHS, the procedure is symmetrical (taxi on the left hand side of the runway).

Aircraft dimensions




## BRAKE CHECK

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN**

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 PM 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.

## BRAKE CHECK

Criteria: P4576, SA
**Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

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

**Applicable to: 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

**Applicable to: ALL**

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

## BRAKE TEMPERATURE

**Applicable to: ALL**

The FCOM limits brake temperature to 300 °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 °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

**Applicable to: ALL**

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

**Applicable to: 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 °C (when the actual brake temperature is 100 °C) to 150 °C (when the actual brake temperature is 300 °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

**Applicable to: ALL**

The flight controls should be checked at a convenient stage, prior to or during taxi, but before arming the autobrake. If the check is carried out during taxi, the PF will maintain a good lookout and control the taxi speed appropriately.
The PF announces "Flight Control Check" and shall then apply full inputs to the sidestick and rudder. The PM then repeats the same procedure for the sidestick only. Full control input must be held for sufficient time for full travel to be reached and indicated on the F/CTL page.
The PM shall monitor the F/CTL page for full travel and correct sense of movement of all of the respective flight control surfaces and call the indications observed. Full travel or neutral position is shown when the index is on or within the travel limit "box". There is no specific requirement to have precisely equal indications within the travel limit "box". Equally, a rudder trim set to zero may have a minor tolerance either side of the zero mark on the F/CTL page.
The check should be conducted in the following sequence:

| PF | PM |
|---|---|
| "Flight Control Check." | |
| Apply full back sidestick followed by full forward sidestick, then release. | Monitor the F/CTL page. |
| | "Full up, full down, neutral." |
| Apply full left sidestick followed by full right sidestick, then release. | |
| | "Full left, full right, neutral." |

*Continued on the following page*

Continued from the previous page

| PF | PM |
|---|---|
| Press the PEDAL DISC pb on the steering handwheel, smoothly apply full left and full right rudder and then return the rudder to neutral. | Monitor the F/CTL page. Follow through on the rudder pedals to confirm full and correct movement. |
| | "Full left, full right, neutral." |
| Ensure that the PM calls are in accordance with flight control inputs. | |
| | Repeat the sidestick inputs, and monitor the F/CTL page. |
| | "Full up, full down, neutral." |
| | "Full left, full right, neutral." |
| Check the F/CTL page to confirm the correct position of all flight controls and the pitch trim indication is in close agreement with the actual THS setting. | |
| "Check." | |

## TAKEOFF BRIEFING CONFIRMATION

**Applicable to: ALL**

This briefing should normally be a brief confirmation of the thorough takeoff briefing made at the parking bay. Any major changes that may have occurred should be reflected in a comprehensive re-briefing. Refer to FCOM PRO-NOR-SOP-10.

## TAXI WITH ONE ENGINE SHUTDOWN

**Applicable to: ALL**

Taxi with an engine shutdown for departure should only be considered in exceptional circumstances, such as extended ATC delays, to prevent fuel on board reducing below the minimum sector requirement.
Due to the infrequent use of this technique, the procedure should be reviewed and briefed prior to actioning. Refer to FCOM PRO-SUP-90.

## LATE CHANGE OF RUNWAY AND/OR TAKEOFF DATA

**Applicable to: ALL**

At airports where the opportunity for a late runway change could be expected, particularly where departure runways are adjacent and parallel, obtain ACARS RTOW for both runways prior to pushback. Provided performance is not limiting, input the same flap configuration for the secondary runway as that generated by the ACARS T/O data printout for the primary runway. Selection of the same flap configuration will reduce the chance of an incorrect configuration for takeoff.

Any modification to data shall be inserted and crosschecked following the same process defined in Normal Procedures. If takeoff data has changed, or in the case of a runway change:

- Obtain new ACARS RTOW . Again the Captain shall check the ACARS RTOW.
- Modify the F-PLN to reflect the new ATC clearance for the runway, SID and transition.
- Select appropriate navaids for the SID.
- Insert the new PERF TO data; the MCDU may not clear the original PERF data when the runway is changed. Check PERF CLB data (speed PRESELECT requirement).
- Confirm FLAPS LEVER set to new configuration.
- Set ATC cleared altitude on FCU. Preset FCU HDG bug if necessary.
- Check transponder code is still correct.
- Rebrief the departure, if necessary.
- Rebrief the flap retraction strategy, if necessary.

## MISCELLANEOUS

**Applicable to: ALL**

### STROBE LIGHT

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

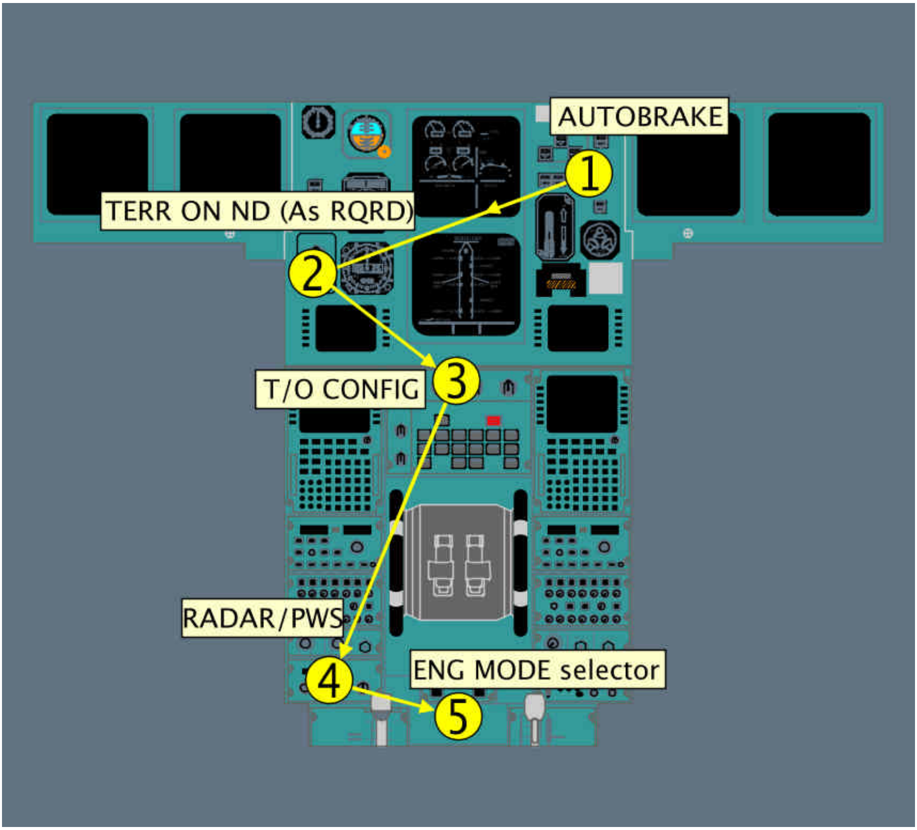
If the takeoff is performed with one pack unserviceable, the procedure states to set the failed pack to OFF. The takeoff may be performed with the other pack ON (if performances permit) with TOGA or FLEX thrust, the pack being supplied by the onside bleed. In this asymmetric bleed configuration, the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

## TAXI FLOW PATTERN

**Applicable to: ALL**

1

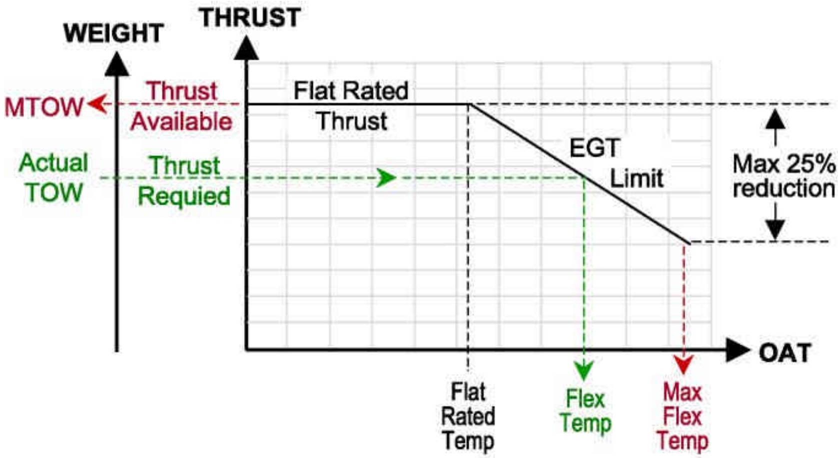
TAXI FLOW PATTERN



# FLEX THRUST TAKEOFF

Applicable to: ALL

The FLEX takeoff reduces EGT, thus increasing engine life and reliability while reducing maintenance and operating costs. The FLEX takeoff can be used when the actual takeoff weight is lower than the maximum permissible takeoff weight for the actual temperature. As the MTOW decreases with increasing temperature, it is possible to assume a temperature at which the actual takeoff weight would become limiting. This assumed temperature is called the FLEX temperature.




Flex Temperature Take-off

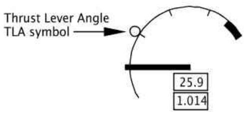
The minimum control speeds associated with the FLEX takeoff are related to VMCG/VMCA at TOGA thrust. Therefore, should the aircraft suffer an engine failure at V1, there is no limitation on selecting TOGA thrust on the remaining engine.

## THRUST SETTING

**Applicable to: ALL**

The PF should announce "SET THRUST". The Captain then applies power in as follows:

If cross wind is at or below 20 kt and there is no tail wind
- From idle to 1.05 EPR / 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.




In case of tailwind or if cross wind is greater than 20 kt:
- 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 kt 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.
The Electronic Engine Control (EEC) computer prevents the engine stabilizing between an approximate range of 60 to 74 % N1, in order to protect against fan flutter. This range is called the Keep-Out-Zone, and the flight crew may notice a non-linear thrust response to thrust lever movement. If one lever is moved out of the Keep-Out-Zone before the other, a very slow movement of the levers may lead to asymmetric engine acceleration.
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.

## TAKEOFF ROLL

**Applicable to: ALL**

Once the thrust is set, the PF announces the indications on the FMA. The PM must check that the thrust is set by 80 kt and must announce "Thrust 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 takeoff, 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 takeoff roll until reaching 80 kt. At this point, the input should be gradually reduced to be zero by 100 kt.

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 kt) 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 takeoffs, routine use of into wind aileron is not necessary. In strong crosswind conditions, small lateral stick input may be used to maintain wings level, 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.
For takeoff in strong, variable crosswinds and/or gusty conditions the use of TOGA thrust is recommended. The use of a higher thrust setting reduces the required runway length and minimizes the aircraft's exposure to gusty conditions during rotation, lift-off and initial climb.
When the reported wind is at, or near to, 90 ° to the runway, the possibility of wind shifts that may result in gusty tailwind components during rotation, or lift-off, increase. The influence of the airport terminal, aircraft hangars, and topographical features can have a significant effect on the crosswind and produce additional turbulence.
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 takeoff, 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

**Applicable to: ALL**

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

## ROTATION

**Applicable to: 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 °/s. Avoid low rotation rates as this will have an impact on takeoff performance by increasing the takeoff ground run. Rotation rates between 2 °/s and 3 °/s will have a minimal impact on takeoff run but rates significantly below 2 °/s should be avoided.

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.

## AIRCRAFT GEOMETRY

Criteria: 320-200
**Applicable to: ALL 320**

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

## AIRCRAFT GEOMETRY

Criteria: 321-200
**Applicable to: ALL 321**

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

## TAIL STRIKE AVOIDANCE

**Applicable to: ALL**

### INTRODUCTION

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 °/s, which reflects the average rates achieved during flight test, and is also the reference rate for performance calculations.

### CONFIGURATION

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.

## AP ENGAGEMENT

**Applicable to: ALL**

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

## VERTICAL PROFILE

**Applicable to: ALL**

SRS engages when the thrust levers are set to the applicable detent for takeoff 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 120 ft/min minimum vertical speed.

This explains why, during takeoff, the IAS which is actually flown in most cases is neither V2+10 (AEO) nor V2 (OEI).

## LATERAL PROFILE

**Applicable to: 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

**Applicable to: ALL**

At the thrust reduction altitude, "LVR CLB" flashes on the FMA. When manual 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 takeoff 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

**Applicable to: 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 or above F speed, the aircraft accelerating (positive speed trend): retract to 1.
- At or above 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 PM should confirm with the PF when it may be deselected.

## TAKE-OFF AT HEAVY WEIGHT

**Applicable to: ALL**

If take-off is carried out at heavy weight, two protections may intervene:
- The Automatic Retraction System (ARS)
- The Alpha Lock function

### THE AUTOMATIC RETRACTION SYSTEM

While in CONF 1+F and IAS reaches 210 kt (VFE CONF1+F is 215 kt), the ARS is activated. The ARS automatically retracts flaps to 0 °. The VFE displayed on the PFD change from VFE CONF1+F to VFE CONF 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

**Applicable to: 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

**Applicable to: 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.

The associated high thrust and high energy state is conducive to a Flap Overspeed. To mitigate this threat consider the followng:

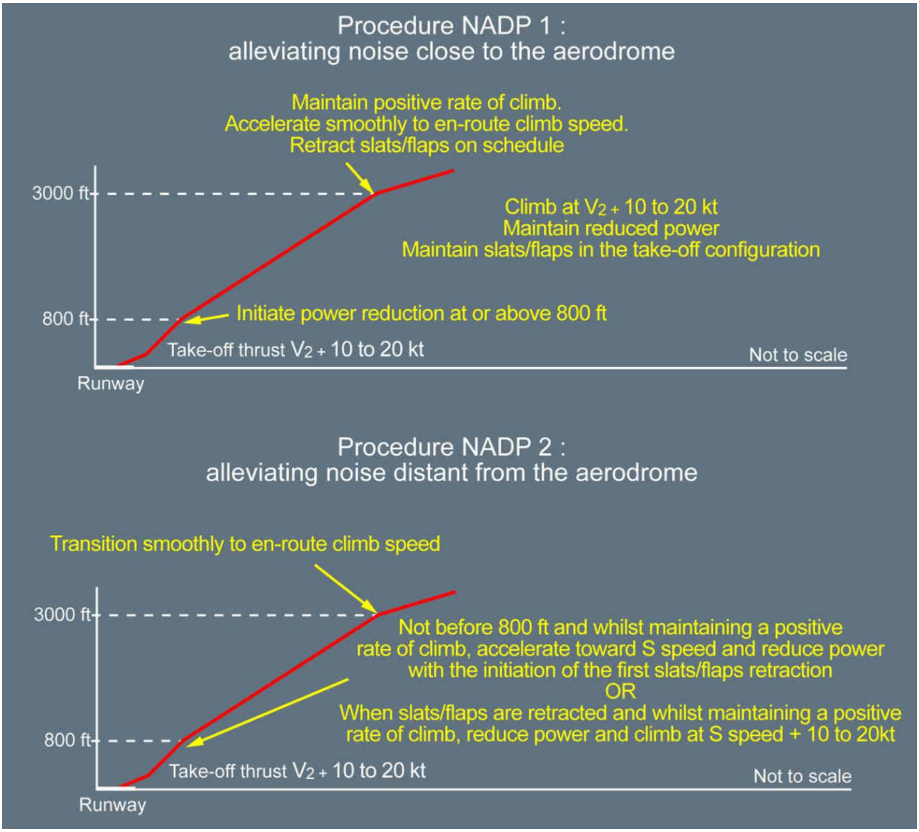
- Use the highest Flex Temperature, appropriate to the conditions.
- Engage autopilot soon after takeoff.
- FMA will change to ALT* and LVR CLB simultaneously.
- Promptly select CLB Thrust as soon as either ALT* or LVR CLB is observed on the FMA.
- Expect faster than normal acceleration, order Flap Retraction as soon as the A/C speed is above F or S speed as appropriate.

## NOISE ABATEMENT TAKE-OFF

**Applicable to: ALL**

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

noise abatement procedure




## CLOSE-IN TURNS AND ALTITUDE RESTRICTIONS AFTER TAKEOFF

**Applicable to: ALL**

Unless stated on the Port Page, the minimum altitude for initiating a turn after takeoff is 400 ft AAL. When it is considered desirable to limit the acceleration or steepen the climb and/or to comply with SID/NAP requirements in the initial climb after takeoff:

1. A suitable speed may be pre-selected in the PERF CLB
   - The preselected speed should be above F speed to allow initial flap retraction to CONF 1,
2. A higher ACC altitude may be inserted in the PERF TO page

- SRS mode will remain engaged in the usual manner when climb thrust is set at the THR RED altitude,

3. A specific procedure may be specified in the Port Page.

It is important to emphasize the above during the flap retraction briefing to fully cater for the different sequence/timing of the acceleration and the interuption(s) to the flap retraction.

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## GENERAL

**Applicable to: 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.

## AP/FD CLIMB MODES

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HTF**

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.

### 1 SELECTED

The selected AP/FD modes in climb are OP CLB and V/S.
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 1 000 ft/min, 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 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.

# AP/FD CLIMB MODES

Criteria: P4320, SA
**Applicable to: B-HSI, B-HSJ, B-HSK, B-HTD, B-HTE, B-HTG, B-HTH**

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.

2 ## SELECTED

The selected AP/FD modes in climb are OP CLB and V/S.
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 1 000 ft/min, 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 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.

# AP/FD CLIMB MODES

Criteria: P4320, P7790, SA
**Applicable to: B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTI**

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.

3 **SELECTED**

The selected AP/FD modes in climb are OP CLB and V/S.
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 1 000 ft/min, 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 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

Applicable to: 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 kt up to 10 000 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 kt /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

**Applicable to: 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 (Place/Distance), i.e. ZZZ,-10 waypoint if the question is "CAN YOU MAKE FL XXX , 10 nm before ZZZ point?"

## LATERAL NAVIGATION

**Applicable to: 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.

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## PREFACE

**Applicable to: ALL**

1 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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

### 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.

## FMS USE

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

### CRUISE FL

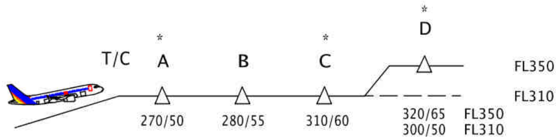
If the aircraft is cleared to a lower cruise flight level than the pre-planned cruise flight level displayed on MCDU PROG page, the cruise Mach number will not be targeted. The crew will update the MCDU PROG page accordingly.
When at cruise FL, the AP altitude control is soft. This means that the AP 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.




* are the points where an entry shall be done.

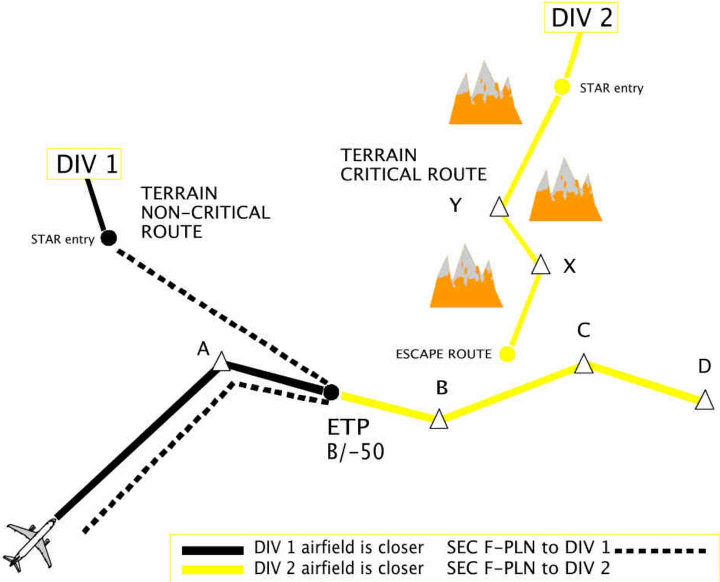
If at D waypoint, the CFP provides the wind at FL 350 but not at FL 310, it is recommended to insert the same wind at FL 310 as the one at FL 350. This is due to wind propagation rules, which might affect the optimum FL computation.

## 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 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




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. *Refer to FCOM/DSC-22_20-60-30 Using the Secondary Flight Plan Function* 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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

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.

## FMS USE: MISCELLANEOUS

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

If ATC requires 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.

## COST INDEX

**Applicable to: 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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

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. +50 kt head wind equates to M +0.01.

### 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.

## SPEED CONSIDERATIONS

Criteria: 22-1090, P3560, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

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. +50 kt head wind equates to M +0.01.
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

**Applicable to: 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 0.3 gbuffet 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 0.2 g. Otherwise, it will be rejected and the message "CRZ ABOVE MAX FL" will appear on the MCDU scratchpad. This message may also be triggered in case of temperature increase leading the aircraft to fly above the REC MAX FL. 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**

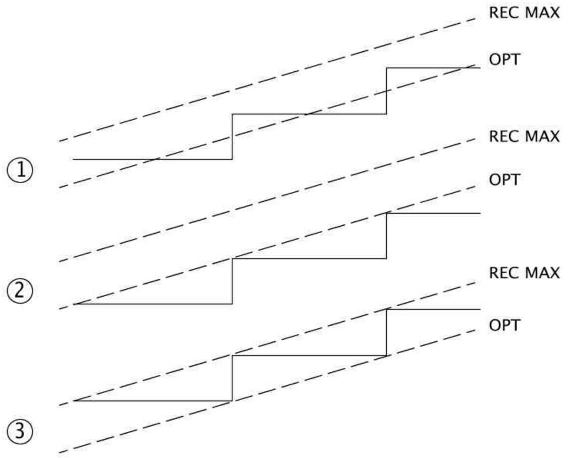
OPT FL displayed on the MCDU is the cruise altitude for minimum cost when ECON MACH is flown and should be followed whenever possible. It is important to note that the OPT FL displayed on the PROG page is meaningful only if the wind and temperature profile has been accurately entered. The crew should 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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

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 2 000 ft above the optimum altitude and then cruising at that flight level until approximately 4 000 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.

OPT FL follow up




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.

## STEP CLIMB

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

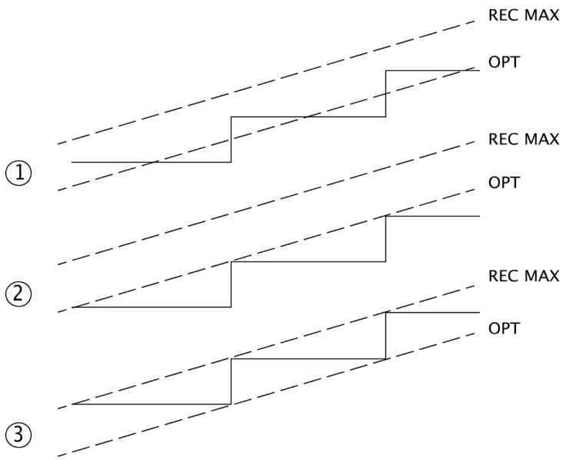
Since the optimum altitude increases as fuel is consumed during the flight, from a cost point of view, it is preferable to climb to a higher cruise altitude when the aircraft weight permits. This technique, referred to as a Step Climb, is typically accomplished by initially climbing approximately 2 000 ft above the optimum altitude and then cruising at that flight level until approximately 4 000 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. *Refer to FCOM/PER-CRZ-ALT-20 WIND ALTITUDE TRADE FOR CONSTANT SPECIFIC RANGE* to provide 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




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

**Applicable to: 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

Criteria: G-V2527-A5, 320-200
**Applicable to: ALL 320**

| OPT +2 000 ft | 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*

## FIGURES

Criteria: G-V2533-A5, 321-200
**Applicable to: ALL 321**

| OPT +2 000 ft | OPT -2 000 ft | OPT -4 000 ft |
|---|---|---|
| 2.4 % | 1.5 % | 4.9 % |

*Specific range penalty when not flying at optimum altitude*

## FUEL MONITORING

**Applicable to: ALL**

The flight plan fuel burn from departure to destination is based on certain assumed conditions. These include gross weight, cruise altitude, planned route, temperature, cruise wind and cruise speed. Actual fuel consumption should be compared with the flight plan fuel consumption at least once every hour.
Many factors influence fuel consumption such as actual flight level, cruise speed, aircraft weight and unexpected meteorological conditions. If fuel consumption appears higher than expected, then calculate the actual kg/gnm and compare this with the planned figure on the Fuel Progress Log. The actual kg/gnm is calculated by dividing the actual fuel burn per hour by the groundspeed.
If planned and actual fuel figures deviate significantly without reason, then suspect a fuel leak and apply the appropriate procedure.
ECAM FOB, Fuel Prediction (FMGC) and CFP should be used to maintain an awareness of the current and predicted fuel state. Both the ECAM FOB and the fuel remaining determined by calculating the difference between BEFORE START fuel and ECAM FUEL USED, are recorded on the Fuel Log. The lesser (more conservative) of these figures is used for decision making.

At least once ever hour, when passing over a waypoint, perform the following fuel check:
- Enter ECAM FOB in the GAUGE / TOTALISER column, on the CFP progress log.
- To the right of FOB, enter the F.USED from the ECAM CRZ page.
- Subtract the F.USED from the BEFORE START fuel to obtain the Fuel Remaining, and enter to the right of F.USED.
- Enter the lesser of FOB and Fuel Remaining in the ACTUAL FUEL column.
- From the ACTUAL FUEL subtract the FR X CONT X MAND and enter the result in the 'CONT / MAND / EXTRA' column for the waypoint.
- Compare this result against the CFP planned contingency fuel in the adjacent column.

## FUEL TEMPERATURE

**Applicable to: 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 4 000 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 M 0.01 produces approximately 0.7 °C increase in TAT.

In either case, up to 1 h may be required for fuel temperature to stabilise. The crew should consider the fuel penalty associated with either of these actions.

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# LANDING PERFORMANCE

Applicable to: ALL

1 ## LANDING PERFORMANCE CONSIDERATIONS

Before commencing an approach to land, the commander shall satisfy himself that, according to the information available, the weather at the aerodrome and the condition of the runway intended to be used should not prevent a safe approach, landing or missed approach.
The flight crew should always consider a landing performance assessment (*Refer to SI-110 General*) in the reported conditions as part of their approach preparation.
A landing performance assessment not only confirms there is adequate landing distance available but also quantifies the margin available for stopping in the event of a long or bounced landing. This increased awareness of the 'excess' runway will assist in the continue/go-around decision making process.
There are some specific triggers for doing in-flight performance assessment:

- **Wet runways**: In particular on smooth runways, in hot and high conditions or for runways with descending slope, the flight crew should check the landing performance.
- **Contaminated runways**
- **Deterioration** of the runway condition since dispatch.
- Under **degrading or rapidly changing conditions** the flight crew should determine the worst acceptable conditions under which the landing can be continued, in case information to that end is received late during the approach
- **Autoland** and/or **autobrake**: The effect must be considered as dispatch RLD does not consider the additional allowance.
- **Runway change** versus assumptions made at dispatch. If the runway to be actually used has more unfavorable characteristics, a specific computation should be made.
- **In-flight system failure** impacting landing performance (change of configuration, increase of approach speed, loss of deceleration devices).
- **Overweight landings**
- **Tailwind landings**
- **Short runways**: Relative to the actual landing weight and environmental conditions
- **Preparation of alternative runways** if the flight crew anticipate late changes.

The flight crew should use all available information to make a realistic assessment of the runway conditions. They should also check how much these conditions may degrade before it becomes impossible to stop the aircraft within the declared available distance. When any doubt exists, requesting to change the runway for a more favorable one, or even deciding a diversion, may be the better solution.

# APPROACH PREPARATION

Applicable to: ALL

Obtain the latest destination weather approximately 15 min prior to descent and update the FMGS for the descent and arrival. During FMGS programming the PF will be head down, so it is important that the PM does not become involved in any tasks that preclude close monitoring of the aircraft. The fuel predictions will be accurate if the F-PLN is correctly entered in terms of arrival, missed approach and alternate routeing. Once the FMGS has been programmed, the PM should cross check the information prior to the approach briefing. With the descent winds entered and the F-PLN arrival properly validated, the FMGS can compute an accurate TOD position. Pilots should crosscheck the FMGS TOD position against their own independently calculated TOD point, based where possible on a DME distance from a navaid.
IOC/CX Engineering should be contacted via ACARS preferably, or VHF, to advise of significant changes to the arrival information, ATA defect codes, or defects which could affect the normal taxi in and shutdown procedures, or dispatch on the next sector, etc. HKG need only be advised if the Auto ACARS uplink of information is inoperative, refer to Part A 8.6.1.4.
The FMGS will be programmed as follows:

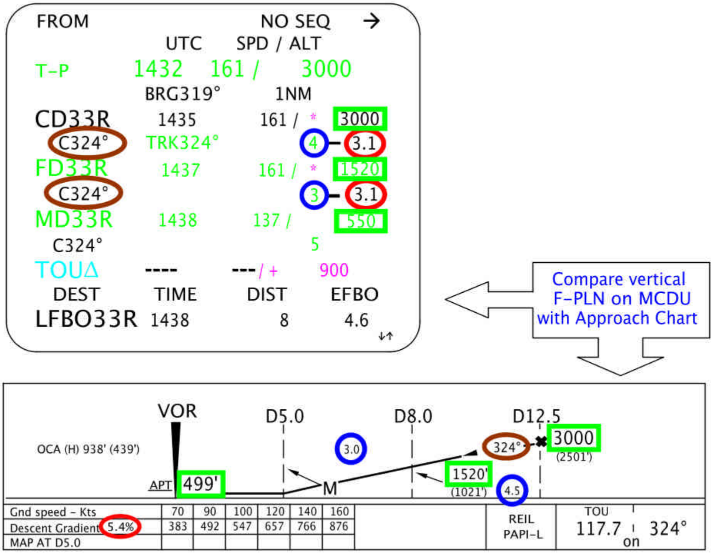

## F-PLN

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

For non-precision approaches:
- Identify the point where the final descent starts (also called Vertical Interception Point or VIP)
- Check the position and altitude of the VIP, and check the value of the FPA after the VIP
- Identify the Missed Approach Point (MAP).

MCDU F-PLN page vs approach chart crosscheck




## 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 kt, insert the lower speed 150 kt/20 kt (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 PM should then cross check the information prior to the Approach briefing.

## APPROACH BRIEFING

**Applicable to: ALL**

The main objective of the approach briefing is for the PF to inform the PM of his intended course of action for the approach. Additionally, potential threats should be highlighted, along with the strategies to minimise these threats. The briefing should be practical and relevant to the actual weather conditions expected. It should be given at a time of low workload if possible, to enable the crew to concentrate on the content. It is important that any misunderstandings are resolved at this time. Refer to SI-080.

## PREFACE

Applicable to: 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 PM will set the MCDU F-PLN page.
In mountainous areas, the selection of TERR ON ND sw enhances the pilot awareness and can be used in any flight phase.
If use of radar is required, consider selecting the radar display on the PF side and TERR on PM side only.

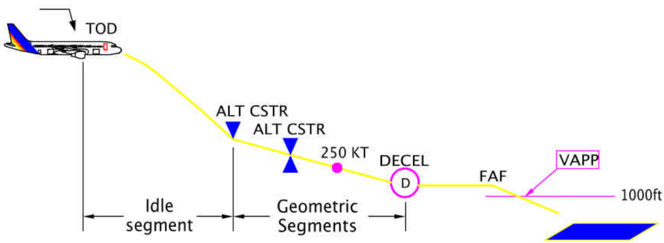
## COMPUTATION PRINCIPLES

Applicable to: ALL

### TOD AND PROFILE COMPUTATION

The FMGS calculates the Top Of Descent point (TOD) backwards from a position 1 000 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

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

Applicable to: 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

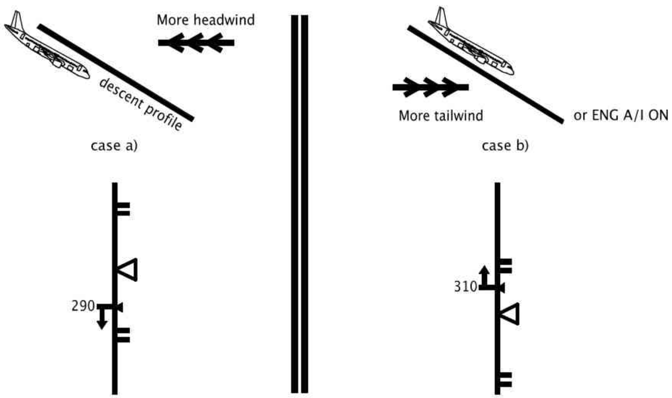
To initiate a managed descent, the pilot will set the ATC cleared altitude on the FCU and push the ALT selector. DES mode engages and is annunciated on the FMA. If an early descent were required by ATC, DES mode would give 1 000 ft/min rate of descent, until regaining the computed profile.
To avoid overshooting 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 kt speed range around the managed target speed to maintain the descent path.

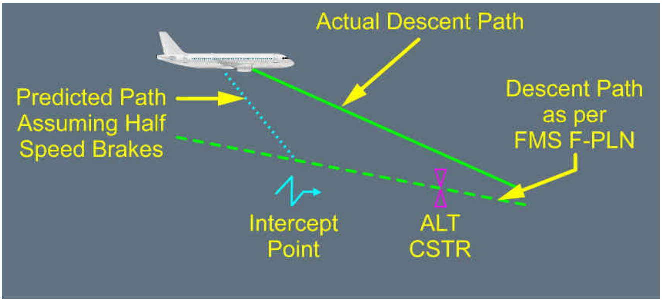
managed descent: speed target range principle




- **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.

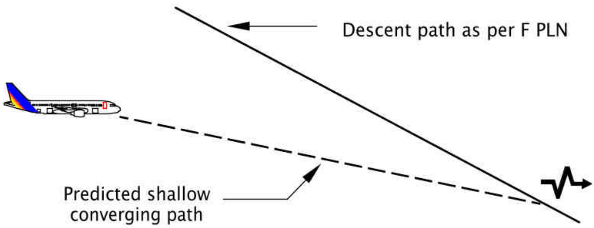
This technique allows an altitude constraint to be matched with minimum use of speedbrakes.
When regaining the descent profile, the speedbrakes should be retracted to prevent the A/THR applying thrust against speedbrakes. If the speedbrakes are not retracted, the "SPD BRK" message on the ECAM memo becomes amber and "RETRACT SPEEBRAKES" is displayed in white on the PFD.

A/C above descent path




- **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




- **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 kt with a pre-computed descent profile assuming managed speed 300 kt, 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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HTF**

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.

## MODE REVERSION

Criteria: P4320, SA
**Applicable to: B-HSI, B-HSJ, B-HSK, B-HTD, B-HTE, B-HTG, B-HTH**

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.

## MODE REVERSION

Criteria: P4320, P7790, SA
**Applicable to: B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTI**

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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

1 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.

## DESCENT CONSTRAINTS

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

2 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.

# PILOT DESCENT MONITORING AND MANAGEMENT

Applicable to: ALL

## PILOT TOD CROSS-CHECK

Multiply the flight level (in thousands of feet) by 4 to calculate the required distance to go (DTG ) to touchdown.

- At FL350, the required DTG is approximately (35 x 4) = 140 nm.

There will be factors for weight and wind but if the FMGC computed descent point is within +/– 20 nm of this figure, then it can be considered acceptable as a gross error check of the FMGC computation.

## PILOT DESCENT MONITORING

All descent management revolves around the relationship between altitude and distance to go (DTG) to touchdown. Consequently the F-PLN page must be realistic. Ensure that the TO waypoint is in front of the aircraft and that the F-PLN is representative of the expected route.
Before being able to assess the aircraft's position relative to the ideal descent profile, it is necessary to have a method of calculating the profile. The following method, illustrated with examples, provides a simple set of rules to monitor and manage the descent profile. It assumes that the MCDU is updated to reflect the expected arrival track.
From top of descent multiply the altitude (in thousands of feet) by 3 and add 1 nm/10 kt above 200 kt IAS, to calculate the required DTG.

- At 20 000 ft, 300 kt, the required DTG is (20 x 3) + 10 = 70 nm.
- At 10 000 ft and 250 kt the required DTG becomes (10 x 3) + 5 = 35 nm.
- At 3 000 ft and 200 kt the required DTG becomes (3 x 3) = 9 nm.

At this stage, the aircraft will be approaching the glideslope and hence a normal 3 ° slope.

### PILOT DESCENT AJUSTMENT

Weather avoidance or ATC vectoring may require descent profile adjustment.
If the aircraft is below the profile (required DTG is less than that shown on the MCDU F-PLN page), select a lower target speed or adjust the V/S until actual DTG = required DTG . After regaining the profile, re-engage managed descent or use selected V/S to maintain the FMGS computed profile.
If the aircraft is above the profile (required DTG is more than that shown on the MCDU F-PLN page), an increased rate of descent will be required. Use speedbrake with OP DES until actual DTG = required DTG, however be alert to the speedbrake induced increased VLS at high altitude. ATC and weather conditions permitting, a higher speed may be selected.

### SUMMARY

The benefit of using this method is its simplicity. It starts with a known quantity (CRZ FL) and works for any speed.
This method does not directly consider wind. As the profile is being regularly re-assessed during the descent, it will naturally show the effect of wind. A tail wind will push the aircraft high and a head wind will drag the aircraft low.
There are numerous variations on this method and ways to finesse the calculations. Whatever method you develop is a matter of personal choice. However, it is essential that you develop and use a descent monitoring and management technique.

## ARRIVAL OPERATING SPEEDS

**Applicable to: ALL**

Refer to FCOM PRO-NOR-SOP-01.

## PREFACE

**Applicable to: 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 M 0.05 decrease during 1 h equates to 4 min 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.

## ICAO MAXIMUM HOLDING AIRSPEEDS

**Applicable to: ALL**

Refer to Part A 8.3.5.1.

## HOLDING SPEED AND CONFIGURATION

**Applicable to: 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 the Maximum Endurance speed when entering the holding pattern. The Maximum Endurance speed is approximately equal to Green Dot and provides the lowest hourly fuel consumption.
If the Maximum Endurance 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 Maximum Endurance speed.

## IN THE HOLDING PATTERN

**Applicable to: 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 -1 000 ft/min 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 FL 310 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:

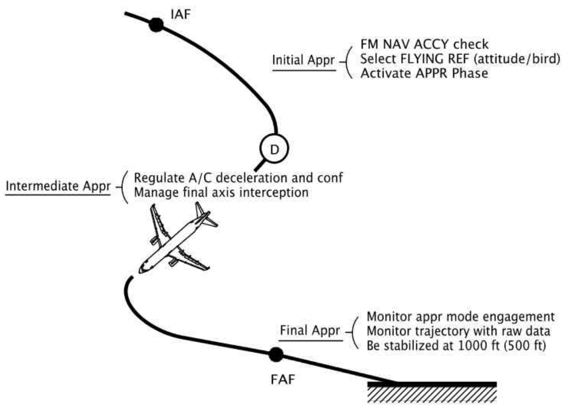
- IMM EXIT (The aircraft will return immediately to the hold fix, exit the holding pattern and resume its navigation) or
- HDG if radar vectors or
- DIR TO if radar vectors.

## PREFACE

Applicable to: 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




## PROCEDURE TURNS

On some approaches the procedure turn must be completed within specified limits. The turn size is determined by the ground speed at which the fix is crossed. If the fix is crossed at an excessively high ground speed, the procedure turn protected airspace may be exceeded. Initiate the turn at Green Dot, and time for 1 min 15 sec from the start of the 45 °/180 ° procedure turn. Select Flaps 1 when turning inbound. Monitor the track to ensure the aircraft remains within the protected airspace. The published procedure turn altitudes are minimum altitudes.
Approach procedures that include a PI-CF leg (procedure turn followed by a course-to-fix leg), indicated by PROC-T on the MCDU F-PLN page, are not to be flown in NAV or FINAL APP modes. These legs must be flown using selected modes.

## PROCEDURAL APPROACHES

The detailed requirements for procedural approaches are laid down in PANSOPs, refer to Volume 5, Flight Supplement, ATC.

## TRACK ESTABLISHMENT

Outbound descent may be commenced immediately following station or fix passage. Conversely, inbound descent may only be commenced when established within 5 ° of the published track.

# INITIAL APPROACH

Applicable to: ALL

## NAVIGATION ACCURACY

The GPS PRIMARY is not available, a navigation accuracy check is to be carried out prior to any approach. The navigation accuracy status determines:

- Which AP/FD modes are to be used, and
- The non precision approach strategy (guidance modes), and
- EFIS display, and
- EGPWS TERR pb selection.

The final approach course may be intercepted in NAV mode if GPS PRIMARY is available or if the navigation accuracy check is positive. Without GPS PRIMARY, navigation accuracy should be monitored in accordance with established procedures. Refer to FCOM DSC-22_20-20-20 Navigation Accuracy Check.
The various approach guidance modes have different Navigation Accuracy requirements, refer to FCOM PRO-NOR-SOP-18 and PRO-NOR-SOP-19.

## APPROACH BRIEFING

Refer to Part A 8.3.13.2 and SI-070.

## APPROACH CATEGORY

The Airbus is classified as a category "D" aircraft in Dragonair operations.

## LANDING MINIMA

Refer to Part A 8.1.3.1.

## THE FLYING REFERENCE

Use of HDG-V/S and the FD is recommended for ILS approaches. It is a requirement to use the FPV and the FPD for non-precision approaches. The FPV should normally be used for non-precision approaches, however, under abnormal conditions e.g. manual flight, the FDs may be easier to follow using HDG-V/S.

## DELAYED FLAP APPROACH (NOISE ABATEMENT)

Do not compromise the stabilised approach criteria to satisfy noise abatement procedures. Where airport noise abatement procedures specify the use of minimum flap for landing, full flap should be used unless operational or non-normal procedures require a different configuration.

## 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.

## 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 and to ensure correct predictions. 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.
Using DIR TO or DIR TO RADIAL IN function arms the NAV mode. If NAV mode is not appropriate, pull the HDG knob to disarm it.

# INTERMEDIATE APPROACH

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

The purpose of the intermediate approach is to bring the aircraft at the proper speed, altitude and configuration at FAF.

1 ## 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 CONF 0, S speed for CONF 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 kt (IAS must

be lower than VFE next), e.g. when the speed reaches green dot +10 kt, the crew should select CONF 1. Using this technique, the mean deceleration rate will be approximately 10 kt/NM in level flight. This deceleration rate will be twice i.e. 20 kt/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 the 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 kt (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.

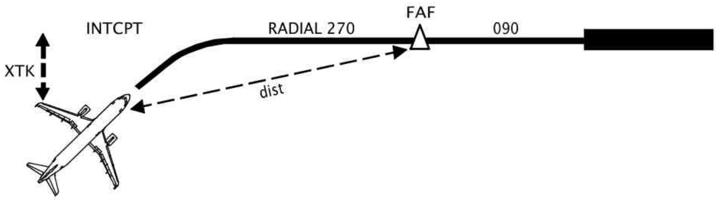
## 2 INTERCEPTION OF FINAL APPROACH COURSE

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.

The flight crew should sequence the F-PLN first, and then press the APPR pb. When the LOC mode is armed or engaged, the flight crew should not perform a DIR TO, in order to sequence the F-PLN as this will result in the FMGS to revert to the NAV mode. In this case, the LOC mode will have to be re-armed and re-engaged, 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




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.

## INTERMEDIATE APPROACH

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

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 CONF 0, S speed for CONF 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 kt (IAS must be lower than VFE next), e.g. when the speed reaches green dot +10 kt, the crew should select CONF 1. Using this technique, the mean deceleration rate will be approximately 10 kt/NM in level flight. This deceleration rate will be twice i.e. 20 kt/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 the 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 kt (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.

3 **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 IN-BND facility. This ensures:

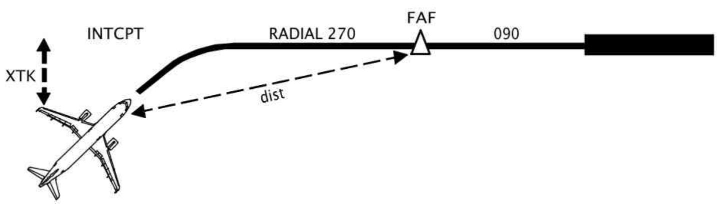
- A proper F-PLN sequencing
- A comprehensive ND display
- An assistance for lateral interception
- The VDEV to be computed on reasonable distance assumptions.

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 90 ° corresponding to radial 270 °.
- Deceleration will not occur automatically as long as lateral mode is HDG

The flight crew should sequence the F-PLN first, and then press the APPR pb. 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




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

Applicable to: 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 the hand on the thrust levers so as to be prepared to react if needed.
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 1 000 ft on the final approach.

In gusty wind conditions, the A/THR response time may be insufficient to cope with an instantaneous loss of airspeed. A more rapid thrust response can be achieved by moving the thrust levers above the CL detent (but below MCT). The thrust will quickly increase towards the corresponding TLA. The A/THR remains armed and becomes active immediately the thrust levers are returned to the CL detent. Therefore, the thrust levers should be returned to CL detent as soon as there is a positive speed trend. However, there are two important points to note:

- Selecting the thrust levers to the TOGA detent, even momentarily, will engage the Go-Around mode, and.
- In some aircraft (HTF, HSD, HSE, HSG, HSI, HTD, HTE), selecting the thrust levers above the CL detent below 100 ft RA will disconnect the A/THR. In this case, returning the thrust levers to the CL detent will set climb thrust. Refer to FCOM DSC-22_30-90.

## 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

Dragonair policy requires that stabilised conditions be achieved by 1 000 ft above the airfield elevation.
If, for any reason, one of the flight parameters deviates from stabilized conditions once the aircraft is below 1 000 ft AAL, the PM will make a call out:

<table>
<tr><th colspan="5">Exceedance and associated PM 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">Speed target +10 kt / -5 kt</td><td>"SPEED"</td></tr>
<tr><td colspan="2">V/S</td><td colspan="2">>-1 000 ft/min</td><td>"SINK RATE"</td></tr>
<tr><td colspan="2">Pitch attitude (A320)</td><td colspan="2">>+10 °/ <-2.5 °</td><td rowspan="2">"PITCH"</td></tr>
<tr><td colspan="2">Pitch attitude (A321)</td><td colspan="2">>+7.5 °/ <-2.5 °</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">Deviation</td><td>>1/4 dot PFD</td><td>"LOC"</td></tr>
<tr><td>Glide slope</td><td>>1 dot PFD</td><td>"GLIDE SLOPE"</td></tr>
<tr><td>NPA only</td><td>Course</td><td colspan="2">Deviation >1/2 dot on PFD<br>or >2.5 ° (VOR)/ >5 ° (ADF)</td><td>“COURSE”</td></tr>
</table>

Following a PM flight parameter exceedance call out, the suitable PF response will be:

- Acknowledge the PM 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.

4 **REACHING THE MINIMA**

Decision to land or go-around must be made at the minima at the latest. Reaching the minima, at MINIMUM call out:

- If appropriate visual reference can be maintained and the aircraft is properly established, continue and land.
- If not, go-around.

The minima should not be set as target altitude on the FCU. If the minima were inserted on the FCU, this would cause a spurious ALT* when approaching minima, 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.

## GROUND SPEED MINI

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

**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

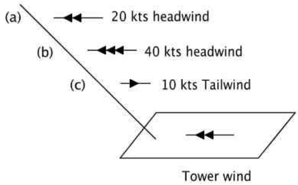
In order to achieve that goal, the aircraft ground speed should never drop below GS mini in the approach, while the winds are changing. Thus the aircraft IAS must vary while flying down, in order to cope with the gusts or wind changes. In order to make this possible for the pilot or for the A/THR, the 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:

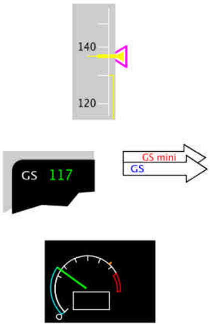
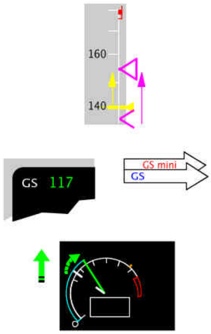
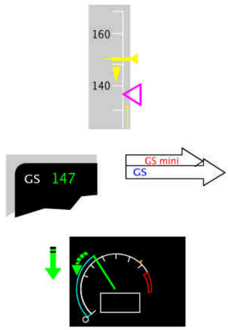
IAS Target Speed = GS mini + Current headwind component

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



| (a) Current wind = tower wind | (b) Head wind gust | (c) 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 |
|  |  |  |

## GROUND SPEED MINI

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

### 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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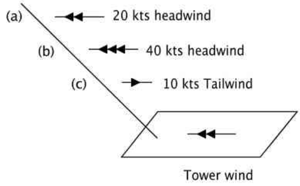
In order to achieve that goal, the aircraft ground speed should never drop below GS mini in the approach, while the winds are changing. Thus the aircraft IAS must vary while flying down, in order to cope with the gusts or wind changes. In order to make this possible for the pilot or for the A/THR, the 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:

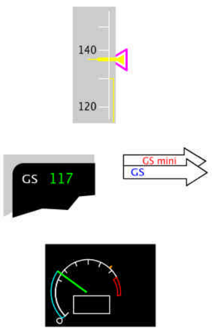
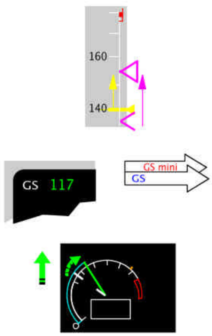
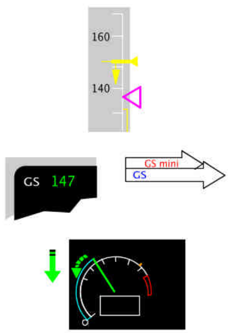
IAS Target Speed = GS mini + Current headwind component

This target speed is limited by VFE -5 in case of very strong gusts, by VAPP in case of tailwind or if instantaneous wind is lower than the tower wind.

<u>example</u>

VLS=130 kts
Tower wind=20 kt Head wind
- Vapp=130 + 1/3 HW =137 kt
- GS mini=Vapp – HW =117 kt




| (a) Current wind = tower wind | (b) Head wind gust | (c) 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 |
|   |   |   |

# PREFACE

**Applicable to: ALL**

This chapter deals with some characteristics of the ILS approach.
For CAT1 ILS, the crew will insert DA/DH values into MDA (BARO ⊲ ) 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 (RADIO ⊲ ) field on MCDU PERF APPR page, since this value is a radio altitude referenced.

# INITIAL APPROACH

**Applicable to: ALL**

## 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.

## 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

**Applicable to: ALL**

## INTERCEPTION OF FINAL APPROACH

The criteria that must be met prior to pressing the APPR pb are detailed in FCOM PRO-NOR-SOP-18.
Pressing the APPR pb arms the approach mode. LOC and G/S are displayed in blue on the FMA.
The second AP, if available, should be selected at this stage.
If the initial ATC clearance is to intercept the localiser only, press the LOC pb on the FCU until cleared for the approach.
Executing some subsequent mode changes through the MCDU (e.g. "DIRECT TO" FAF to update the flight plan), will disengage the armed modes of G/S and LOC blue. Reselection of APPR pb will be necessary.

Monitor aircraft position to anticipate and confirm the correct LOC and G/S beam is being intercepted to protect against false captures. Observe the FMA for the correct modes during the ILS capture process.

## FINAL APPROACH

Applicable to: ALL

### FINAL APPROACH

Plan to intercept the glideslope from below with at least Flaps 1 selected. When approaching one dot below the glideslope, select Flaps 2. In managed speed, the aircraft will decelerate to F speed. If the glideslope is intercepted in level flight below 2 000 ft AAL, the aircraft may need to be configured beyond CONF 2 prior to glideslope capture in order to achieve the stabilised approach criteria.
After glideslope capture, set the missed approach altitude on the FCU and check that it is displayed on the PFD. If the F-PLN has sequenced correctly, either automatically or manually, a blue go-around procedure will be displayed on the ND, indicating that NAV mode is available for the go-around. If there is no go-around procedure displayed, the F-PLN may be incorrectly sequenced and the go-around will have to be flown using selected modes and raw data.
Select the gear down approaching 2 500 ft AAL. Selecting L/G down is the cue for PM to arm ground spoilers and set NOSE switch to TAXI, and RWY TURN OFF switch ON. Once the gear is down, select the remaining stages of flap.

1 ### GLIDE SLOPE INTERCEPTION FROM ABOVE

The following procedure shall only be applied when established on the localizer and APPR is Armed. There are a number of factors which might lead to a glide slope interception from above. In such a case, the crew must anticipate the intercept from above and react without delay to ensure the aircraft is stabilised for landing before 1 000 ft AAL.
In order to achieve the best rate of descent and avoid exceeding Vfe, the crew should promptly increase drag by lowering the landing gear and selecting a minimum of Conf 2 (preferably landing flap) using speedbrake as required.
Use of Managed speed is recommended.

| | |
|---|---|
| Recognition – | Realize that a G/S intercept from above is possible |
| Preparation – | Configure the aircraft by increasing drag |
| Procedure – | Set FCU altitude above current altitude and then select V/S -2 000 ft/min |

#### Recognition

- Recognise that an intercept from above may be required.

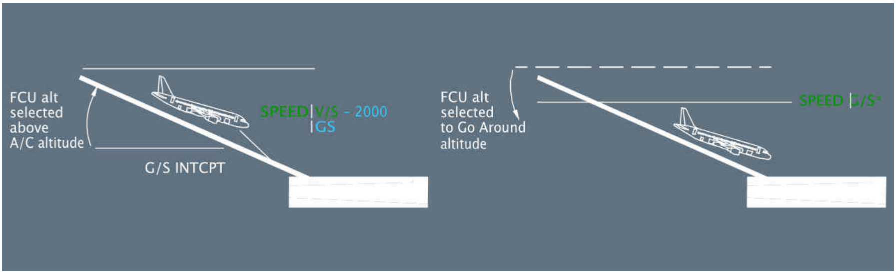
## Preparation

- Announce “Intercept from above”
- Select gear down.
- Select minimum Conf 2 without delay (preferably Conf 3)

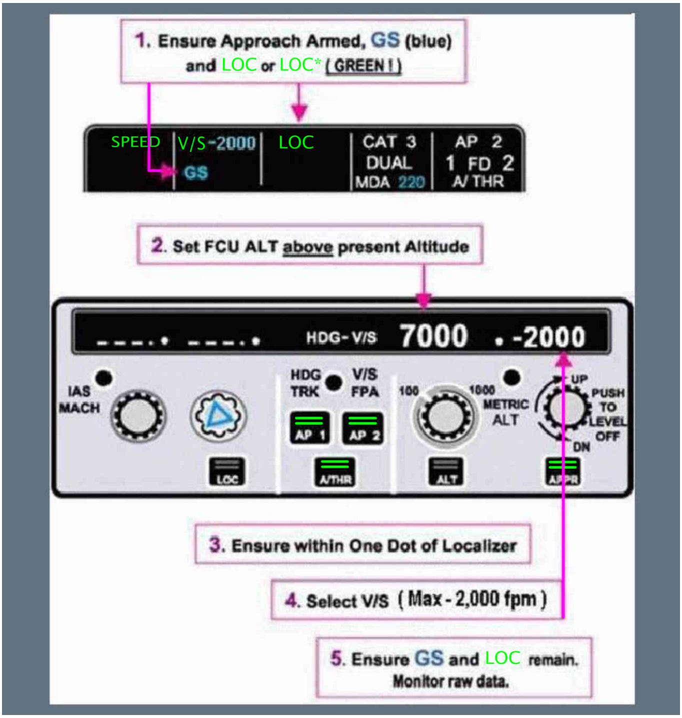
## Procedure

- Arm APPR and confirm G/S is armed
- Set the FCU altitude above aircraft altitude to avoid unwanted ALT*
- Select initial V/S -2 000 ft/min. If speed is approaching Vfe, reduce selected V/S as required. Select Landing Flap
- Set the go-around altitude in the FCU (when below go-around altitude)

A/C high above G/S - recommended g/s capture technique




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 go-around altitude will be set on the FCU and speed reduced so as to be stabilised for landing by 10 00 ft.




## MISCELLANEOUS

Close to the ground, avoid large down corrections. Give priority to attitude and sink rate. (*Refer to NO-170 TAIL STRIKE AVOIDANCE*).

In case of a 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 an 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 warning, the crew must perform a go-around.

# LATE RUNWAY CHANGE

Applicable to: ALL

## LATE RUNWAY CHANGE

If an airport has a number of active landing runways, programme the SEC F-PLN with the ILS for an alternative runway during the approach preparation, to cover the possibility of a late runway change. There is no requirement to enter the complete STAR.
If a runway change occurs and there is time available to achieve the approach stabilisation criteria, apply the following procedure:

- Pull HDG. At this point, LOC and G/S revert to HDG and V/S.
- Activate the SEC F-PLN.
- Adjust the HDG to intercept second runway LOC.
- Adjust V/S as required.
- Confirm ILS ident on PFD.
- Press APPR pbon FCU.
- Monitor ILS capture.
- Confirm correct missed approach altitude is set.
- Confirm correct TO waypoint on the ND to ensure NAV mode is available in the event of a missed approach.

# ILS RAW DATA

Applicable to: ALL

## INITIAL APPROACH

### FLYING REFERENCE

The Flight Path Vector (FPV) is to be used as the flying reference.

### APPROACH PHASE ACTIVATION

The approach technique is the stabilized approach.

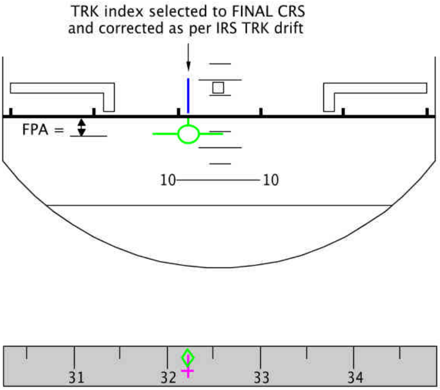
## INTERMEDIATE APPROACH

The TRK index will be set to the ILS course and, once established on the LOC, the tail of the FPV 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 FPV in the direction of the LOC index, and when re-established on the LOC, set the tail of the FPV on the TRK index again. If there is further LOC deviation, a slight IRS drift should be suspected. The FPV 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 ½ 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 FPV 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 FPV to the G/S angle.



## PREFACE

**Applicable to: ALL**

This chapter deals with some characteristics of the Non Precision Approach (NPA).

NPA are defined as:
- VOR, VOR-DME
- NDB, NDB-DME
- LOC, LOC-DME
- LOC-BC (not permitted by company policy)
- RNAV
- RNAV (GNSS), RNAV (GPS), GPS. In this section, RNAV (GNSS) will be used to refer to all of these three approach definitions.

An RNAV approach is an instrument approach procedure that relies on aircraft area navigation equipment (FMS) for navigational guidance. The FMS on Airbus aircraft is certified RNAV equipment that provides lateral and vertical guidance referenced from an FMS position. The FMS uses multiple sensors for position updating including GPS, DME-DME, VOR-DME, LOC-GPS and IRS.
An RNAV (GNSS), RNAV (GPS), or GPS approach is an approach is an RNAV approach requiring GNSS/GPS position update. Airbus aircraft using FMS as the primary means of navigational guidance have been approved to fly such approaches provided an RNP of 0.3 or smaller is used.
Non-ILS approaches are flown using FINAL APP or FPA pitch modes and LOC, FINAL APP or TRACK lateral modes.
In order to ensure that the aircraft does not descend below MDA in the event of a missed approach, an aircraft allowance may need to be added to the MDA/MDH, Part A 8.3.9.1 refers.

## APPROACH STRATEGY

**Applicable to: ALL**

The type of approach and the navigation accuracy will determine the approach guidance modes. Where possible, it is preferable to fly a managed approach (FINAL APP mode). Whether managed or selected guidance is used, use of the AP is recommended. Where practical, the final descent segment (FAF  to touchdown) should be flown using a constant angle.

## LIMITATIONS

Applicable to: 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 final approach is not modified by the crew.

### F-PLN CROSSCHECK

The approach in the navigation database must be validated by scrupulous comparison between the database profile and the published procedure. This includes a check of approach and missed approach tracks and distances, speed and altitude constraints. Identify the position and altitude of the Final Descent Point (FDP), and check the value of the FPA after this FDP against the published procedure.
Anomalies in the coding of some non precision approaches prohibit the use of managed vertical guidance (FINAL APP mode), and will result in erroneous V/DEV guidance on the PFD. Refer to FCOM PRO-NOR-SOP-19, OEB and FCOM bulletin.

## INITIAL APPROACH

Applicable to: ALL

### NAVIGATION ACCURACY

Confirm GPS PRIMARY.
For RVAV (GNSS) approaches, 2 FMGS and 2 GPS are required to commence the approach. The GPS MONITOR page must display NAV for both GPSs. Both FMGS must be in GPS PRIMARY.
For non-precision approaches referenced to ground based radio aids, if GPS PRIMARY is not available, check the navigation accuracy to confirm that the planned approach strategy remains valid. If managed guidance does not correspond with raw data, the use of selected guidance is mandatory. Refer to FCOM PRO-NOR-SOP-19.
A managed approach can be continued following a NAV ACCUR DOWNGRAD if raw data indicates that the guidance is satisfactory.

### FLYING REFERENCE

The Flight Path Vector/Flight Path Director (FPV/FPD ) shall be used for all non-precision approaches.

## APPROACH PHASE ACTIVATION

Normal approach stability requirements apply to non-precision approaches. However, as non-precision approaches are rarely flown, consider inserting a speed constraint of VAPP at the FAF to ensure a timely deceleration.

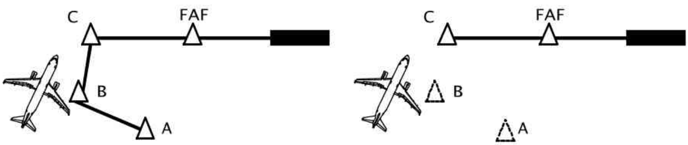
# INTERMEDIATE APPROACH

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

## 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 APP 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.

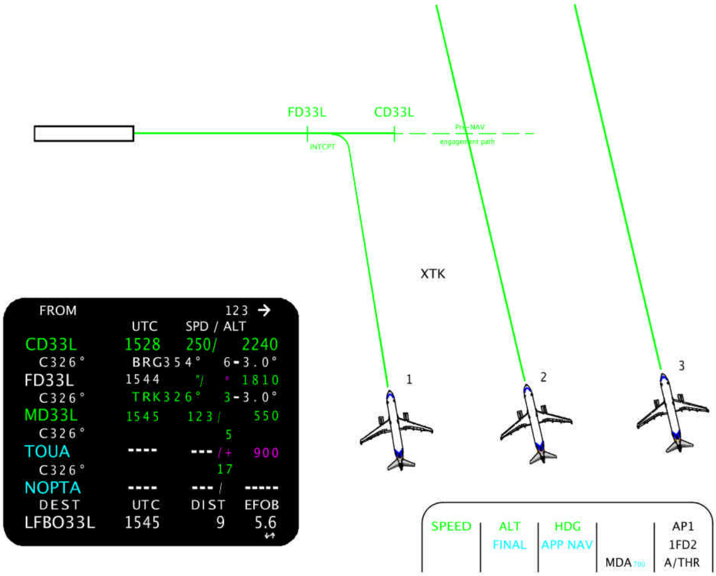
Radar vectors: pilot has monitored the TO WPT and cleared successively A and B when no longer probable. Hence VDEV is meaningful and APPR NAV or NAV may be armed.

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.

  The conditions for engagement of FINAL mode are as follows:
  - The aircraft should be stabilized laterally and vertically before the Vertical Interception Point (VIP), which is the point where the final descent starts
  - The DECEL must be sequenced and the FMS approach phase must be active
  - APP NAV must be engaged, and FINAL must be armed
  - The FMS must provide predictions
  - The ND should display a blue arrow at the point where the FMS predicts engagement of FINAL.

  _Note:_ *A white arrow indicates that at least one of the engagement conditions is not met.*

If the green solid line intercepts theF-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.




- 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.

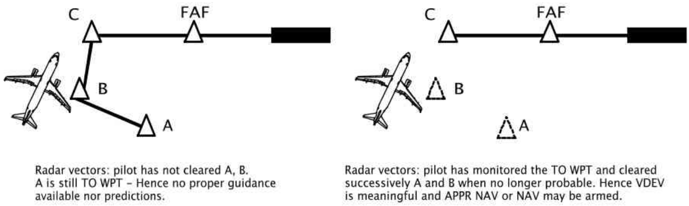
## INTERMEDIATE APPROACH

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

### INTERCEPTION OF FINAL APPROACH COURSE

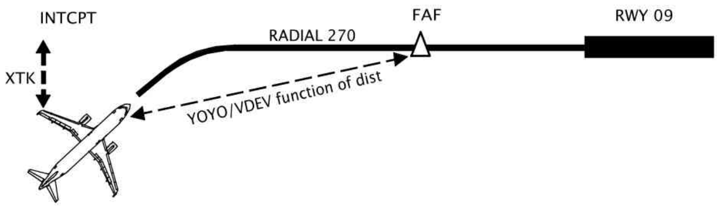
It is essential to have a correct F-PLN in order to ensure proper final approach guidance. Indeed the NAV and APP NAV modes are always guiding the aircraft along the F-PLN active leg and the managed vertical mode ensures VDEV =0, VDEV, being computed along the remaining F-PLN to destination. Hence, the 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




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



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

  The conditions for engagement of FINAL APP mode are as follows:
  - The aircraft should be stabilized laterally and vertically before the Vertical Interception Point (VIP), which is the point where the final descent starts
  - The DECEL must be sequenced and the FMS approach phase must be active
  - APP NAV must be engaged, and FINAL must be armed
  - The FMS must provide predictions
  - The ND should display a blue arrow at the point where the FMS predicts engagement of FINAL APP.

    _Note:_ *A white arrow indicates that at least one of the engagement conditions is not met.*

- 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.

## FINAL APPROACH

**Applicable to: ALL**

It is essential that the crew does not modify the final approach in the MCDU FPLNpage.

The final approach will be flown either

- Managed or
- Selected

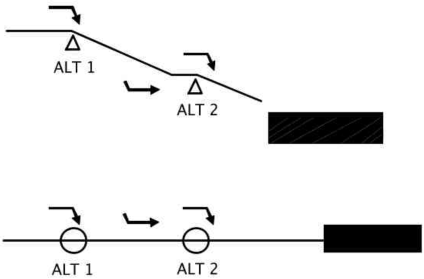
### MANAGED

For a managed approach, FINAL APP becomes active and the FMS 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 APP does not engage at the beginning of the final descent, the flight crew should consider to interrupt the instrument approach procedure unless they can maintain visual references throughout the approach.
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




## 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.

## REACHING THE MINIMA

Criteria: SA

1 **Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP**

When approaching MDA, expand the scan to include outside visual cues. When the required visual conditions to continue the approach are met, disconnect the AP. The PM shall then select the FDs off and set the runway QDM in the TRK window. If not visual by the MDA or MAP, whichever occurs first, go-around. Do not fly level at MDA whilst attempting to achieve the required visual reference, except when a circling approach to another runway is planned. In this case, level flight at circling minima prior to the missed approach point is permitted. If not visual by the MAP, execute a go-around.
MDA is the lowest permitted altitude for AP use. If the AP is still engaged following a managed approach, it will disconnect at MDA –50 ft. The modes will revert to TRK/FPA.

## REACHING THE MINIMA

Criteria:

2 **Applicable to: B-HSQ, B-HSR, B-HST, B-HSU**

3

When approaching MDA, expand the scan to include outside visual cues. When the required visual conditions to continue the approach are met, disconnect the AP. The PM shall then select the FDs off and set the runway QDM in the TRK window. If not visual by the MDA or MAP, whichever occurs first, go-around. Do not fly level at MDA whilst attempting to achieve the required visual reference, except when a circling approach to another runway is planned. In this case, level flight at circling minima prior to the missed approach point is permitted. If not visual by the MAP, execute a go-around.
MDA is the lowest permitted altitude for AP use. If the AP is still engaged following a managed approach, it will disconnect at the MAP. The modes will revert to TRK/FPA.

## VOR, VOR-DME, NDB AND NDB-DME APPROACH

**Applicable to: ALL**

VOR and NDB approaches are flown using one of the following three strategies:
- Lateral and vertical guidance selected by the crew using TRK-FPA modes,
- Lateral guidance managed by the FM and vertical guidance selected by the crew using NAV-FPA modes,
- Lateral and vertical guidance managed by the FM in FINAL APP mode.

Some charts provide a table of DME versus altitude. On those charts which do not have this table, an expected FPA for the final approach can be calculated by dividing the first 2 digits of the height at the FAF by the distance to go, e.g. 2 000 ft at 6 nm equates to a 3.3 ° approach path. When using this method, ensure that the FAF crossing height is used, i.e. the figure in brackets on the chart and not the FAF crossing altitude.

## LOC AND LOC BACK COURSE APPROACH

**Applicable to: ALL**

LOC approaches are flown using the LOC signal for lateral navigation and FPA for vertical guidance. The LOC pb will arm the LOC AP/FD mode. The ILS pb will display LOC deviation on the PFD The PFD's VDEV symbol should be disregarded since it may be incorrect if the Missed Approach Point is located before the runway threshold.
LOC Back Course approaches are not authorised.

## RNAV (GNSS) APPROACH

**Applicable to: ALL**

The following two strategies are available for performing RNAV (GNSS) approaches:

- Lateral and vertical guidance managed by the FM in FINAL APP mode. This is the recommended strategy. This strategy shall be used for approach with minima defined as LNAV/VNAV minima (i.e approach flown to a decision altitude (DA)).
- Lateral guidance managed by the FM and vertical guidance selected by the crew using NAV/FPA modes. This strategy may be used for approach with minima defined as LNAV minima (i.e. approach flown to a minimum descent altitude (MDA)), and shall be used for approaches which are conducted when the temperature is below a published limit, or when low temperature corrections are applied to approach altitudes.

Both GPSs must be available and GPS PRIMARY displayed on both MCDUs prior to commencing the approach. However once the approach has commenced, note that a single failure, such as NAV GPS 1 FAULT, will not cause the loss of GPS PRIMARY, since the remaining GPS will update both FMGS. If GPS PRIMARY LOST is displayed on the ND(s), it will be accompanied by a triple-click aural alert, even though NAV ACCURACY HIGH may still be displayed.
Crew procedures following a NAV FM/GPS POSITION DISAGREE caution, FMS1/FMS2 POS DIF message on the MCDU scratchpad, or if GPS PRIMARY LOST is displayed on one or both NDs, depends on whether the approach is standalone, or overlayed on a radio navaid procedure. Refer to FCOM PRO-NOR-SOP-19.

## DETAILED APPROACH SEQUENCE

**Applicable to: ALL**

### MANAGED NON-PRECISION APPROACH

Fly the intermediate approach conventionally and configure the aircraft in a similar manner to an ILS.

Use the following technique:

- For RNAV (GNSS) approach, check both GPS are in NAV mode on the GPS MONITOR page, and GPS PRIMARY is displayed on both MCDUs. Check RNP has sequenced to the approach value (0.30/0.37 nm).
- Check that deceleration occurs at the decel pseudo-waypoint, or if not, activate the approach phase approx 10 nm prior to the FAF.
- Select TRK/FPA display, confirm the FPV and the FPD are displayed on the PFD.
- Ensure LS/ILS is not selected.
- When cleared for the approach, press the APPR pb to arm APP NAV and FINAL. If previously in NAV, APP NAV engages immediately.
- Do not engage the second AP.

- Check the FMGS computed descent point, represented as a blue arrow, is displayed on the ND. It may not necessarily coincide with the chart descent point because the FMGS attempts to compute a continuous final descent path.
- V/DEV appears in approach phase with FINAL armed.
- Ensure raw data is correctly displayed.
- FINAL APP engages when the aircraft intercepts the vertical flight path.
- Set the go-around altitude.
- Use managed speed unless there are specific ATC requirements.
- Start the chrono at the FAF to check FAF to MAP time (if applicable).
- Monitor the approach using FPV/FPD and VDEV on the PFD, XTK and F-PLN waypoints on the ND with GPS PRIMARY, and confirmed by navaids for VOR, NDB and overlay approaches. Cross-check altitudes and distances with those published on the approach chart.

## SELECTED NON-PRECISION APPROACH

Fly the intermediate approach conventionally and configure the aircraft in a similar manner to an ILS. The approach can be flown fully selected or, if navigation accuracy allows, managed laterally and selected vertically.

## PARTIALLY SELECTED APPROACH

For a partially selected approach, i.e. managed laterally and selected vertically, continue as for a managed non-precision approach with the following additional consideration:

- Fly the final approach in NAV and FPA modes (LOC and FPA for LOC approaches).

## FULLY SELECTED APPROACH

For a fully selected approach:

- Fly the final approach in TRK/FPA modes.

## BOTH PARTIALLY AND FULLY SELECTED APPROACHES

For both partially and fully selected approaches, use the following technique:

- Check that deceleration occurs at the decel pseudo-waypoint, or if not, activate the approach phase approx 10 nm prior to the FAF.
- Select TRK/FPA display, confirm the FPV and the FPD are displayed on the PFD.
- For LOC approaches, ensure LS is selected. When cleared to intercept the localiser or localiser back course, press the LOC pb to arm the LOC mode.
- 1 nm prior to the final descent point, pre-select the desired FPA.
- Pull the FPA selector 0.2 nm prior to the final descent point to achieve a smooth interception of the final descent path.
- Use managed speed unless there is a specific ATC speed requirement.
- Start the chrono at the FAF to check FAF to MAP time (if applicable).

- Monitor the approach using FPV/FPD on the PFD, XTK and F-PLN waypoints on the ND with GPS PRIMARY, and confirmed by navaids for VOR, NDB and overlay approaches. For LOC approaches, monitor lateral displacement using the LOC pointer on the PFD. Cross-check altitudes and distances with those published on the approach plate. The VDEV indication on the PFD may be erroneous and must be disregarded (refer to FCOM PRO-NOR-SOP-19, OEB and FCOM bulletin).
- When the aircraft is below the missed approach altitude, set the missed approach altitude on the FCU.

## COLD WEATHER OPERATIONS

**Applicable to: ALL**

For all Non Precision Approaches, there is a minimum OAT. Below this temperature, the error on the barometric altitude is no longer acceptable, and altitude should be corrected in temperature. As it is not authorized to make these altitude corrections to the final approach segment of the FM Flight Plan (F-PLN) through the MCDU, it is not possible to use FINAL APP when OAT is below this minimum OAT. The flight crew must then use selected vertical guidance. This minimum OAT is indicated on the approach chart or must be defined by the operator based on the terrain profile (plus adequate margin).
For more information on approach in cold weather, *Refer to SI-010 COLD WEATHER OPERATIONS AND ICING CONDITIONS.*

# CIRCLING

Applicable to: ALL

The circling approach is the visual phase of an instrument approach to bring an aircraft into position for landing on a runway which is not suitably located for a straight-in approach (e.g. due to wind conditions).

## APPROACH PREPARATION

The flight crew performs the approach preparation before starting the descent, including tuning of the reference navaids. They should include the following additional items in the FMS programming:

### F-PLN

Lateral: Enter STAR, instrument approach procedure, including the missed approach procedure for instrument approach.
Vertical: Insert F speed as constraint at FAF since the circling approach will be flown in configuration 3, landing gear down and F speed. Check altitude constraints.

### 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

## APPROACH BRIEFING

The flight crew should perform the Approach Briefing with additional items specific to the circling procedure:
- Circling minima as published on the Approach chart or as per Company Operations Manual
- Direction of circling, if restricted according to the Approach chart, e.g. due to terrain. It is preferable that PF should be on the same side as the direction of circling, e.g. for circling to the left, PF should be CM1
- Significant obstacles in airport vicinity
- Technique to be used (e.g. AP and A/THR, FPV) and configuration
- Action in the case of loss of visual references.

## FINAL INSTRUMENT APPROACH

The flight crew flies a stabilized approach at F speed, configuration 3 and landing gear down.

## CIRCLING APPROACH

| | |
|---|---|
| **CAUTION** | The flight crew must conduct the flight within the circling area, while maintaining required visual references at all times. |

The following can be used to assist the flight crew in the circling approach pattern:
- Selected modes with AP are recommended. Waypoints can be entered before the approach to assist the flight crew in the circling approach pattern. However, they must not fly this pattern with AP engaged in NAV mode
- The ND in ROSE NAV with 10 nm on the EFIS display can be used for situational awareness
- In support to the timing technique, the flight crew should initiate the base turn when the aircraft is approximately on the 45 ° angle of the runway threshold.

Note: *The circling area which ensures obstacle clearance is based on a maximum speed of 205 kt for Category D aircraft (ICAO PANS-OPS and JAR OPS). Maintaining F speed during the circling procedure assists the aircraft to remain within the safe circling area. In regions where TERPS criteria apply, the circling areas are more restrictive. Refer to Part A 8.1.3.*

Initial Configuration:
- Gear Down
- Flap 3
- Select TRK/FPA

At the Circling MDA(H) at the latest:
- Perform a level off

At MAP, if the flight crew finds no visual reference:
- Initiate a go-around

When required conditions for circling are satisfied:
- Select a track of 45 ° away from the final approach course (or as required by the published procedure)
- When wings level, start the chrono
- After approximately 30 s select the downwind track parallel to the landing runway
- At any time in the downwind leg, activate the SEC F-PLN to display the landing runway and to take credit of the ground speed mini function in final approach when managed speed is used. Nevertheless, the flight crew should avoid a too early activation of the SEC F-PLN in order to keep the missed approach procedure of the instrument approach within the FMS if a go-around is necessary.
- When the aircraft is abeam the runway threshold, start the CHRONO. The time from abeam threshold to the beginning of the base turn depends on the height above touchdown: Approximately 3 s /100 ft.
- By the end of the downwind leg, disconnect the AP, select both FD's OFF and keep the A/THR.

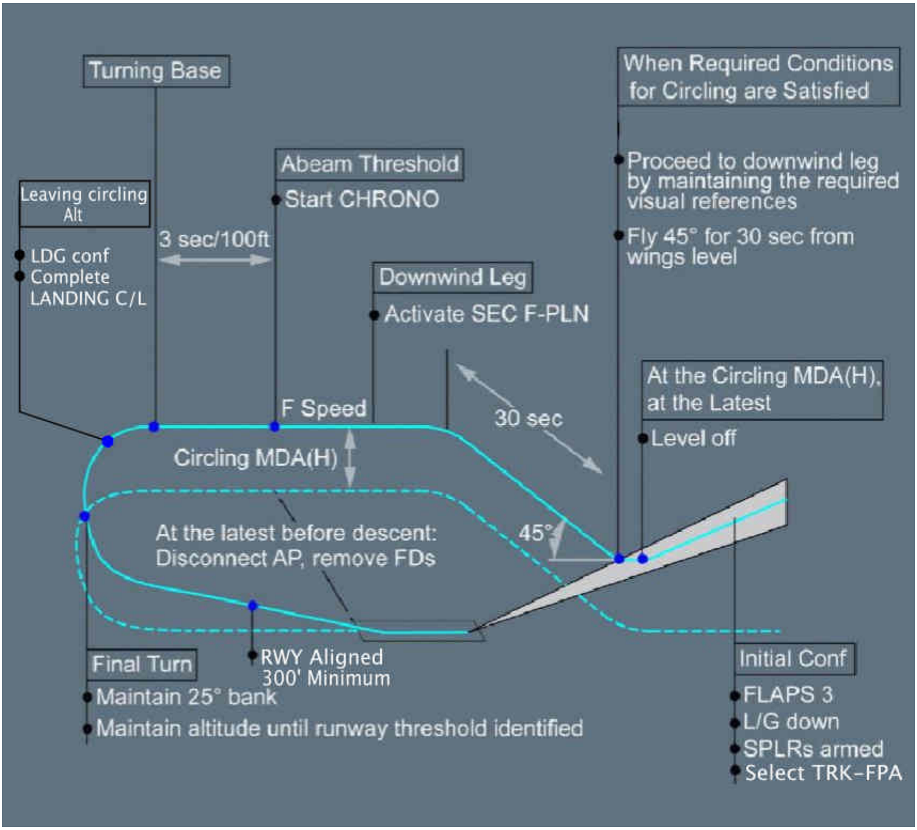
- To perform the final turn, initially maintain 25 ° bank angle and maintain the altitude until the visual references for the intended runway are distinctly visible and identifiable
- When leaving the circling altitude, select the landing configuration.
- When the aircraft is fully configured for landing, complete LANDING checklist.

If, at any time during the circling procedure, the required visual references are lost, the main objective is to climb and to leave the circling area into the missed approach of the initial instrument approach, while remaining within the obstacle-free area, unless otherwise specified, refer to Part A 8.3.7.2.
When the SEC F-PLN is activated, the go-around procedure in the FMS is associated with the landing runway, and not with the instrument approach. Therefore, if visual references are lost during the circling approach, the flight crew should fly the go-around using selected guidance, following the pre-briefed missed approach procedure, unless otherwise specified.
For circling approach with one engine inoperative, *Refer to AO-020 CIRCLING ONE ENGINE INOPERATIVE*.

## CIRCLING APPROACH PATTERN

**Applicable to: ALL**

1



## INITIAL APPROACH

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

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 F-PLN 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
- FPV 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 downwind track altitude will be set on FCU

## INITIAL APPROACH

Criteria: 22-1090, P7520, SA
**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU, B-HTG, B-HTH, B-HTI**

The flight crew must keep in mind that the pattern is flown visually. However, the cross track error on ND is a good cue of the aircraft lateral position versus the runway centerline. This indication can be obtained when performing a DIR TO radial inbound on the last available waypoint, positionned on the extended runway centerline.

The crew will aim to get the following configuration on commencement of the downwind leg:
- Both AP and FDs will be selected off
- FPV 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 downwind track altitude will be set on FCU

## INTERMEDIATE/FINAL APPROACH

**Applicable to: ALL**

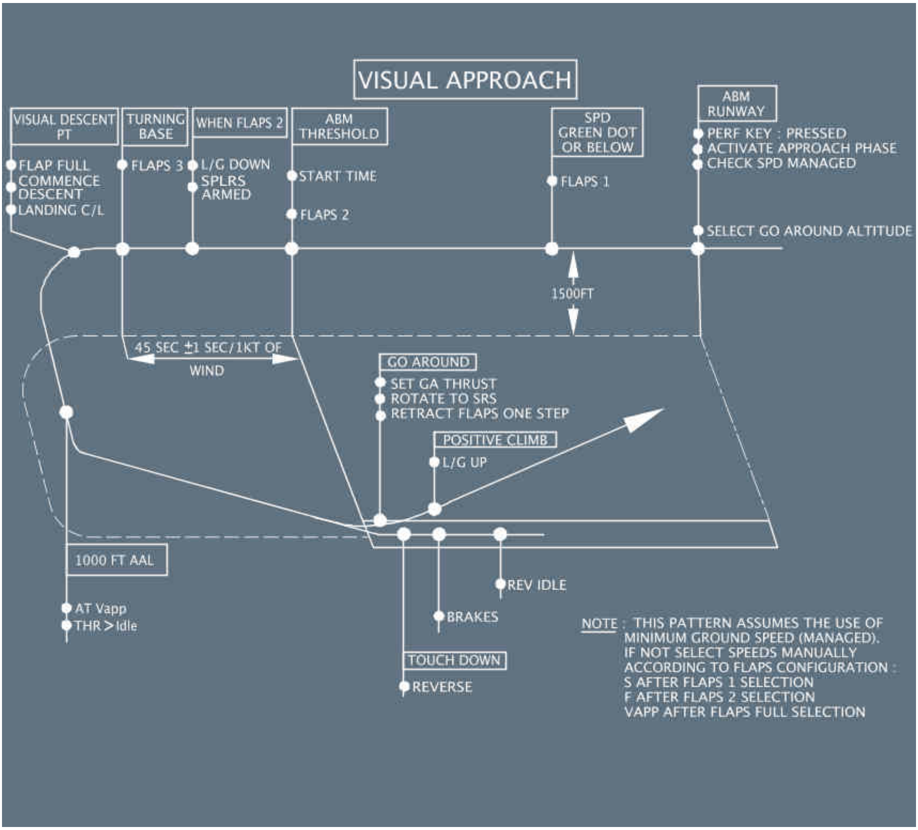
Assuming a 1 500 ft AAL circuit, the base turn should be commenced 45 s after passing abeam the downwind threshold (± 1 second/kt of head/tailwind).
The final turn onto the runway centreline will be commenced with 20 ° angle of bank. Initially the rate of descent should be 400 ft/min, increasing to 700 ft/min when established on the correct descent path.

The pilot will aim to be configured for landing by 1 500 ft AAL. If not stabilised by 1 000 ft a go-around must be carried out.

## VISUAL APPROACH DIAGRAM

Applicable to: ALL

1



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# GENERAL

Applicable to: ALL

CAT II 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 and the aircraft properly stabilized. Hence,

- The automatic landing is required in CAT III operations including roll out in CAT IIIB.
- The automatic landing is the preferred landing technique in CAT II 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

Airport capabilities regarding Low Visibility Operations (LVO) and autoland are stipulated on the relevant Port Page. The airport authorities are responsible for establishing and maintaining the equipment required for CAT II/III approach and landing. Prior to planning a CAT II/III approach, ensure that Low Visibility Procedures (LVP) are in force at the airport.

# DEFINITION

Applicable to: ALL

## DECISION HEIGHT

The Decision Height (DH) is the wheel height above the runway elevation by which a go around must be initiated unless appropriate 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 safely. 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 parts 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 CAT 3 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 50 ft.

## 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 | 100 ft ≤DH <200 ft | 100 ft ≤DH <200 ft | 100 ft ≤DH <200 ft |
| | RVR | RVR ≥350 m<br>RVR ≥1 200 ft | 350 m ≤RVR <800 m<br>1 200 ft ≤RVR <2 400 ft | RVR ≥300 m<br>RVR ≥1 000 ft |
| CAT IIIA | DH | No DH or DH <100 ft | No DH or DH <100 ft | DH <100 ft (1) |
| | RVR | RVR ≥200 m<br>RVR ≥700 ft | RVR ≥200 m<br>RVR ≥700 ft | RVR ≥200 m<br>RVR ≥700 ft |
| CAT IIIB | DH | No DH or DH <50 ft | No DH or DH <50 ft | No DH or DH <50 ft |
| | RVR | 50 m ≤RVR <200 m<br>150 ft ≤RVR <700 ft | 50 m ≤RVR <200 m<br>150 ft ≤RVR <700 ft | 75 m ≤RVR <200 m<br>250 ft ≤RVR <700 ft |

*(1) DH ≥50 ft if fail passive*

# FLIGHT PREPARATION

**Applicable to: ALL**

In addition to the normal flight preparation, the following preparation must be performed when CAT II or CAT III approach is planned:

- Ensure that destination airport meets CAT II or CAT III requirements
- Check aircraft required equipment for CAT II or CAT III in QRH
- Check that crew qualification is current
- Consider extra fuel for possible approach delay
- Consider weather at alternate

# APPROACH PREPARATION

Applicable to: ALL

## LIMITATIONS

- The crew will check that tower wind remains within the limit for CAT II or CAT III approaches (*Refer to FCOM/LIM-22-20 Maximum Wind Conditions for Cat II or Cat III Automatic Approach Landing and Roll Out*)
- The autoland maximum altitude must be observed.

## AIRCRAFT CAPABILITY

The failures that may affect the aircraft's CAT II or CAT III 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 10 m (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.

| Conditions | CAT I | CAT II | CAT III | |
|---|---|---|---|---|
| | | | WITH DH | NO DH |
| Flying technique | Manual flying or AP/FD, A/THR | AP/FD, A/THR down to DH | AP/FD/ATHR and Autoland | |
| Minima & weather | DA (DH) Baro ref Visibility | DH with RA RVR | | |
| Autoland | Possible with precautions | Recommended | Mandatory | |

## GO AROUND STRATEGY

The crew must be ready mentally for go-around at any stage of the approach. Should a failure occur above 1 000 ft RA, all ECAM actions (and DH amendment if required) should be completed before reaching 1 000 ft RA, otherwise a go-around should be initiated. This ensures proper task sharing for the remainder of the approach. Furthermore, refer to FCOM PRO-NOR-SRP-01-70 for failures and associated actions below 1 000 ft RA that should lead to a go-around.

## APPROACH BRIEFING

Additional briefing items should be considered before commencing CATII/III approaches, refer to QRH NP. Information about precision approaches and guidance on the use of the FMGS can be found in FCOM PRO-NOR-SRP-01-70. Company policy regarding Low Visibility Operations (LVO) is provided in Part A 8.4.1 with additional information in FCOM PRO-SUP-91-60.

# APPROACH PROCEDURE

**Applicable to: ALL**

## TASK SHARING

The workload is distributed in such a way that the PF primary tasks are supervising and decision making and the PM 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 green" when displayed on FMA.

The PM is head down throughout the approach and landing. The PM monitors:

- The FMA and calls all mode changes below 350 ft as required (i.e. after PF calls "LAND green")
- The Auto call out
- The aircraft trajectory or attitude exceedance
- Any failures

The PM should be go-around minded.

## SOME SYSTEM PARTICULARS

- Below 700 ft RA, data coming from the FMS is 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 ft is sensed.
- Flare comes at or below 40 ft
- THR IDLE comes at or below 30 ft
- RETARD auto call out comes at 10 ft 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. Refer to Part A 8.4.1.2.

Required conditions to continue

- With DH
  In CAT II operations, the conditions required at DH to continue the approach are that the visual references should be appropriate 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 CAT III 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 inappropriate 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 look outside to assess that the autoland is properly carried out, considering the appropriate visual references.
For CAT II 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 PM will use standard call out. Additionally, he will advise ATC when aircraft is properly controlled (speed and lateral trajectory).

## FAILURE AND ASSOCIATED ACTIONS

**Applicable to: ALL**

The failures that may affect the aircraft's CAT II/III capability are listed in the QRH. Most of the systems required for the different autoland capabilities are monitored by the FMGS. If a failure of a monitored system is detected after the APPR pb is pressed, but above the alert height, a new approach capability will be displayed on the FMA along with a "triple click" audio warning. In this case, the reduced approach category will not be displayed on the Status page. In addition, reduced approach capabilities displayed on the Status page are removed and transferred to the FMA when the APPR pb is pushed. The approach capabilities that can be displayed on the FMA are CAT 1, CAT 2, CAT 3 SINGLE or CAT 3 DUAL.
There are also a number of failures which affect the aircraft's landing capability that are not monitored by the FMGS and are consequently not reflected on the FMA.
Following any failure that does not incur a landing capability downgrade on ECAM STATUS or FMA, refer to the "Landing Capability Equipment Required" table in the QRH to establish the actual landing capability.
Should a failure occur above 1 000 ft RA, all ECAM actions, including DH amendment if required, should be completed before reaching 1 000 ft RA. If this is not possible, initiate a go-around. An alert generated below 1 000 ft (and down to the Alert Height in CAT 3 DUAL) should normally lead to a go-around and a reassessment of the system capability, unless the required visual reference has been acquired. Below 1 000 ft, there is generally insufficient time to properly analyse the consequences of the fault, perform the necessary ECAM actions, check system configuration and any limitations, then carry out a re-briefing. The decision to continue the approach must be based on sound judgement.

## AUTOLAND IN CAT 1 OR BETTER WEATHER CONDITIONS

**Applicable to: ALL**

The crew may wish to practice automatic landings in CAT 1 or better weather conditions for training purposes. 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.

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## PREFACE

Applicable to: 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

## LANDING PERFORMANCE

Applicable to: ALL

1 Landing performance must be considered prior to every approach.
Providing dispatch criteria are met, a landing on a long, dry runway below maximum landing weight will not require a physical check of the required landing distance. However, when landing with a performance related failure, or on short runways, or with adverse environmental conditions an assessment of the landing distance should be made.
Calculating the landing distance not only confirms there is adequate landing distance available but also quantifies the margin available for stopping in the event of a long or bounced landing. This increased awareness of the 'excess' runway will assist in the continue/go-around decision making process.
Conditions when it would be considered advisable to check the landing distance include:

- Performance related failures
- Overweight landings
- Short runways
- Wet/Contaminated runways
- Tailwind
- Windshear

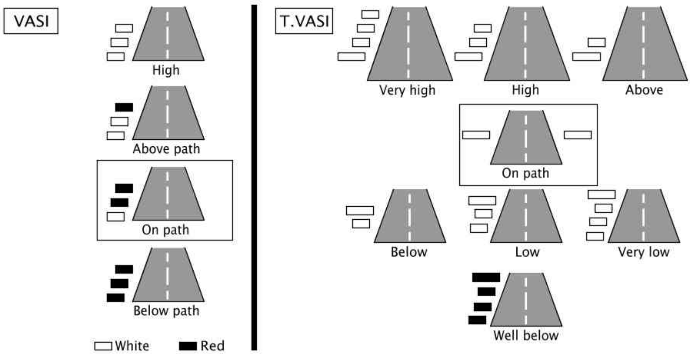
Landing performance may be assessed using either ACARS Landing or QRH In Flight Performance.

## MAIN GEAR CLEARANCE

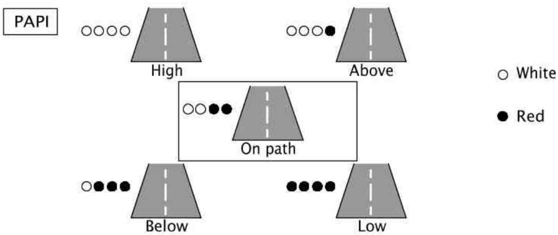
Applicable to: ALL

The boxed images below are the one to retain to ensure about 20 ft wheel clearance at threshold.

use of VASI/TVASI/PAPI




use of VASI/TVASI/PAPI




This technique will ensure that performance margins are not compromised and provide adequate main gear clearance.

## FLARE

Applicable to: 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 ° in 8 s. 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.

Prior to flare, avoid destabilization of the approach and steepening the slope at low heights in attempts to target a shorter touchdown. If a normal touchdown point cannot be achieved or if

destabilization occurs just prior to flare, a go-around (or rejected landing) should be performed.
The PM monitors the rate of descent and should call "*SINK RATE*"if the vertical speed is excessive prior to the flare.
From stabilized conditions, the flare height is about 30 ft.
This height varies due to the range of typical operational conditions that can directly influence the rate of descent.
Compared to typical sea level flare heights for flat and adequate runway lengths, pilot need to be aware of factors that will require an earlier flare, in particular:

- High airport elevation.
  Increased altitude will result in higher ground speeds during approach with associated increase in descent rates to maintain the approach slope.
- Steeper approach slope (compared to nominal 3 °).
- Tailwind.
  Increased tailwind will result in higher ground speed during approach with associated increase in descent rates to maintain the approach slope.
- Increasing runway slope.
  Increasing runway slope and/or rising terrain in front of the runway will affect the radio altitude callouts down to over flying the threshold used by the flight crew to assess the height for the start of flare possibly causing flare inputs to be late. The visual misperception of being high is also likely.

Note that the cumulative effect of any of the above factors combined for one approach will require even more anticipation to perform an earlier flare.
If the flare is initiated too late then the pitch changes will not have sufficient time to allow the necessary change to aircraft trajectory. Late, weak or released flare inputs increase the risk of a hard landing.

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 ( or "prompt") 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. When best adapted, the pilot will rapidly retard all thrust levers: depending on the conditions, the pilot will retard earlier or later. However, the pilot must ensure that all thrust levers are at IDLE detent at the latest at touchdown, to ensure ground spoilers extension at touchdown.
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. Do not allow the aircraft to float or do not attempt to extend the flare by increasing pitch attitude in an attempt

to achieve a perfectly smooth touchdown. 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 wings-level should be flown with the aircraft (cockpit) positioned on the extended runway centerline until the flare.

### 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 lateral loads on the main landing gear.

The recommended de-crab technique is to use all of the following:
- The rudder to align the aircraft with the runway heading during the flare.
- The roll control, if needed, to maintain the aircraft on the runway centerline. Any tendency to drift downwind should be counteracted by an appropriate lateral (roll) input on the sidestick.

In the case of strong crosswind, in the de-crab phase, the PF should be prepared to add small bank angle into the wind in order to maintain the aircraft on the runway centerline. The aircraft may be landed with a partial de-crab (residual crab angle up to about 5 °) to prevent an excessive bank. This technique prevents wingtip (or engine nacelle) strike caused by an excessive bank angle.
As a consequence, this may result in touching down with some bank angle into the wind (hence with the upwind landing gear first).

## CALL OUT

Criteria: SA
**Applicable to: ALL 320**

If pitch attitude exceeds 10 °, the PM will announce "PITCH".

## CALL OUT

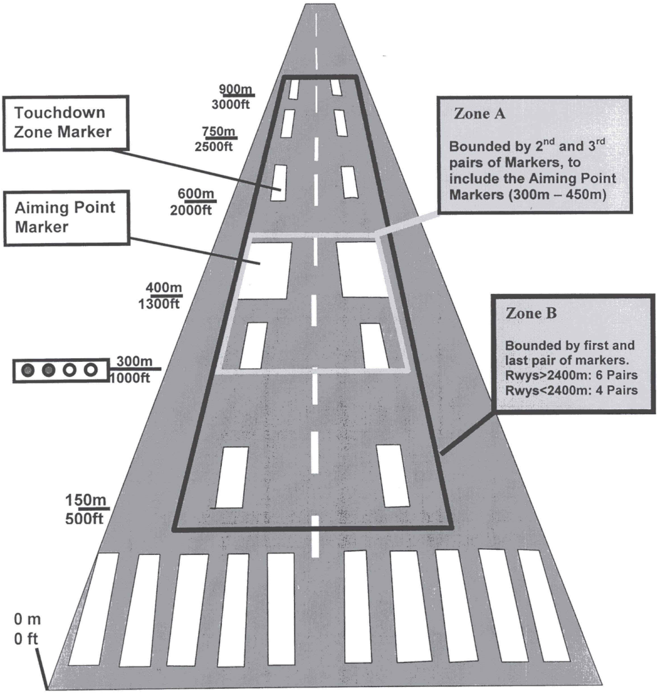
Criteria: SA, 321-200
**Applicable to: ALL 321**

If pitch attitude exceeds 7.5 °, the PM will announce "PITCH".

## TOUCHDOWN POINT

**Applicable to: ALL**

- The aiming point for all approaches will be the Aiming Point Markers.
- Touchdown should be achieved within Zone A. If touchdown is anticipated outside this zone, the Commander should consider correcitive action, dependent on runway length and conditions, which may include a rejected landing.
- Touchdown prior to Zone B is not permitted; if anticipated beyond Zone B, a rejected landing is mandatory unless the Commander is satisfied that sufficient distance remains under the current conditions to safely complete the landing.




## DEROTATION

**Applicable to: 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

Applicable to: 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.

2 ### 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.
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.

## BRAKING

Applicable to: ALL

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.

## 3 THRUST REVERSERS

Thrust reverser efficiency is proportional to the square of the speed. So, it is recommended to use reverse thrust at high speeds.
On dry runway only and if landing performance permits, the flight crew can select and maintain reverse IDLE until taxi speed is reached. For any other case, immediately select REV MAX on all reverser levers after main landing gear touches down.
The flight crew must select REV MAX if the aircraft is affected by any failure that impacts the landing performance or if required due to an emergency.
After the flight crew selects reverse thrust, they should perform a full stop landing.
A slight pitch-up, easily controlled by the crew, may appear when the thrust reversers are deployed before the nose landing gear touches down.
The maximum reverse thrust is obtained at N1 between 70 % and 85 % and is controlled by the FADEC.
Below 70 kt, 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 kt. However, the use of maximum reverse is allowed down to aircraft stop in case of emergency.
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 kt/sec.

## BRAKES

The use of auto brake versus pedal braking should observe the following guidelines:

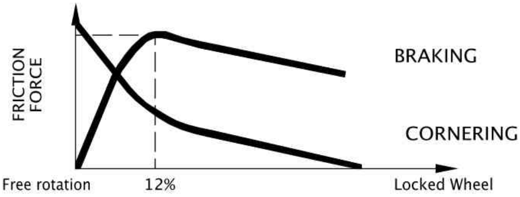
- Autobrake shall be armed for all landings.
- The use of autobrake is preferable because it minimizes the number of brake applications and thus reduces brake wear. Additionally, the autobrake provides a symmetrical brake pressure application which ensures an equal braking effect on both main landing gear wheels on wet or evenly contaminated runway. More particularly, the autobrake is recommended on short, wet, contaminated runway, in poor visibility conditions and in Auto land.
- The use of LO autobrake should be preferred on long and dry runways whereas the use of MED autobrake should be preferred for short or contaminated runways. The use of MAX autobrake 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. However, this should not preclude arming of the autobrake for landing.
- On long dry runways where minimal braking is anticipated, the autobrake may be disengaged after touchdown provided the aircraft has landed within the Touchdown Zone. 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 green DECEL light comes on when the actual deceleration is 80 % of the selected rate. For example the DECEL light might not appear when the autobrake is selected on a contaminated runway, because the deceleration rate is not reached with the autobrake properly functioning. Whereas the DECEL light might appear with LO selected on a dry runway while only the 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.
Autobrake does not relieve the pilot of the responsibility of achieving a safe stop within the available runway length.

## CROSS WIND CONDITIONS

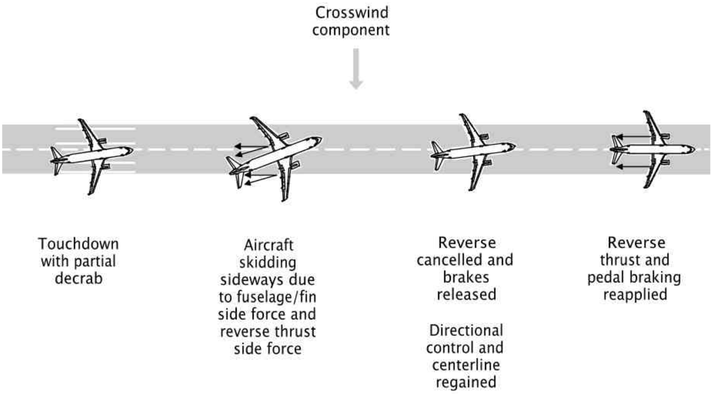
The reverse thrust side force and crosswind component can combine to cause the aircraft to drift to the downwind side of the runway if the aircraft is allowed to weathercock into wind after landing. Additionally, as the anti-skid system will be operating at maximum braking effectiveness, the main gear tire cornering forces available to counteract this drift will be reduced.

braking force and cornering force vs antiskid




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




## CLEARANCE AT TOUCH DOWN

Criteria: 320-200
**Applicable to: ALL 320**

| Geometry limit at touch down | Pitch attitude at VAPP(Vref +5 kt) (1) | Pitch attitude at touch down | Clearance (2) |
|---|---|---|---|
| 13.5 ° | 3.3 ° | 7.6 ° | 5.9 ° |

*(1) Flight path in approach: -3 °*
*(2) Clearance = geometry limit - pitch attitude at touch down*

# CLEARANCE AT TOUCH DOWN

Criteria: 321-200
**Applicable to: ALL 321**

| Geometry limit at touch down | Pitch attitude at VAPP(Vref +5 kt) (1) | Pitch attitude at touch down | Clearance (2) |
|---|---|---|---|
| 10.8 ° | 2.4 ° | 6.6 ° | 4.2 ° |

(1) *Flight path in approach:-3 °*
(2) *Clearance = geometry limit - pitch attitude at touch down*

# TAIL STRIKE AVOIDANCE

**Applicable to: ALL**

Although most of tail strikes are due to deviations from normal landing techniques, some are associated with external conditions such 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 the right touchdown attitude and airspeed.
During the flare, the pilot should not concentrate on the airspeed, but only on the attitude with external cues.
Specific PM 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.

## 4 AIRCRAFT SYSTEM FOR TAIL STRIKE PREVENTION

The following aircraft systems help to prevent tail strike occurrence:
- A "PITCH-PITCH" synthetic voice sounds when the pitch attitude becomes excessive,
- A tail strike pitch limit indicator appears on the PFD to indicate the maximum pitch attitude to avoid a tail strike.

This design is installed on HSO, HSP, HSQ and HSR.

## 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.

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## PREFACE

**Applicable to: 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 FOR THE GO-AROUND

**Applicable to: 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 stabilised approach criteria in FCOM PRO-NOR-SOP-01 will not be achieved.
- Any GPWS, TCAS or windshears alert occur
- Adequate visual cues are not obtained reaching the minima.

## AP/FD GO-AROUND PHASE ACTIVATION

Criteria: 22-1058, P4319, SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO**

1 The go-around phase is activated when the thrust levers are set to the TOGA detent, the full forward thrust levers position, 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 FPV 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 momentarily but without delay, to the TOGA detent, the full forward thrust levers position, in order to ensure proper activation of the Go-Around phase (guidance modes and FMS flight phase).

If this is not done:
- The FMS remains in the Approach phase, and
- Since the Go-Around phase is not active, the FMS does not automatically restring the approach procedure in the active F-PLN, and

- The active F-PLN is neither modified, nor erased, and
- When at the destination airfield, the FMS sequences the F-PLN and the aircraft flies the Missed Approach procedure (the Missed Approach becomes green on the ND and on the MCDU F-PLN page), and
- At the end of the Missed Approach procedure, when all the waypoints are sequenced, the active F-PLN becomes "PPOS - DISCONT".

## AP/FD GO-AROUND PHASE ACTIVATION

Criteria: P10694, P4319, SA
**Applicable to: B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

2 The go-around phase is activated when the thrust levers are set to the TOGA detent, the full forward thrust levers position, provided the flap lever is selected to Flap 1 or greater. The FDs bars are displayed automatically and SRS and NAV 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 FPV 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 momentarily but without delay, to the TOGA detent, the full forward thrust levers position, in order to ensure proper activation of the Go-Around phase (guidance modes and FMS flight phase).

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- At the end of the Missed Approach procedure, when all the waypoints are sequenced, the active F-PLN becomes "PPOS - DISCONT".

## GO-AROUND PHASE

**Applicable to: ALL**

The SRS mode guides the aircraft with the highest speed of VAPP or IAS at time of TOGA selection (limited to maximum of VLS +25 with all engines operative or VLS +15 with one engine inoperative with FMS 2) until the acceleration altitude where the target speed increases to green dot.

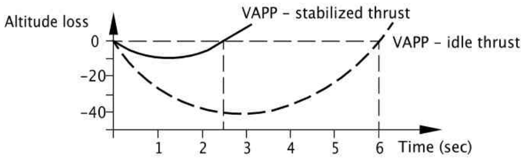
Some FMS misbehaviour may prevent this automatic target speed increase. Should this occur, pulling the FCU ALT knob for OP CLB manually disengages SRS mode and allows the target speed to increase to green dot. It should be noted however, that the target speed increases to green dot speed as soon as ALT* 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

Applicable to: 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.

altitude loss following a go-around




## LEAVING THE GO-AROUND PHASE

Applicable to: ALL

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

**Applicable to: ALL**

A rejected landing is defined as a go-around manoeuvre initiated after touchdown of the main landing gear.
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 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

**Applicable to: 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 5 min after touchdown or just prior to stopping at the gate (whichever occurs first). Selecting brake fans before reaching the gate allows avoiding blowing carbon brake dust on ground personal.

## BRAKE TEMPERATURE

Criteria: SA
**Applicable to: ALL 320**

If there is a significant difference in brake temperature between the wheels of the same gear, when reaching the gate, 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. Selecting brake fans before reaching the gate allows avoiding blowing carbon brake dust on ground personal.
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 MEL provides information regarding brake ground cooling time, both with and without brake fans .

## BRAKE TEMPERATURE

Criteria: K2113, P3341, SA
**Applicable to: ALL 321**

If there is a significant difference in brake temperature between the wheels of the same gear, when reaching the gate, 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. Selecting brake fans before reaching the gate allows avoiding blowing carbon brake dust on ground personal.
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 MEL provides information regarding brake ground cooling time, both with and without brake fans ◁✻ .

## ENGINES COOLING PERIOD

**Applicable to: ALL**

To avoid engine thermal stress, it is required that the engine be operated at, or near, idle for a cooling period (*Refer to FCOM/PRO-NOR-SOP-24 PARKING - ENG MASTER SWITCHES*)

## TAXI WITH ONE ENGINE SHUTDOWN

**Applicable to: ALL**

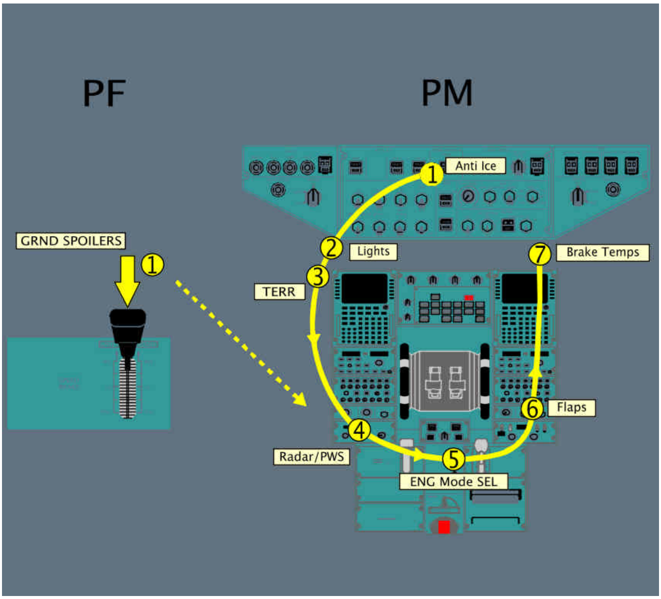
Refer to FCOM PRO-SUP-90.

## AFTER LANDING FLOW PATTERN

**Applicable to: ALL**

1

AFTER LANDING FLOW PATTERN



# ABNORMAL OPERATIONS

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## AO-PLP PRELIMINARY PAGES



## AO-010 GENERAL



## AO-020 OPERATING TECHNIQUES



## AO-022 AUTOFLIGHT



## AO-024 ELECTRICAL

TABLE OF CONTENTS

## AO-026 FIRE PROTECTION



## AO-027 FLIGHT CONTROLS



## AO-028 FUEL



## AO-029 HYDRAULIC



## AO-032 LANDING GEAR



## AO-034 NAVIGATION



## AO-070 POWER PLANT



## AO-090 MISCELLANEOUS

SUMMARY OF HIGHLIGHTS

| Localization Title | Toc Index | ID | Reason |
|---|---|---|---|
| AO-020 REJECTED TAKEOFF | B | 1 | **Update of list of amber cautions for which rejected takeoff procedure should be carried out even above 100 kt to include "ENG 1(2) THR LEVER FAULT", since this failure case will lead to reduction to IDLE on affected engine.** |
| | | | **Update of the technical wording** |
| AO-020 INTRODUCTION TO EMERGENCY EVACUATION | C | 2 | Effectivity update: The information now also applies to MSN 0633, 0756, 0784, 0812, 0930, 0993, 1024, 1253, 1695, 1721, 1984, 2021, 2229, 2238, 2428, 5024, 5030, 5362, 5429. |
| AO-020 ENGINE FAILURE AFTER V1 WITH SPEED RESTRICTION | G | 3 | Update of the illustration |
| AO-022 FMGC FAILURE | A | 1 | Effectivity update: The information now also applies to MSN 5024, 5030, 5362, 5429. |
| AO-026 SMOKE DETECTION AND PROCEDURE APPLICATION | B | 1 | Solution revised in order to clarify AVIONICS SMOKE procedure in case of perceptible smoke. |
| AO-026 SMOKE/FUMES/AVNCS SMOKE PAPER PROCEDURE | D | 2 | DU revised to insert space between "AVIONICS SMOKE" and "ECAM" |
| AO-090 COCKPIT WINDSHIELD/WINDOW CRACKED | A | 1 | Update of the link to the FCOM Description chapter. |
| AO-090 SOP TASK SHARING FOR AN EMERGENCY DESCENT | B | 2 | PF announcement changed to PM |
| | | | PM announcement changed to PF |
| AO-090 EMERGENCY DESCENT FLOW PATTERN | B | 3 | **16 Aug 2012 : Modification of the illustration** |

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## PREFACE

**Applicable to: 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 OP-040 ECAM handling.

## USE OF AUTOPILOT

**Applicable to: ALL**

The use of the autopilot is strongly recommended in the case of engine failure. The AP can be used throughout the entire flight envelope with an engine out including autoland, except for non precision approaches in the following modes: FINAL APP, NAV V/S and NAV/FPA. In these cases, only FD may be used.
In case of other failures, the AP can used down to 500 ft AGL in all modes, however it has not been certified in all configurations and its performance cannot be guaranteed. If the A/P is used in such circumstances, remain vigilant and be prepared to disconnect the A/P if the aircraft deviates from the desired or safe flight path.

## MONITORING AND CROSS-CHECKING

**Applicable to: ALL**

Monitoring and cross-checking are essential components of effective procedures and remain primary tasks for all crew members. The PF shall monitor all ECAM/checklist actions.

## MEMORY ITEMS

**Applicable to: ALL**

The following procedures are to be applied from memory:

- WINDSHEAR
  - PF Calls: "Windshear TOGA!"
- WINDSHEAR AHEAD
- TCAS
- EGPWS
  - PF Calls: "Pull Up TOGA!" (Pull Up Warning only)

- LOSS OF BRAKING
  - PF Calls: "Loss of Braking!"
- EMER DESCENT (immediate actions)
  - PF Calls: "Emergency Descent!"
- UNRELIABLE AIRSPEED INDICATIONS / ADR CHECK PROC (memory items)
  - PF Calls: "Unreliable Airspeed!"
- CREW INCAPACITATION
- STALL RECOVERY
- STALL WARNING AT LIFT-OFF

## LAND ASAP

**Applicable to: ALL**

In an abnormal situation the Captain, being responsible for the operation and the safety of the flight, must make the decision to continue the flight as planned or divert. In all cases, the Captain is expected to take the safest course of action.

The ECAM assists the crew in making this decision by indicating LAND ASAP either in amber or red:
- If an abnormal procedure causes a LAND ASAP to appear in amber on the ECAM, the crew should consider the seriousness of the situation and the selection of a suitable airport.
- If an emergency procedure causes LAND ASAP to appear in red on the ECAM, the crew should land at the nearest suitable airport at which a safe approach and landing can be made.

Following the failure of an engine on a twin-engined aircraft, an emergency situation exists and the Captain shall land at the nearest suitable airfield.
The relative suitability of airports is at the Captain's discretion based on a number of factors including, but not limited to; weather, navigation aids, runway length and fire and rescue support facilities. The Captain may determine that, based on the nature of the situation and an examination of the relevant factors, it is preferable not to divert to the nearest airport but to continue to a more suitable airport at a greater distance. The intent is the Captain may consider the airports available in the immediate vicinity of the location where the engine failure occurs. Where more than one suitable airport is available within a similar distance, the Captain may then include commercial and engineering considerations when determining relative suitability. It is not the intention to provide discretion to fly past or away from perfectly suitable airports in order to reach a more distant airport that is preferred purely on the grounds of commercial or engineering considerations. In all cases, continued flight beyond the nearest suitable airport is only justified if all safety factors have been fully considered, and the conclusion reached that safety is not in any way compromised by continued flight.

For a fire that cannot be confirmed as extinguished, or persistent smoke, the safest course of action is to descend and carry out an Emergency Landing with consideration being given to a possible passenger evacuation.
In the case of a LAND ASAP in red, consider an Overweight Landing rather than delaying to burn excess fuel.

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# LOW SPEED ENGINE FAILURE

**Applicable to: 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 TAKEOFF

**Applicable to: ALL**

## FACTORS AFFECTING RTO

Experience has shown that a rejected takeoff can be hazardous, even if correct procedures are followed. Some factors that can detract from a successful rejected takeoff 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 takeoff briefing is required. During this briefing, the crew should confirm that the computed takeoff data reflects the actual takeoff conditions e.g. wind and runway condition. Any changes to the planned conditions require the crew to re-calculate the takeoff data. In this case, the crew should not be pressurised into accepting a takeoff clearance before being fully ready. Similarly, the crew should not accept an intersection takeoff until the takeoff 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.

## 1 DECISION MAKING

A rejected takeoff is a potentially hazardous manoeuvre and the time for decision-making is limited. To minimize the risk of inappropriate decisions to reject a takeoff, many warnings and cautions are inhibited between 80 kt and 1 500 ft. Therefore, any warnings received during this period must be considered as significant.

To assist in the decision makingprocess, the takeoff is divided into low and high speeds regimes, with 100 kt being chosen as the dividing line. The speed of 100 kt 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 kt, the Captain will seriously consider discontinuing the takeoff if any ECAM warning/caution is activated.
- Above 100 kt, and approaching V1, the Captain should be "go-minded" and only reject the takeoff in the event of a major failure, sudden loss of thrust, any indication that the aircraft will not fly safely, any red ECAM warning, or any amber ECAM caution listed below:
  - F/CTL SIDESTICK FAULT
  - ENG FAIL
  - ENG REVERSER FAULT
  - ENG REVERSE UNLOCK
  - ENG 1(2) THR LEVER FAULT

  If a tire fails within 20 kt 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.

  V1 is the maximum speed during the takeoff roll at which the pilot must take the first action to stop the aircraft within the accelerate-stop distance.

  V1 is also the minimum speed in the takeoff roll, following a failure of the critical engine at V1, at which the pilot can continue the takeoff and achieve the required height above the takeoff surface within the takeoff distance.

The decision to reject the takeoff 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 takeoff, he will announce his intention by calling "Go!"
- If a decision is made to reject the takeoff, the Captain calls "Stop!" This call both confirms the decision to reject the takeoff 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

During the rejected takeoff, the First Officer monitors and calls "Rev Green, Decel" (as appropriate) during the deceleration. It is important to remember the following:

- If the takeoff is rejected prior to 72 kt, the spoilers will not deploy and the autobrake will not be activated. In any case, spoiler deployment may not be visible to the crew if the SD automatically displays the failure page.
- The “Decel” call confirms that the DECEL light is illuminated on the Autobrake panel, however this light only indicates the selected deceleration rate is or is not being achieved, irrespective of the autobrake system itself. For example, it may not illuminate on a contaminated runway with the autobrake working properly due to the effect of the antiskid system.

- If the autobrake response does not seem appropriate for the runway condition, apply and maintain full manual braking.
- If the autobrake is unserviceable, the Captain should simultaneously apply maximum pressure on both pedals as the thrust levers are set to idle. The aircraft will stop in the minimum distance only if the brake pedals are kept fully depressed until the aircraft comes to a stop.
- If normal braking is inoperative, immediately select the A/SKID&N/W STRG switch to OFF and modulate brake pressure as required below 1 000 psi.
- Full reverse may be used until a complete stop is achieved. However if there is sufficient runway available for the deceleration, reduce reverse thrust preferably when passing 70 kt.
- Do not attempt to clear the runway until it is absolutely clear an evacuation is not necessary and that it is safe to do so. If the aircraft comes to a complete stop using autobrake, release the autobrake prior to taxi by disarming the spoilers.

The Captain brings the aircraft to a complete stop, sets the parking brake and, using the PA, announces "Attention! Cabin Crew at Stations!" prior to calling for " ECAM actions." The following table details the SOP task sharing for a rejected takeoff before V1.

| CAPT | F/O |
|---|---|
| If GO Decision.............. "Go!" | |
| If RTO Decision.............. "Stop!"<br>Simultaneously:<br>Thrust Levers.............. IDLE<br>Reverse Thrust.............. MAX AVAIL<br>Braking.............. MONITOR *(Note 1)*<br><br><br>Aircraft stopped *(Note 5)*<br>Reverse.............. STOW<br>Parking Brake.............. APPLY<br>PA.............. "Attention! Cabin Crew at Stations."<br>Call.............. "ECAM actions." | <br><br><br>Reversers.............. "Reverse green." *(Note 2)*<br>Deceleration.............. "Decel/No Decel." *(Note 3)*<br>Any Audio.............. CANCEL<br>ATC.............. NOTIFY *(Note 4)*<br>EMER EVAC Checklist.............. LOCATE<br><br><br><br><br>ECAM actions.............. INITIATE |
| **In the case of an Engine Fire complete the ECAM until EMER EVAC PROC....... APPLY, then:** | |
| Call.............. "Emergency Evacuation Checklist." | EMER EVAC Checklist.............. READ & DO<br>• ATC.....NOTIFY is confirmation that ATC were advised during the deceleration phase.<br>• CABIN CREW.....ALERT is confirmation the "Attention! Cabin Crew at Stations" PA was made.<br>• Pause after reading "If Evacuation required?" |
| **If Evacuation Required:** | |

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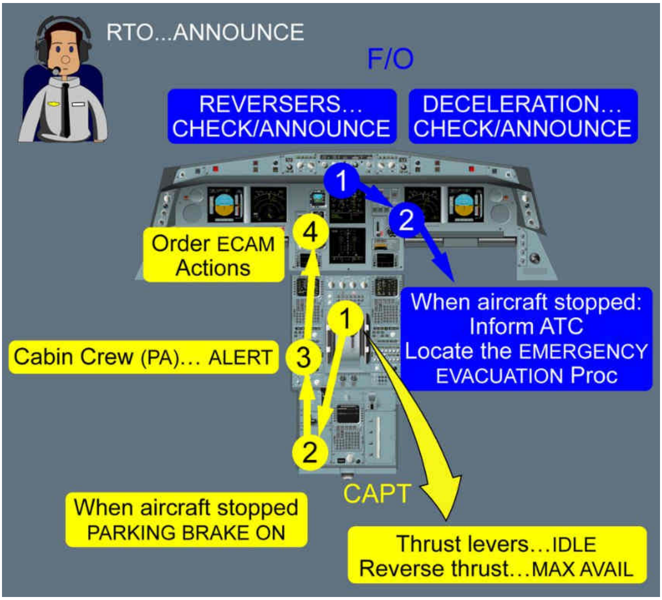
| | |
|---|---|
| PA........................................ "Evacuate! Evacuate!"<br>EVAC COMMAND........................................ ON<br>EVAC Horn Shutoff........................................ PRESS<br>Last to leave the aircraft. Evacuate via rear door, if possible. | ATC........................................ ADVISE EVACUATION *(Note 6)*<br>Proceed to Cabin and evacuate using any avail exit. |
| **If Evacuation Not Required:** | |
| PA........................................ "Cabin Crew resume duties." | ATC........................................ ADVISE INTENTIONS |

<u>*Note:*</u>
1. *If the autobrake is unserviceable apply maximum manual braking. If required MAX autobrake and FULL reverse may be used until the aircraft is stopped. (If the RTO is initiated below 72 kt the autobrake will not activate and the ground spoilers will not deploy.)*
2. *In case of reverser failure or if reverse was not selected call, "No reverse engine 1(2)!" or "No reverse!" as appropriate.*
3. *If the green DECEL light is not illuminated call, "No Decel!"*
4. *The standard ICAO phraseology for any stopping event on the runway is, "Stopping."*
5. *Consider positioning the aircraft to keep any possible fire away from fuselage.*
6. *Use VHF 1 and declare a "MAYDAY."*

<u>Rejected takeoff flow pattern</u>



## INTRODUCTION TO EMERGENCY EVACUATION

2 **Applicable to: ALL**

The typical case in which an emergency evacuation is required is an uncontrollable engine fire on the ground, which may occur following a rejected takeoff or after landing.
In the case of a rejected takeoff, described earlier in this chapter, the Captain calls “Stop!” to announce his decision and indicate that he has control. Once the aircraft has stopped and the parking brake set, he uses the PA to announce "Attention! Cabin Crew at Stations!" and calls for “ECAM actions.”
In all other cases, the Captain calls “I have control,” if required, and brings the aircraft to a stop. Once the aircraft has stopped and the parking brake set, he uses the PA to notify the cabin crew of a potential evacuation by ordering “Attention! Cabin Crew at Stations!” and then calls for “ECAM actions.”

In the case of an engine fire on the ground:
- Consider positioning the aircraft to keep the fire away from the fuselage, taking into account the wind direction. The First Officer carries out the ECAM actions and the Captain decides on the next course of action, depending on the circumstances. Give consideration to:
  - Possible passenger evacuation of the aircraft on the runway.
  - Vacating the runway as soon as possible.
  - Communicating intentions or requests to ATC.
- All applicable actions are displayed on the ECAM ENG FIRE ON GROUND procedure. The First Officer completes the ECAM actions down to and including “EMER EVAC PROC...APPLY”. The Captain then calls for the **EMER**GENCY **EVAC**UATION checklist, which is completed down to 'If Evacuation Required'. The First Officer completes the ECAM and checklist items in a read-and-do manner without confirmation of actions, while the Captain evaluates the situation. If the fire remains out of control after discharging the agents, the Captain must order the evacuation.
- When the aircraft batteries are supplying all the electrical power, only the right hand dome light is available. The SOPs require the dome light be selected to BRT or DIM, with the DIM position recommended for takeoff. If normal electrical power is lost, selection of the dome light to BRT will make it easier to read the checklist.

## THE EMERGENCY EVACUATION PROCEDURE

**Applicable to: ALL**

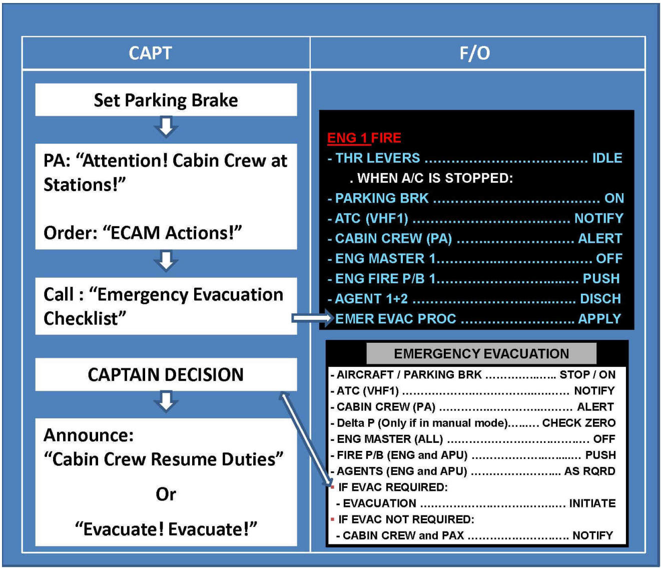
If an evacuation is required for any reason, the flight crew will find the **EMER**GENCY **EVAC**UATION checklist is included on the plasticised Normal Checklist.

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 procedure.
  Since MAN CAB PRESS is never used for takeoff 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)…NOTIFY reminds the captain to notify the cabin crew. If notification has already been given (e.g. as part of the RTO procedure), there is no need to repeat the notification.
- EVACUATION…INITIATE requires the captain confirmation that the emergency evacuation is still required. If still required, the captain:
  - Notifies the cabin crew to start the evacuation,
  - Activates the EVAC command.

If at any stage after the Cabin Crew have been placed on alert and the Captain decides the alert level should be cancelled, the phrase "Cabin Crew Resume Duties" should be used. It should be noted that as soon as the evacuation order is triggered, this decision is irreversible.
On the ground with the engines stopped, only the right hand dome light is operational and the three positions (BRT, DIM, OFF) remain available allowing completion of the **EMER**GENCY **EVAC**UATION procedure.
When the aircraft is on battery power only, the crew seats can only be operated mechanically.

# TASKSHARING IN CASE OF EMERGENCY EVACUATION

**Applicable to: ALL**




When applying the **EMER**GENCY **EVAC**UATION procedure, the F/O will select the engine masters OFF and push the FIRE pb, without any confirmation from the Captain.

# ENGINE FAILURE AFTER V1

**Applicable to: ALL**

## AIRCRAFT HANDLING

If an engine fails after V1 the takeoff 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:**

Avoid following the SRS immediately after take-off as it will initially be commanding too high an attitude. Once the FD pitch bar comes down towards the aircraft symbol, follow the SRS order. This may demand a lower pitch attitude to acquire or maintain V2. When safely airborne with a positive ROC and RA increasing, retract the landing gear.

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 minimized 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. 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, trim out the rudder forces prior to autopilot engagement. This requires approximately 17 ° of rudder trim, which takes approximately 15 s to apply.

Once AP is engaged, the rudder trim is managed through the AP and, hence, manual rudder trim command, including reset, is inhibited.

Once airborne with a positive rate of climb and the radio altitude increasing, the PM calls "Positive Climb," and the PF then calls for "Gear Up."

## THRUST CONSIDERATIONS

Consider the use of TOGA thrust, keeping in mind the following:

- For a FLEX takeoff, selecting the operating engine to TOGA provides additional performance margin but is not a requirement of the reduced thrust takeoff 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.
- ALT/NAV mode changes may occur if TOGA is selected after the V/S knob is pressed with flaps/slats retracted. HDG mode will engage and command the aircraft heading at the time of TOGA selection.
- Takeoff thrust is limited to 10 minutes.

## PROCEDURE

### INITIATION OF THE PROCEDURE

The PM closely monitors the aircraft's flight path and cancels any Master Warning or Caution. AT 400 ft AGL, the PM reads the ECAM title dislayed on the top line of the E/WD. Once the PF has stablised the flight path, he confirms the failure by repeating the ECAM title. If it is necessary to delay the ECAM procedure, he orders "Standby." Otherwise he announces "I have control, ECAM actions." It is not necessary to rush into the ECAM actions and 400 ft AGL is the minimum height at which commencement of the actions should be considered. Procedures are initiated on the PF's command.

Normally, only these actions involving movement of the THRUST LEVER and/or ENG MASTER and those actions required to clear RED warnings are carried out prior to level acceleration and flap retraction. In the case of ENG FAILURE WITHOUT DAMAGE, this means stopping ECAM actions at the ENG 1(2) RELIGHT action line. However, in the event of ENG FAILURE WITH DAMAGE or ENG FIRE, the ECAM procedure is continued down to the boxed ENG 1(2) SHUT DOWN message and the engine is secured. For less critical failures, ECAM actions can be interrupted when necessary to allow both pilots to monitor normal operational requirements.

### ACCELERATION SEGMENT

At the engine-out acceleration altitude, push the V/S knob 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 TAKEOFF 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 levers are already in the FLX/MCT detent, move levers to CL and then back to MCT to engage the A/THR.
When an engine failure occurs after takeoff, 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 takeoff flight path, continue the ECAM until the STATUS is displayed. At this point, the After Takeoff Checklist should be completed. The STATUS page should be reviewed and then the OEBs consulted (if applicable).
The following table details the SOP task sharing for an engine 1 fire after V1.

| PF | PM |
|---|---|
| | V1......................................................."V1." (or auto callout) |
| If still on runway, Captain calls........................................................"Go!" *(Note 1)* | |
| Directional Control.........................Keep straight with rudder. | |
| | Any Audio............................................................ CANCEL |
| | VR.............................................................................."Rotate." |
| Pitch Altitude........................ 12.5 ° initially then follow SRS | |
| | ANNOUNCE................................ "Positive Climb." *(Note 2)* |
| ANNOUNCE........................................................"Gear Up." | |
| | ANNOUNCE........................................................"Gear Up." |
| | Select LDG GEAR up. |
| If FLX T/O.....................................Consider TOGA *(Note 3)* | Workload permitting, call the failure e.g. "Engine Fire" or "Engine Failure." |
| TRIM............................. Centre β target and set RUD TRIM | |
| A/P.........................................................ENGAGE *(Note 4)* | |
| When flight path is stabilised (minimum 400ft AGL) | |
| | ANNOUNCE........."Master Warning, Engine 1 Fire." *(Note 5)* |
| ANNOUNCE.."Engine 1 Fire, I have control, ECAM actions." | |
| | ECAM actions...............................................Read and Do |
| When appropriate, consider EOSID requirements (FM database, Port Page) | |
| | Read ECAM.................................... "Thrust Lever 1, Idle." |
| | Place hand on Thrust Lever 1. |
| | ANNOUNCE............................................. "No.1, Confirm?" |
| Confirm the correct Thrust Lever. | |
| ANNOUNCE.......................................... "No.1, Confirmed." | |
| | Move Thrust Level 1 to idle. |
| | ANNOUNCE..............................................................."Idle." |
| | Read ECAM.................................. "Engine Master 1, Off." |
| | Place hand on the Engine Master 1. |
| | ANNOUNCE............................................. "No.1, Confirm?" |

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| | |
|---|---|
| Confirm the correct Engine Master.<br>ANNOUNCE.......................................... "No.1, Confirmed." | Select Engine Master 1 off.<br>ANNOUNCE.............................................................. "Off." |

- Following an engine failure without a fire, the ECAM will require an IF DAMAGE evaluation. If obvious damage - overheat, seizure, stalls, explosions, severe vibration, loss of engine indications - continue as per ECAM. If in doubt or if there is no damage then stop the ECAM actions at 'ENG 1/2 RELIGHT.....INITIATE'. Any detailed system examination and the ENG RELIGHT C/L should only be considered after flap retraction.

| | |
|---|---|
| | Read ECAM................................."Engine Fire pb 1, Push."<br>Place hand on the Engine Fire pb 1.<br>ANNOUNCE............................................. "No.1, Confirm?" |
| Confirm the correct Engine Fire pb:<br>ANNOUNCE............................................ "No.1 Confirmed." | |
| | Open guard and push the Engine Fire pb 1.<br>ANNOUNCE........................................................... "Push."<br>Read ECAM...................................... "Agent 1, Discharge."<br>Place hand on the Agent 1 pb.<br>ANNOUNCE................. "Fire, Agent 1, Discharge." *(Note 6)*<br>Press Agent 1 pb and confirm DISCH light illuminated.<br>Read ECAM...................................................."ATC notify." |
| ATC............................................."MAYDAY/PAN." *(Note 7)* | |
| | Any time the FIRE lights are out:<br>ANNOUNCE........................................................ "Fire out." |
| Confirm that the fire is out.<br>ANNOUNCE........................................................... "Check." | |
| | Continue ECAM actions down to:<br>ENG 1 SHUTDOWN<br>ANNOUNCE......................................"Engine 1 Shutdown." |
| ANNOUNCE..................................................."Stop ECAM." | |
| | Stop ECAM until the aircraft is clean and climbing away in the 4th segment. |
| At the EO ACC altitude - push V/S knob. | |

- Retract flaps and slats on schedule

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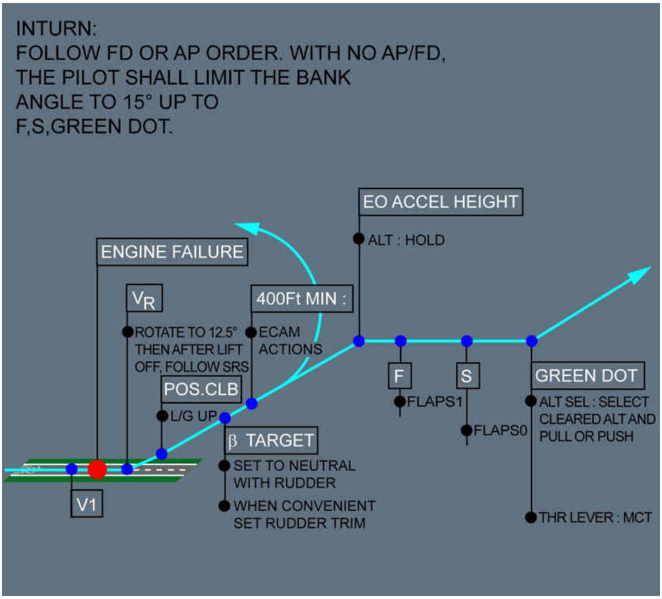
| | |
|---|---|
| • As the speed trend arrow reaches Green Dot speed, pull ALT knob for OP CLB mode and confirm/set target altitude.<br>• Set thrust levers to MCT ('LVR MCT' flashing on PFD).<br>• If FLX thrust in use, move the thrust lever to CL then back to FLX/MCT detent. | |
| ANNOUNCE............................................"Continue ECAM." | |
| | Continue ECAM actions down to the Status page. |
| | ANNOUNCE........................................................... "Status." |
| ANNOUNCE.............. "Stop ECAM, After Takeoff Checklist." | |
| | AFTER T/O C/L...............................................COMPLETE |
| When After Takeoff Checklist is complete: | |
| ANNOUNCE............................................"Continue ECAM." | |
| | Read and review the Status page. |
| | ANNOUNCE................................"ECAM actions complete." |

*Note:*
*1. Confirmation for F/O that a decision has been made.*
*2. Positive V/S and increasing RA.*
*3. The application of TOGA will very quickly result in 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.*
*4. The use of autopilot is **strongly** recommended.*
*5. If the PM fails to read the ECAM title then the PF reads the ECAM title and the PM repeats it. The PF then responds "I have control, ECAM actions."*
*6. Because this action on the overhead panel is not confirmed by PF, follow normal protocol of 'System/Selector/Action.'*
*7. Radio call to be made at an appropriate time depending on workload and conditions.*

Engine failure after V1




## ENGINE FAILURE AFTER V1 WITH SID SPEED RESTRICTION

**Applicable to: ALL**

If the procedure to be flown following a failure above V1 has a speed restriction that is lower than the Green Dot speed, a two stage clean up will be required.
Follow the procedure above for an Engine Failure after V1 until the acceleration altitude and then as follows:

| PF | PM |
|---|---|
| • At the EO ACC altitude - push V/S knob.<br>• Select SPD to the SID speed constraint - pull SPD/MACH knob. | |
| • Retract flaps and slats on schedule as requried, (at least CONF 1 will be required if SID speed constraint is below Green Dot). | |

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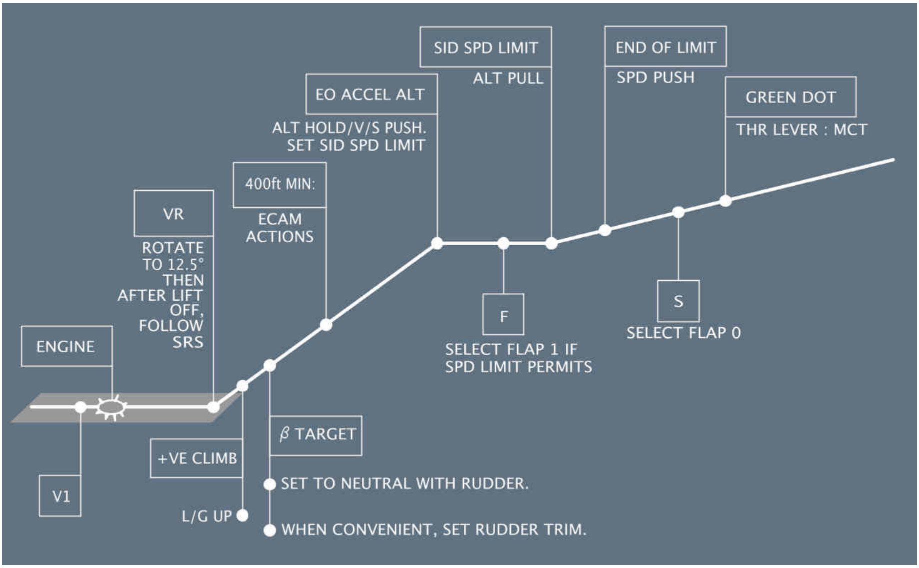
| | |
|---|---|
| • As the speed trend arrow reaches the selected speed, pull ALT knob for OP CLB mode and confirm/set target altitude.<br>• When the SID speed constraint no longer applies, push SPD/MACH knob for managed SPD mode. Confirm target speed is Green Dot, otherwise revert to Selected SPD. | |
| • Retract flaps and slats on schedule. The aircraft will accelerate in a shallow climb. | |
| • At Green Dot speed, set thrust levers to MCT ('LVR MCT' flashing on PFD).<br>• If FLX thrust in use, move the thrust lever to CL then back to FLX/MCT detent. | |
| ANNOUNCE............................................"Continue ECAM." | |
| | Continue ECAM actions down to the Status page. |
| | ANNOUNCE.......................................................... "Status." |
| ANNOUNCE.............. "Stop ECAM, After Takeoff Checklist." | |
| | AFTER T/O C/L...............................................COMPLETE |
| When After Takeoff Checklist is complete: | |
| ANNOUNCE............................................"Continue ECAM." | |
| | Read and review the Status page. |
| | ANNOUNCE..............................."ECAM actions complete." |

3

ENGINE FAILURE AFTER V1 WITH SPEED RESTRICTION




## ENGINE FAILURE DURING INITIAL CLIMB-OUT

**Applicable to: ALL**

Proceed as above. If the failure occurs above V2, maintain the SRS commanded attitude. In any event the minimum speed must be V2.
When an engine failure is detected, the FMGS produces predictions are based on the engine-out configuration and any pre-selected speeds entered in the MCDU are deleted.

## ENGINE FAILURE DURING CRUISE

**Applicable to: 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 the FCOM PER-OEI-GEN-05 Strategy.
Unless a specific procedure has been established before dispatch (considering ETOPS or mountainous areas), the standard strategy is used.

Note: *Pressing the EO CLR key on the MCDU restores the all engine operative predictions and performance. Reverting to one engine-out performance again is not possible.*

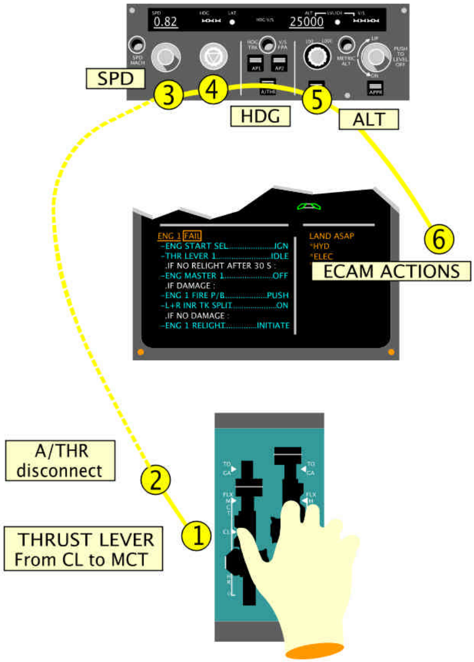
## PROCEDURE

As soon as the engine failure is recognized, the PF will simultaneously:
- Set all thrust levers to MCT
- Disconnect the A/THR

Then the PF will:
- Select the SPD/MACH appropriate to the strategy
- Select a HDG to keep clear of the airway, compliant with RVSM or other state requirements, and preferably heading towards an alternate, if appropriate. Consider the aircraft position relative to any relevant critical or equi-time point.
- Select the LRC ceiling or driftdown ceiling, appropriate to the strategy, in the FCU ALT window and pull the ALT knob for OP DES when the target speed is reached.
- Call for the ECAM actions.

Placing the thrust lever(s) to MCT and carrying out the ECAM actions should not be rushed, as it is important to complete the procedure correctly. Generally, there is sufficient time to cross-check all actions. However, at high levels close to limiting weights, more urgency is required, as speed decays more quickly. Avoid decelerating below Green Dot.

Engine failure during cruise flow pattern




The A/THR is disconnected to avoid any engine thrust reduction when selecting speed according to strategy or when pulling for OP DES to initiate the descent. With the A/THR disconnected, the target speed is controlled by the elevator when in OP 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.

**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

## STANDARD STRATEGY

Set M .78/300 kt. This speed is chosen to ensure the aircraft is within the stabilised windmill engine relight in-flight envelope. The thrust is fixed at MCT with A/THR disconnected and speed is controlled by the elevator. The REC MAX EO cruise level displayed on the EO PROG page, equates to LRC with anti-icing off. The nearest semi-circular or RVSM cruise level at or below this level should be set on the FCU. Once established in the descent, the time to descend and predicted descent distance can be checked on the relevant performance table in the QRH.
If V/S becomes less than 500 ft/min, select V/S - 500 ft/min with the A/THR on. This is likely to occur approaching the level-off altitude, or at light weights.

Cruise altitude and speeds are also available in the QRH in case of a double FM failure.
Once established at the level off altitude, long-range cruise performance with one engine out may be extracted from the QRH or refer to FCOM PER-OEI-ALT-10.

## OBSTACLE STRATEGY

To minimise the rate and angle of descent and enable the aircraft to clear high terrain or obstacles on the intended flight path, the drift down procedure should be adopted. The procedure is similar to the standard strategy, except the speed target is Green Dot and the angle of descent is reduced. The drift down ceiling at Green Dot speed is available in the QRH. The PROG page displays the EO REC MAX ALT assuming LRC speed.
The drift down ceiling at Green Dot is higher than the EO REC MAX ALT and the aircraft should be able to stabilise at this altitude. If terrain remains a concern after reaching the drift down ceiling, maintain the obstacle strategy (Green Dot/MCT) so as to fly an ascending cruise-climb profile.
When clear of obstacles, set the LRC ceiling on the FCU and descend if required. Accelerate to the LRC speed and engage the A/THR.

**Applicable to: B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HTG, B-HTH, B-HTI**

## STANDARD STRATEGY

Set M .78/300 kt. This speed is chosen to ensure the aircraft is within the stabilised windmill engine relight in-flight envelope. The thrust is fixed at MCT with A/THR disconnected and speed is controlled by the elevator. The REC MAX EO cruise level displayed on the EO PROG page, equates to LRC with anti-icing off. The nearest semi-circular orRVSM cruise level at or below this level should be set on the FCU. Once established in the descent, the PERF CRZ page shows time to descend and predicted descent distance. These can also be checked on the relevant performance table in the QRH.
If V/S becomes less than 500 ft/min, select V/S - 500 ft/min with the A/THR on. This is likely to occur approaching the level-off altitude, or at light weights.
Cruise altitude and speeds are also available in the QRH in case of a double FM failure.
Once established at the level off altitude, long-range cruise performance with one engine out may be extracted from the QRH or refer to FCOM PER-OEI-ALT-10.

## OBSTACLE STRATEGY

To minimise the rate and angle of descent and enable the aircraft to clear high terrain or obstacles on the intended flight path, the drift down procedure should be adopted. The procedure is similar to the standard strategy, except the speed target is Green Dot and the angle of descent is reduced. The PERF CRZ page displays the drift down ceiling, assuming Green Dot speed. Conversely, the PROG page displays the EO REC MAX ALT assuming LRC speed.
The drift down ceiling at Green Dot is higher than the EO REC MAX ALT and the aircraft should be able to stabilise at this altitude. If terrain remains a concern after reaching the drift down ceiling, maintain the obstacle strategy (Green Dot/MCT) so as to fly an ascending cruise-climb profile.

When clear of obstacles, set the LRC ceiling on the FCU and descend if required. Accelerate to the LRC speed and engage the A/THR.

## ENGINE-OUT LANDING

**Applicable to: ALL**

Maximum use of the AP should be made to minimise crew workload. Autoland is available with one engine inoperative.
A manual approach and landing with one engine inoperative is conventional . Use rudder trim to keep the sideslip indication centred. The sideslip indication remains yellow as long as the EPR on the remaining engine is below 1.25 EPR. With flap selected and thrust above this value, the indicator changes to the engine-out mode blue β target. This visual cue indicates that the aircraft is approaching its maximum thrust capability. Although the A/THR is available, some pilots may prefer to use manual thrust as they find it easier to anticipate rudder inputs as the power changes.
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 can 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

**Applicable to: ALL**

In normal conditions, circling with one engine inoperative requires the downwind leg to be flown in CONF 3, with the landing gear extended.
In hot and high conditions and at high landing weights, 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 QRH ABN-80 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.
The minimum circling altitude is normally 1 000 ft AAL. If the approach is flown at less than 750 ft RA, the warning 'L/G NOT DOWN' will be triggered. The 'TOO LOW GEAR' warning is to be expected, if the landing gear is not downlocked by 500 ft RA.

## ONE ENGINE INOPERATIVE GO-AROUND

**Applicable to: ALL**

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. V/S PUSH 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, refer to AO-020 Engine Failure After V1.
At certain weights and CG positions, it may not be possible to satisfy β target demands at VLS. Consequently, when obstacle clearance is assured, accelerate to a speed at which the β target can be satisfied.

## THRUST LEVER MANAGEMENT IN CASE OF INOPERATIVE REVERSER(S)

**Applicable to: ALL**

If at least one reverser is operative, select reverse thrust on both engines during a rejected takeoff, and after landing in accordance with normal procedures. Note that the ENG 1(2) REVERSER FAULT caution may be triggered on the ECAM after reverse is selected to remind the crew that one reverser is inoperative.
If no reversers are operative, do not select reverse thrust during a rejected take-off, or after landing. However the PF must still select both thrust levers to the IDLE detent as per normal procedures.
These recommendations apply in case of in-flight failure (including engine failure) and/or in the case of MEL dispatch with reverser(s) deactivated. With one or both reverser(s) inoperative, briefings should include a review of thrust reverser status and handling technique.

## RECOVERY FROM ALPHA PROTECTION AND ALPHA FLOOR

**Applicable to: ALL**

### GENERAL

If ALPHA PROT or ALPHA FLOOR is triggered inadvertently, recover from these protection modes as soon as other considerations allow by easing forward on the sidestick to reduce the angle of attack below the value set for ALPHA PROT, while simultaneously increasing thrust.

### ALPHA PROT

Pitch control will return to the normal load factor law if the stick is pushed forward of neutral, but will re-enter ALPHA PROT if the stick is released with the indicated airspeed still below Vα PROT. Consequently, to exit ALPHA PROT properly, reduce the angle of attack to a value less than that set for ALPHA PROT.
The PFD shows the recovery clearly, because the indicated speed will be above the black and amber strip when out of ALPHA PROT. When no longer in ALPHA PROT, increase speed above VLS (top of the amber strip) as soon as other considerations allow.

### ALPHA FLOOR

ALPHA FLOOR will normally be triggered just after ALPHA PROT is entered, and TOGA thrust will be applied automatically. 'TOGA LK' appears on the FMA to indicate that TOGA thrust is locked. To recover to a normal flight condition, ALPHA PROT should be exited by easing forward on the sidestick, as described above. The 'TOGA LK' thrust condition should be canceled by using the A/THR disconnect pushbutton on either thrust lever as soon as a safe speed above VLS is regained.

## STALL RECOVERY

**Applicable to: ALL**

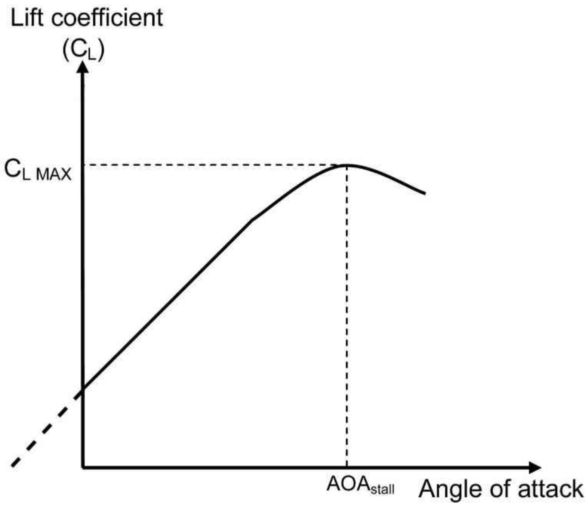
Refer to FCOM PRO-ABN-10 for the Stall Recovery Procedure.

### DEFINITION OF THE STALL

The stall is a condition in aerodynamics where the Angle of Attack (AOA) increases beyond a point such that the lift begins to decrease.

As per basic aerodynamic rules, the lift coefficient (CL) increases linearly with the AOA up to a point where the airflow starts to separate from the upper surface of the wing. At and beyond this point, the flight crew may observe:
- Buffeting, which depends on the slats/flaps configuration and increases at high altitude due to the high Mach number
- Pitch up effect, mainly for swept wings and aft CG. This effect further increases the AOA.

Lift Coefficient versus Angle of Attack

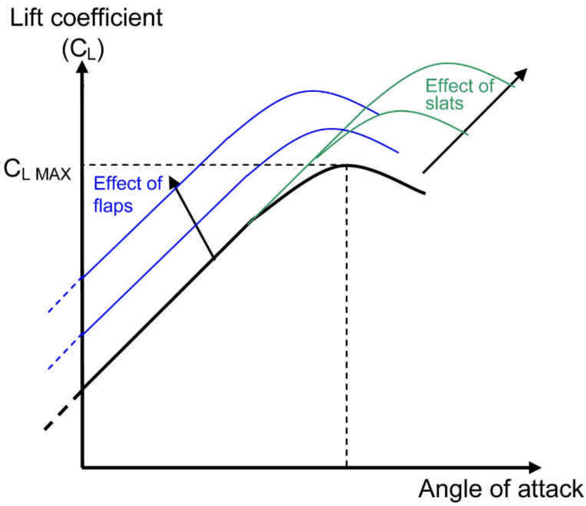



If the AOA further increases up to a value called $AOA_{stall}$, the lift coefficient will reach a maximum value called $C_{L\ MAX}$.

When the AOA is higher than $AOA_{stall}$, the airflow separates from the wing surface and the lift coefficient decreases. This is the stall.

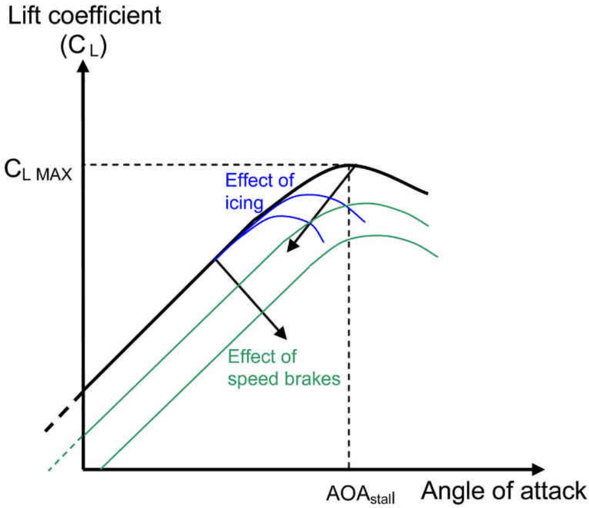
The stall will always occur at the same AOA for a given configuration, Mach number and altitude.

Influence of slats and flaps on Lift Coefficient versus Angle of Attack




Slats and Flaps have a different impact on the Lift coefficient obtained for a given AOA. Both Slats and Flaps create an increase in the maximum lift coefficient.

Influence of speed brakes and icing on Lift Coefficient versus Angle of Attack




On the contrary, speed brake extension and ice accretion reduce the maximum lift coefficient. Flight control laws and stall warning threshold take into account these possible degradations.

To summarize, loss of lift is only dependant on AOA. The AOA $_{stall}$ depends on:

- Aircraft configuration (slats, flaps, speed brakes)
- Mach and altitude
- Wing contamination

## STALL RECOGNITION

The flight crew must apply the stall recovery procedure as soon as they recognize any of the following stall indications:

- Aural stall warning
  The aural stall warning is designed to sound when AOA exceeds a given threshold, which depends on the aircraft configuration. This warning provides sufficient margin to alert the flight crew in advance of the actual stall even with contaminated wings.
- Stall buffet
  Buffet is recognized by airframe vibrations that are caused by the non-stationary airflow separation from the wing surface when approaching $AOA_{stall}$.
  When the Mach number increases, both the $AOA_{stall}$ and $C_{L\ MAX}$ will decrease.
  The aural stall warning is set close to AOA at which the buffet starts. For some Mach numbers the buffet may appear just before the aural stall warning.

## STALL RECOVERY

- The immediate key action is to reduce AOA:
  The reduction of AOA will enable the wing to regain lift.
  This must be achieved by applying a nose down pitch order on the sidestick. This pilot action ensures an immediate aircraft response and reduction of the AOA.
  In case of lack of pitch down authority, it may be necessary to reduce thrust.
  Simultaneously, the flight crew must ensure that the wings are level in order to reduce the lift necessary for the flight, and as a consequence, the required AOA.
  As a general rule, minimizing the loss of altitude is secondary to the reduction of the AOA as the first priority is to regain lift.
  As AOA reduces below the $AOA_{stall}$, lift and drag will return to their normal values.
- The secondary action is to increase energy:
  When stall indications have stopped, the flight crew should increase thrust smoothly as needed and must ensure that the speed brakes are retracted.
  Immediate maximum thrust application upon stall recognition is not appropriate. Due to the engine spool up time, the aircraft speed increase that results from thrust increase, is slow and does not enable to reduce the AOA instantaneously.
  Furthermore, for under wing mounted engines, the thrust increase generates a pitch up that may prevent the required reduction of AOA.

When stall indications have stopped, and when the aircraft has recovered sufficient energy, the flight crew can smoothly recover the initial flight path.

## STALL WARNING AT LIFT-OFF

At lift-off, a damaged AOA probe may cause a stall warning to spuriously sound in the cockpit.

If the aural stall warning sounds at liftoff, the flight crew must fly the appropriate thrust and pitch for takeoff in order to attempt to stop the aural stall warning and ensure a safe flight path.
The flight crew applies TOGA thrust in order to get the maximum available thrust. Simultaneously, the pilot flying must target a pitch angle of 15 ° and keep the wings level in order to ensure safe climb.
Then, when a safe flight path and speed are achieved, if the aural stall warning is still activated the flight crew must consider that it is a spurious warning.

## FMGC FAILURE

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN**

### 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 QRH ABN-80 for computer reset considerations and then will then *Refer to FCOM/PRO-SUP-22-10 Automatic FMGS Reset and Resynchronization - FM Reset* or QRH ABN–22 to reload both FMGC as required.
Following a double FMGC failure, consider the RNP requirements.

## FMGC FAILURE

Criteria: LR
1 **Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

### 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.

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The crew will refer to QRH ABN-80 for computer reset considerations and will then *Refer to FCOM/PRO-SUP-22-10 Automatic FMGS Reset and Resynchronization - FM Reset* or QRH ABN-22 to reload both FMGC as required.
If the FMGCs cannot be recovered, the MCDU features a NAV B/UP function which provides simplified IRS based navigation (*Refer to FCOM/DSC-22_20-60-130 General*). The F-PLN is still available as the MCDU continuously memorizes the active flight plan in its internal memory. It should be noted that the FM source selector must be at NORM to allow the NAV B/UP prompt to be displayed on the MCDU MENU page.
Following a double FMGC failure, consider the RNP requirements.

# INTRODUCTION TO EMERGENCY ELECTRICAL CONFIGURATION

**Applicable to: 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

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI**

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 kt, the DC BAT BUS is automatically connected and below 50 kt, the AC ESS BUS is shed.

## TECHNICAL BACKGROUND

Criteria: K2113, P5768, SA
**Applicable to: ALL 321, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

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 kt, 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 kt, the DC BAT BUS is automatically connected and below 50 kt, the AC ESS BUS is shed.

## GENERAL GUIDELINES

Criteria: SA
**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI**

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, (*Refer to OP–040–ECAM HANDLING*).
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 min 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 min 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 1 000 ft
- Navaids tuning on RMP1 will be anticipated.

Only raw data is available for the approach. Both Radio altimeters are lost and consequently there will be no automated voice callouts.
Thrust reversers, normal braking, antiskid and nose wheel steering are not available. Alternate braking without antiskid is available, but must be limited to 1 000 psi.
During the landing roll, the AC ESS BUS is shed automatically below 50 kt, consequently all CRTs will be lost.

## GENERAL GUIDELINES

Criteria: K2113, P5768, SA
**Applicable to: ALL 321, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

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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, (*Refer to OP–040–ECAM HANDLING*).
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 kt) to keep the emergency generator supplying the electrical network.
Only raw data is available for the approach. Both Radio altimeters are lost and consequently there will be no automated voice callouts.
Thrust reversers, normal braking, antiskid and nose wheel steering are not available. Alternate braking without antiskid is available, but must be limited to 1 000 psi.
During the landing roll, the AC ESS BUS is shed automatically below 50 kt, consequently all CRTs will be lost.

## REMAINING SYSTEMS

**Applicable to: 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, DME1 |
| COMMUNICATE | VHF1, HF1, ATC1 |

On BAT, some additional loads are lost such as FAC1 and FMGC1.

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## PREFACE

**Applicable to: ALL**

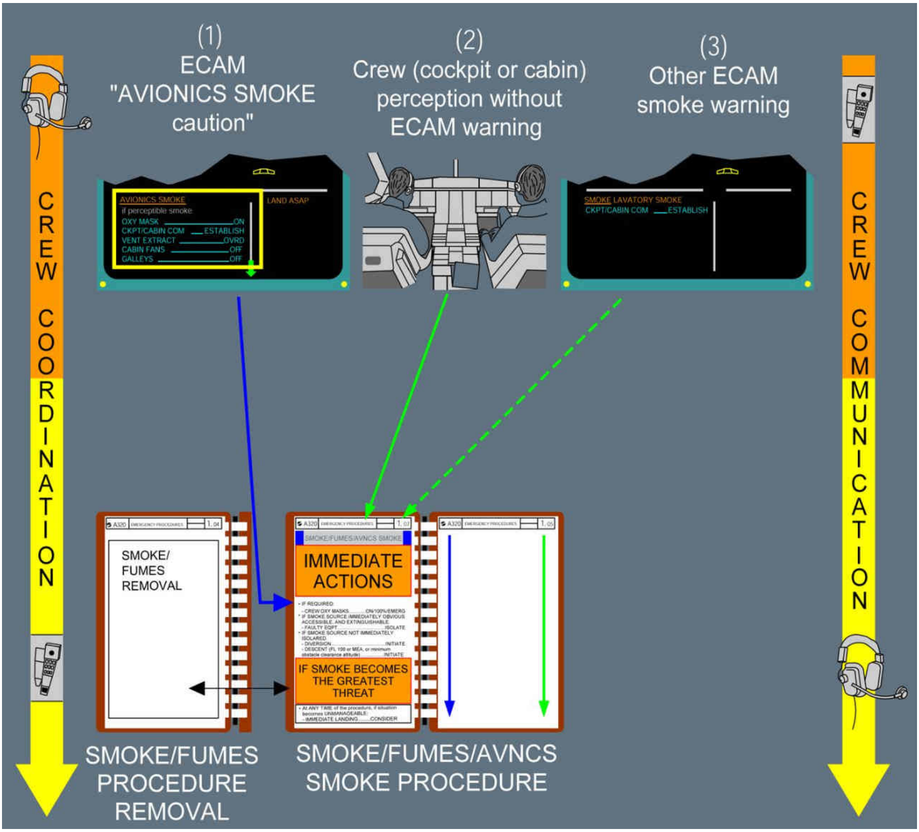
Fire and/or smoke in the fuselage present the crew with potentially difficult situations. Not only will they have to deal with the emergency itself but also the passengers are likely to panic should they become aware of the situation. It is essential therefore, that action to control the source of combustion 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

**Applicable to: ALL**

1 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 "AVIONICS 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.
The AVIONICS SMOKE ECAM procedure should be applied only IF SMOKE IS PERCEPTIBLE.
The smoke is perceptible if the Flight Crew can confirm it visually or by smell.
If Smoke is not perceptible, the Flight Crew should consider a spurious warning and therefore stop the AVIONICS SMOKE procedure.
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




## COORDINATION WITH CABIN CREW

**Applicable to: ALL**

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

Applicable to: 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:

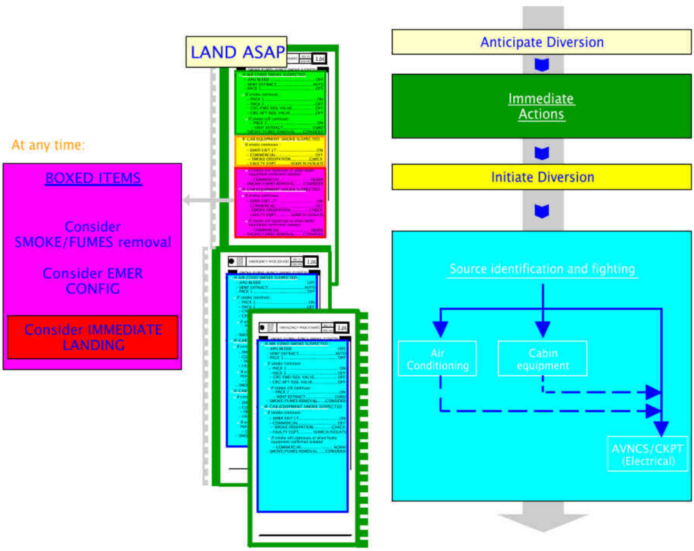
- Diversion to be anticipated
- Immediate actions

▶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




## 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 be 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.

## 2 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.
In this part of the procedure, the flight crew must consider setting the Emergency Electrical Configuration, to shed as much equipment as possible. This is in order to attempt to isolate the smoke source.
If at least one battery is charging when one side and then the other side of the electrical system are shed, the DC1, DC2, and BAT bus bars become inoperative for the remainder of the flight.
Therefore, the procedure for attempting to partially shed the electrical system was removed from

the smoke procedure. This change in the procedure is to enable the flight crew to recover the normal electrical configuration for landing, particularly to recover normal braking.
If the flight crew sets the electrical emergency configuration following a smoke detection in the avionic compartment ("AVIONICS SMOKE" ECAM caution triggered), the ECAM does not displays the same procedure as the one displayed following the loss of main generators. In fact in this case, the ECAM displays a specific procedure that takes into account the smoke detection: As the flight crew has voluntarily set the electrical emergency configuration, the purpose of the ELEC EMER CONFIG ECAM procedure is not to try to restore the generators, but to remain in electrical emergency configuration, and restore generators before landing to perform the landing in normal electrical configuration.

### 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).
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

**Applicable to: ALL**

The cargo smoke detectors are sensitive to the extinguishing agent. Therefore, even after successfully extinguishing a cargo fire, the SMOKE FWD (AFT) CARGO SMOKE warning can be expected to remain. LAND ASAP in red is displayed on the ECAM. As there is no method of checking whether a cargo fire has been extinguished, divert to the nearest suitable airport.
Once the isolation valves are closed, the cargo is not ventilated. Thus, the cargo temperature is unreliable.
Order the ground crew not to open the door of the affected cargo compartment, unless passengers have disembarked and fire services are present.
On the ground, smoke warnings may be triggered due to high levels of humidity or following spraying of a compartment to comply with quarantine regulations. If a SMOKE warning occurs on the ground with cargo compartment doors open, do not immediately discharge the extinguishing agent without first ordering the ground crew to investigate and eliminate the smoke source. If the warning is confirmed to be false, then once extinguished, it will be necessary to reset the CARGO VENT controller C/Bs to restore normal cargo ventilation. Refer to FCOM PRO-ABN-26.

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# ABNORMAL FLAPS/SLATS CONFIGURATION

Applicable to: 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 TAKEOFF

Should a flap/slat retraction problem occur at takeoff, the crew will PULL the speed knob for selected speed to stop the acceleration and avoid exceeding VFE. The overspeed 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 -5 kt"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.
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

**Applicable to: ALL**

Significant fuel leaks, although rare, are sometimes difficult to detect. Maintaining the fuel log and comparing fuel on board to expected flight plan fuel during regular fuel checks, will alert the crew to any discrepancy. This should then be investigated without delay. Fuel checks should be carried out when sequencing appropriately spaced waypoints and at least once every hour. Any time an unexpected fuel quantity indication, ECAM fuel message or imbalance is noted, a fuel leak should be considered. Initial indications should be carefully cross-checked by reference to other means. If possible, conduct a visual inspection of the wings and engines to check for signs of a leak.
If a leak is suspected, action the FUEL LEAK abnormal checklist. If the leak is from the wing or cannot be located, it is IMPERATIVE the cross-feed valve is not opened.
The Fuel Check Procedure is described in NO-070 Fuel Monitoring.

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# HYDRAULIC GENERATION PARTICULARITIES

Applicable to: 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

Applicable to: 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. *Refer to OP-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.

## REMAINING SYSTEMS

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN**

| | | Remaining systems | | |
|---|---|---|---|---|
| Flight phase | Systems | HYD G+B SYS LO PR | HYD G+Y SYS LO PR | HYD B+Y SYS LO PR |

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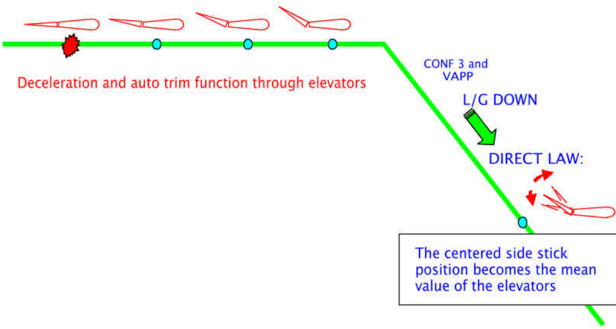
| | | | | |
|---|---|---|---|---|
| Cruise | Auto pilot | Inop | Inop | Inop |
| | Yaw damper | YD2 only | Inop | YD1 only |
| | Control law | ALTN LAW and DIRECT LAW when L/G DN | ALTN LAW and DIRECT LAW when L/G DN | NORM LAW |
| | Stabilizer | Avail | Inop See (1) | Avail |
| | Spoilers | 2 SPLRS/wing | 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 See (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 |

(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.*




(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.*

## REMAINING SYSTEMS

Criteria: P4576, SA
**Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

| | | 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 See (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 See (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 |

(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.*
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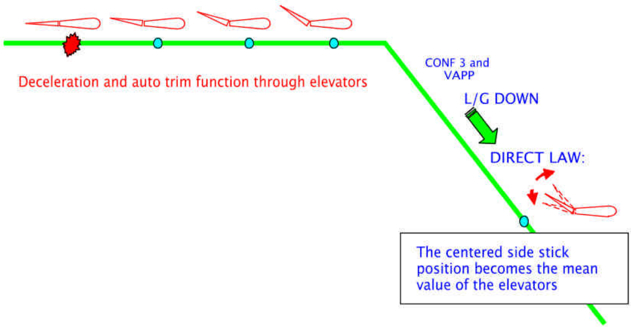


(2) *High pitch during approach should be expected. Approach briefing should outline it for tail strike awareness and pitch attitude will be monitored during flare.*

## LDG WITH ABNORMAL L/G

**Applicable to: ALL**

To avoid unnecessary application of the L/G GRAVITY EXTENSION and the LDG WITH ABNORMAL L/G QRH procedures, the flight crew must check for the three landing gear green indications on the ECAM WHEEL SD page: at least one green triangle on each landing gear is sufficient to indicate that the landing gear is down and locked. The flight crew must also rely also on the “LDG GEAR DN” green MEMO. This is sufficient to confirm that the landing gear is downlocked.
If one landing gear is not downlocked, the flight crew must perform the LDG WITH ABNORMAL L/G QRH procedure. In this case, 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 flight 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 s 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.

## NOSE WHEEL STEERING FAULT

**Applicable to: ALL**

If the Nose Wheel Steering (NWS) is lost for taxiing, the flight crew can steer the aircraft with differential braking technique. If the flight crew does not have experience with this technique, he should preferably request a towing to return to the gate. The flight crew can request the towing early in approach, if the failure has been triggered in flight.

## LOSS OF BRAKING

**Applicable to: ALL**

### GENERAL

If the flight crew does not perceive deceleration when required, the flight crew will apply the LOSS OF BRAKING procedure from memory because of the urgency of the situation.

### PROCEDURE

The procedure is available both in the FCOM and the QRH. Some items need to be highlighted:

#### USE OF REVERSE THRUST

- The efficiency of the reverse thrust decreases with aircraft speed.
- If needed, full reverse thrust may be used until coming to a complete stop. However, the use of high levels of reverse thrust at low airspeed can cause gases to re-enter the compressor. This can cause engine stalls that may result in excessive EGT.
- In addition, the use of reverse thrust (even at idle) increases the risk of foreign object damage (FOD).

## A/SKID & N/W STRG OFF

- Select A/SKID & N/W STRG sw OFF to revert to alternate braking.
- Do not apply brake pressure when setting the A/SKID & N/W STRG sw OFF: the same pedal force or displacement produces more braking action in alternate mode than in normal mode.
- For this reason it is important to break up the action in three steps:

  1. Release the brake pedals
  2. Select A/SKID & N/W STRG sw OFF
  3. Modulate brake pedal pressure to maximum 1 000 PSI. At low ground speed, adjust brake pressure as required. Monitor the brake pressure on the BRAKE PRESS triple indicator.
- Task-sharing: The PF calls for “A/SKID & N/W STRG OFF” and the PNF then executes the action. In case of urgency and conditions permitting, the PF can himself select the A/SKID & N/W STRG sw OFF without call.

## PARKING BRAKE

- Use short successive parking brake applications to stop the aircraft.
- Brake onset asymmetry may be felt at each parking brake application
- If possible, delay the use of parking brake until low speed, to reduce the risk of tire burst and lateral control difficulties.

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## ADR/IRS FAULT

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN**

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.*

## ADR/IRS FAULT

Criteria: P9171, SA
**Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

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 and A/THR and the flight controls revert to ALTN LAW.
In the case of a triple ADR failure, AP and A/THR are lost and the flight controls revert to ALTN LAW. The NAV ADR 1+2+3 FAULT warning is triggered and the ECAM procedure requires that the 3 ADRs be switched OFF, to replace the PFD's normal speed scale and altitude indication by the Back-Up Speed Scale (BUSS) and GPS altitude information.
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

Applicable to: ALL

## PREFACE

The ADRs detect most of the failures affecting the airspeed or altitude indications. These failures lead to:

- Lose the associated speed or altitude indications in the cockpit
- Trigger the associated ECAM alerts.

However, there may be some cases where an airspeed and/or altitude output is erroneous, while the ADRs do not detect it as erroneous. In such a case, no ECAM alert is triggered and the cockpit indications may appear to be normal whereas they are actually false. Flight crew must have in mind the typical symptoms associated with such cases in order to detect this situation early and apply the "UNRELIABLE SPEED INDIC/ADR CHECK PROC" QRH procedure.

## MAIN REASONS FOR ERRONEOUS AIRSPEED/ALTITUDE DATA

The most probable reason for erroneous airspeed and/or altitude information is an obstruction of the pitot and/or static probes. Depending on how the probes(s) is obstructed, the effects on cockpit indications differ.
It is highly unlikely that the aircraft probes will be obstructed at the same time, to the same degree and in the same way. Therefore, the first effect of erroneous airspeed/altitude data in the cockpit will most probably be a discrepancy between the various indications (CAPT PFD, F/O PFD and STBY instruments).

## CONSEQUENCES OF OBSTRUCTED PITOT TUBES OR STATIC PORTS

All the aircraft systems which use anemometric data, have been built-in fault accommodation logics. The fault accommodation logics rely on a voting principle: When the data provided by one source diverges from the average value, the systems automatically reject this source and continue to operate normally using the remaining two sources. The flight controls system and the flight guidance system both use this voting principle.
However, there may be some cases where the airspeed or altitude output is erroneous without being recognised 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 action. When only one source provideds erroneous data, a simple crosscheck of the parameters generated by the three ADRs allows the faulty ADR to be identified. This identification becomes more difficult in extreme sistuations when two or all three ADR sources provide erroneous information.

## NORMAL SITUATION

Each ELAC receives speed information from the three ADRs and compares the three values. The ELACs do not use the pressure altitude.
Each FAC receives speed information and pressure altitude information from the three ADRs and compares the three values.

## ONE ADR OUTPUT IS ERRONEOUS AND THE TWO REMAINING ARE CORRECT

The ELAC and the FAC and/or FMGC eliminate the erroneous ADR. There is no cockpit effect (no caution, normal operation is continued), except that one display is wrong and the autoland capability is downgraded to CAT 3 SINGLE.

## TWO ADR OUTPUTS ARE ERRONEOUS, BUT DIFFERENT, AND THE REMAINING ADR IS CORRECT, OR IF ALL THREE ARE ERRONEOUS, BUT DIFFERENT :

Both the AP and A/THR disconnect. The ELACs trigger the F/CTL ADR DISAGREE ECAM caution.
The flight controls revert to ALTN 2 law. The high speed protection and low speed protection lost.

On both PFDs:
- The SPD LIM flag appears
- No VLS, no VSW and no VMAX is displayed.

This situationis latched for the remainder of the flight, until the ELACs are reset on ground, without any hydraulic pressure.
However, if the anomaly is only transient, the AP and the A/THR can be re-engaged when the disagree disappears.

## 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 following chart provides a non-exhaustive list of failure cases and their consequences on airspeed and altitude indications. It should be noted that the cases described below cover situations where probes (e.g. pitot) are totally obstructed. There can be multiple intermediate configurations with similar, but not exactly 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, or transient 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 is transient. |

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| | |
|---|---|
| Ice accretion due to pitot heat failure, or pitot obstruction due to foreign objects. Obstructed drain holes. | Total pressure blocked. Constant IAS in level flight, until obstruction is cleared.<br>In climb, IAS increases. In descent, IAS decreases.<br>Abnormal AP/FD/ATHR behavior :<br>a. AP/FD pitch up in OP CLB to hold target IAS.<br>b. AP/FD pitch down in OP 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.

## IN-SERVICE EXPERIENCE OF HIGH ALTITUDE PITOT OBSTRUCTIONS

Analysis of the in-service events shows that:
- The majority of unreliable speed events at low altitude are permanent situations, due to the obstruction of pitot probes by rain, severe icing, or foreign objects (refer to the table above).
- At high altitude, typically above FL 250, the cases of unreliable speed situation are mostly a temporary phenomenon: They are usually due to contamination of the pitots by water or ice, in specific meteorological conditions. In-service experience shows that such a contamination typically disappears after a few minutes, allowing to recover normal speed indications.

# "UNRELIABLE SPEED INDIC/ADR CHECK PROC" QRH PROCEDURE

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN**

## INTRODUCTION

The "UNRELIABLE SPEED INDIC/ADR CHECK PROC" procedure has two objectives:
- To identify and isolate the affected ADR(s)
- If not successful, to provide guidelines to fly the aircraft until landing.

It includes the following steps:
1. Memory items (if necessary),
2. Troubleshooting and isolation,
3. Flight using pitch/thrust references.

## WHEN TO APPLY THIS PROCEDURE?

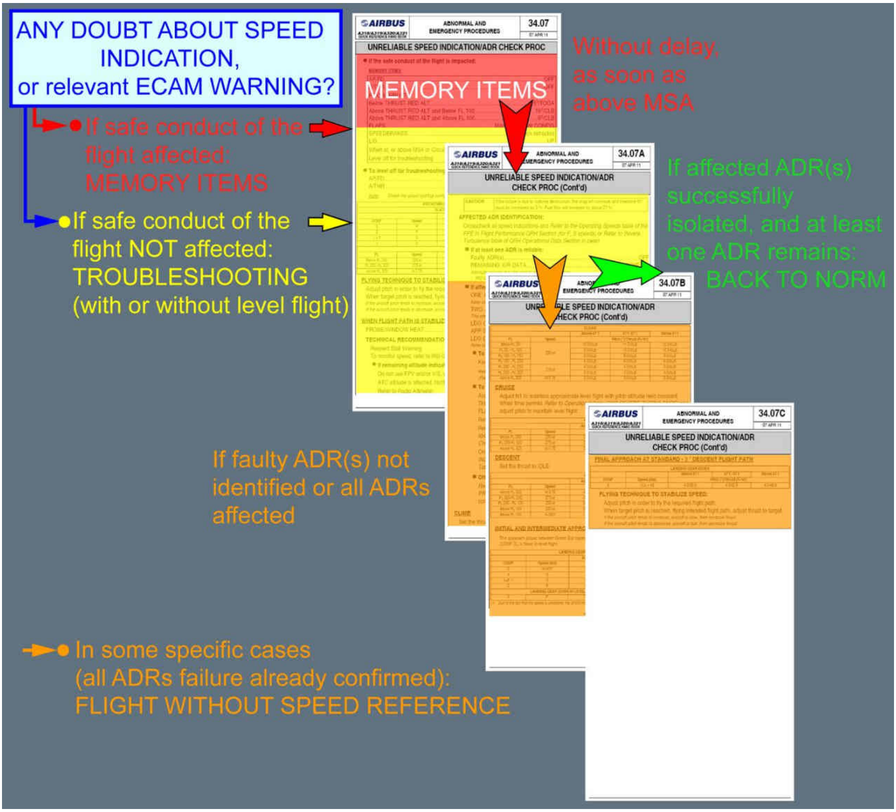
The flight crew should consider applying the "UNRELIABLE SPEED INDIC/ADR CHECK PROC" procedure when:
- The "ADR CHECK PROC...CONSIDER" action line is displayed on ECAM, for example due to the NAV ADR DISAGREE ECAM alert, or
- The flight crew suspects an erroneous indication, without any ECAM alert.

The flight crew can suspect an erroneous speed/altitude indication, in the following cases:
1. A speed discrepancy (between ADR 1, 2, 3, and standby indications),
2. Fluctuating or unexpected changes of the indicated airspeed or altitude,
3. Abnormal correlation of basic flight parameters (pitch, thrust, airspeed, altitude and vertical speed indications). For example:
   - The IAS increases, whereas there is an important nose-up pitch
   - The IAS decreases, whereas there is an important nose-down pitch
   - The IAS decreases, whereas there is a nose-down pitch and the aircraft is descending
4. An abnormal behavior of the AP/FD and/or the A/THR
5. The STALL warning triggers, the OVERSPEED warning triggers, or the FLAP RELIEF messageappears on the E/WD, and this is in contradiction with the indicated airspeeds. In this case:
   - Rely on the STALL warning. Erroneous airspeed data does not affect the STALL warning, because the STALL warning is based on Angle Of Attack (AOA) data
   - Depending on the situation, the OVERSPEED warning may be false or justified. When the OVERSPEED VFE warning triggers, the appearance of aircraft buffet is a symptom that the airspeed is indeed excessive.
6. The barometric altitude is not consistent with the radio altitude (when the RA is displayed)
7. The aerodynamic noise reduces whereas the indicated airspeed increases, or vice versa
8. In approach, it is not possible to extend the landing gear using the normal landing gear system.

*Note:* *1. Crew coordination is important. The PM should confirm any discrepancy:*
- *Between the standby airspeed indications and the speed indication on his/her PFD,*
- *Between his/her PFD and the Pilot Flying's PFD.*

*2. Because the barometric altitude may be erroneous, the aircraft may not be able to accurately maintain level flight. In addition, the ATC transponder may transmit an incorrect altitude to ATC or to other aircraft, which can lead to confusion. Therefore, the flight crew should advise ATC of the situation without delay.*

## HOW TO APPLY THIS PROCEDURE?




## MEMORY ITEMS

The flight crew applies the memory items, if the safe conduct of the flight is affected. The memory items enable to rapidly establish safe flight conditions in all phases of flight and in all aircraft configurations (weight and slats/flaps).

The flight crew must apply the memory items, if they have a doubt on their ability to safely fly the aircraft in the short term with the current parameters, ie:
- The flight crew has lost situation awareness, or
- The current pitch and thrust are not appropriate for the current flight conditions, or
- The aircraft has an unexpected flight path for the current flight conditions.

When the PF has stabilized the target pitch and thrust values, the flight crew applies the QRH procedure to level off and troubleshoot the problem. The flight crew must apply the QRH procedure without delay, because flying with the memory pitch/thrust values for an extended period of time can lead to exceed the aircraft speed limits.

*Note:* *The flight crew must respect the STALL warning.*

## TROUBLESHOOTING AND ISOLATION

### GENERAL

The flight crew must crosscheck speed and altitude indications on CAPT PFD, F/O PFD and STBY instruments, in order to identify and isolate the faulty ADR(s).

Depending on the cause of the problem, the altitude indication may also be unreliable. There are however, a number of correct indications available to the crew. The flight crew can use the following indication:
- The GPS altitude and GPS ground speed (when available, displayed on the MCDU GPS POSITION page)
- The RA, at low altitude

To identify the affected ADR(s), the flight crew should level off (if not already in level flight) and stabilize the flight path using the "PITCH/THRUST TABLE FOR INITIAL LEVEL OFF" table of the QRH procedure.

### LEVEL OFF AND STABILIZATION (IF REQUIRED)

The table gives the proper pitch and thrust values to stabilize level flight according to weight and altitude.
If the altitude information is unreliable, the FPV and V/S are also affected. In this case, the GPS altitude, if available, is the only means to confirm whether the aircraft is maintaining level flight.
When the altitude information is reliable, use the FPV.

● **If the FPV is reliable, or if the 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 necessary to maintain level flight is above the table's pitch target, the aircraft is slow, then increase thrust,
  - If the aircraft pitch necessary to maintain level flight is below the table's 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 quickly stabilize the speed, without inducing altitude changes.

- **If the FPV is not reliable and the 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.

### TROUBLESHOOTING AND FAULT ISOLATION

When one indication differs from the others, the flight crew may be tempted to reject the outlier information. They should be aware, however, that two, or even all three ADRs can provide identical but erroneous data.

| | |
|---|---|
| **WARNING** | Do not instinctively reject an outlier ADR. |

Once the flight crew has identified the affected ADR(s), they must turn it (them) off. This triggers the corresponding ECAM warnings and drills. The flight crew must follow these drills to address all the consequences on the various aircraft systems. If the flight crew identifies at least one ADR to be reliable, the flight crew must use it, and therefore stop the procedure.
If the flight crew cannot identify the affected ADR(s) or if all speed indications remain unreliable, the flight crew must turn 2 ADRs off to prevent the flight control laws from using two consistent but unreliable ADR data. The flight crew must keep one ADR on.

## FLYING WITH PITCH/THRUST TABLES

When the troubleshooting procedure does not permit to identify at least one correct indication, this part of the procedure gives pitch/thrust references to safely fly the aircraft in all flight phases, down to landing.
The flight crew may directly apply this part of the procedure if they know that no speed information is reliable (for instance in case of dual pitot heating failure, plus an ADR failure), or if level off for troubleshooting 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 flight 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, prefer a standard ILS approach, with a -3 ° G/S, if available. If final descent is started with stabilized speed (VAPP), on a -3 ° flight path with the thrust setting recommended in the table, the resulting pitch attitude should be close to the recommended table pitch value. If an adjustment is required, vary the thrust, as explained in the initial level off paragraph.

## "UNRELIABLE SPEED INDIC/ADR CHECK PROC" QRH PROCEDURE

Criteria: P9171, SA
**Applicable to: B-HSO, B-HSP, B-HSQ, B-HSR, B-HST, B-HSU**

### INTRODUCTION

The "UNRELIABLE SPEED INDIC/ADR CHECK PROC" procedure has two objectives:
- To identify and isolate the affected ADR(s)
- If not successful, to provide guidelines to fly the aircraft until landing.

It includes the following steps:
1. Memory items (if necessary),
2. Troubleshooting and isolation,
3. Flight using pitch/thrust references or the Back-Up Speed Scale (BUSS, below FL 250), if the troubleshooting has not enabled to isolate the faulty ADR(s).

### WHEN TO APPLY THIS PROCEDURE?

The flight crew should consider applying the "UNRELIABLE SPEED INDIC/ADR CHECK PROC" procedure when:
- The "ADR CHECK PROC...APPLY" action line is displayed on ECAM, for example due to the NAV ADR DISAGREE ECAM alert, or
- The flight crew suspects an erroneous indication, without any ECAM alert.

The flight crew can suspect an erroneous speed/altitude indication, in the following cases:
1. A speed discrepancy (between ADR 1, 2, 3, and standby indications),
2. Fluctuating or unexpected changes of the indicated airspeed or altitude,
3. Abnormal correlation of basic flight parameters (pitch, thrust, airspeed, altitude and vertical speed indications). For example:
   - The IAS increases, whereas there is an important nose-up pitch,
   - The IAS decreases, whereas there is an important nose-down pitch,
   - The IAS decreases, whereas there is a nose-down pitch and the aircraft is descending.
4. An abnormal behavior of the AP/FD and/or the A/THR,
5. The STALL warning triggers, the OVERSPEED warning triggers, or the FLAP RELIEF message appears on the E/WD, and this is in contradiction with the indicated airspeeds. In this case:
   - Rely on the STALL warning. Erroneous airspeed data does not affect the STALL warning, because the STALL warning is based on Angle Of Attack (AOA) data,
   - Depending on the situation, the OVERSPEED warning may be false or justified. When the OVERSPEED VFE warning triggers, the appearance of aircraft buffet is a symptom that the airspeed is indeed excessive.
6. The barometric altitude is not consistent with the radio altitude (when the RA is displayed),

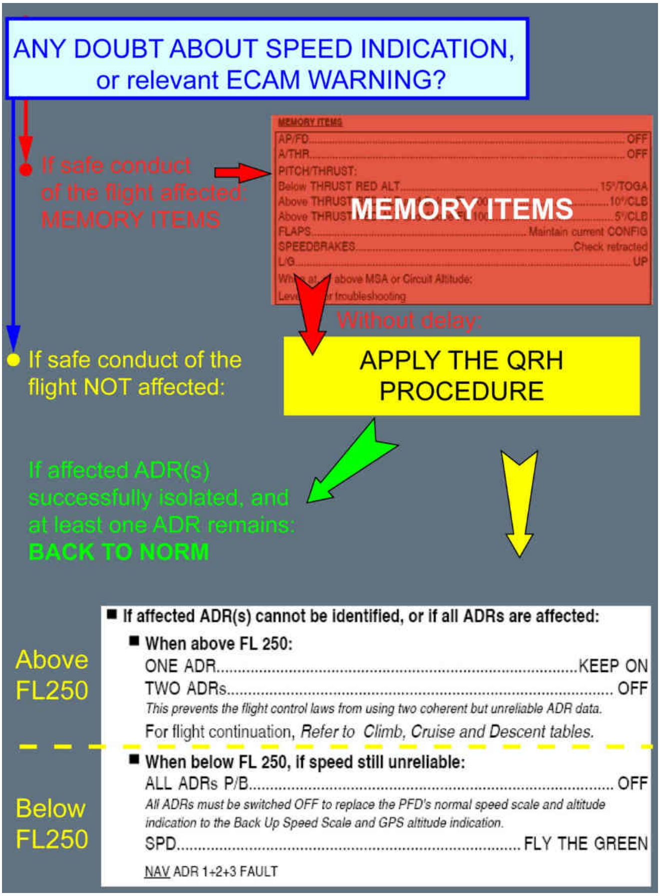
7. The aerodynamic noise reduces whereas the indicated airspeed increases, or vice versa,
8. In approach, it is not possible to extend the landing gear using the normal landing gear system.

<u>*Note:*</u> *1. Crew coordination is important. The PM should confirm any discrepancy:*

- *Between the standby airspeed indication and the speed indication on his/her PFD,*
- *Between his/her PFD and the Pilot Flying's PFD.*

*2. Because the barometric altitude may be erroneous, the aircraft may not be able to accurately maintain level flight. In addition, the ATC transponder may transmit an incorrect altitude to ATC or to other aircraft, which can lead to confusion. Therefore, the flight crew should advise ATC of the situation without delay.*

## HOW TO APPLY THIS PROCEDURE?




## MEMORY ITEMS

The flight crew applies the memory items, if the safe conduct of the flight is affected. The memory items enable to rapidly establish safe flight conditions in all phases of flight and in all aircraft configurations (weight and slats/flaps).

The flight crew must apply the memory items, if they have a doubt on their ability to safely fly the aircraft in the short term with the current parameters, ie:

- The flight crew has lost situation awareness, or
- The current pitch and thrust are not appropriate for the current flight conditions, or
- The aircraft has an unexpected flight path for the current flight conditions.

When the PF has stabilized the target pitch and thrust values, the flight crew applies the QRH procedure to troubleshoot the problem. The flight crew must apply the QRH procedure without delay, because flying with the memory pitch/thrust values for an extended period of time can lead to exceed the aircraft speed limits.

*Note:* *The flight crew must respect the STALL warning.*

## TROUBLESHOOTING AND ISOLATION

### GENERAL

The flight crew must crosscheck speed and altitude indications on CAPT PFD, F/O PFD and STBY instruments, in order to identify and isolate the faulty ADR(s).

Depending on the cause of the problem, the altitude indication may also be unreliable. There are however, a number of reliable indications available to the crew. The flight crew can use the following indications:

- The GPS altitude and GPS ground speed (when available, displayed on the MCDU GPS POSITION page)
- The RA, at low altitude

To identify the affected ADR(s), the flight crew should level off (if not already in level flight) and stabilize the flight path using the "PITCH/THRUST TABLE FOR INITIAL LEVEL OFF" table of the QRH procedure.

### LEVEL OFF AND STABILIZATION (IF REQUIRED)

The table gives the proper pitch and thrust values to stabilize level flight according to weight and altitude.
If the altitude information is unreliable, the FPV and V/S are also affected. In this case, the GPS altitude, if available, is the only means to confirm whether the aircraft is maintaining level flight.
When the altitude information is reliable, use the FPV:

- **If the FPV is reliable, or if the 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 necessary to maintain level flight is above the table's pitch target, the aircraft is slow, then increase thrust,
    - If the aircraft pitch necessary to maintain level flight is below the table's 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 enables to quickly stabilize the speed, while maintaining level flight.
- **If the FPV is not reliable and the 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.

**TROUBLESHOOTING AND FAULT ISOLATION**

When one indication differs from the others, the flight crew may be tempted to reject the outlier information. They should be aware, however, that two, or even all three ADR(s) can provide identical but erroneous data.

| | |
|---|---|
| **WARNING** | Do not instinctively reject an outlier ADR. |

When the flight crew has identified the affected ADR(s), they must turn it (them) off. This triggers the corresponding ECAM warnings and drills. The flight crew must follow these drills to address all the consequences on the various aircraft systems. If the flight crew identifies at least one ADR as being reliable, the flight crew must use this reliable ADR, and stop the procedure.

## ABOVE FL 250: FLYING THE PITCH/THRUST TABLES

If the flight crew cannot identify the affected ADR(s) or if all speed indications are unreliable, the flight crew must turn two ADRs off to prevent the flight control laws from using two consistent but unreliable ADR data. The flight crew must keep one ADR on to prevent the BUSS activation.
When the troubleshooting did not enable to identify at least one correct indication, the last part of the procedure provides pitch/thrust tables to fly the aircraft above FL 250, in the following phases:

- Climb,
- Cruise,
- Descent.

The flight crew may directly apply this part of the procedure if they already know that no speed information is reliable (for instance in case of dual pitot heating failure, plus an ADR failure), or if it is not convenient to level off for troubleshooting from an operational point of view, for instance in descent.
When Flying the aircraft with unreliable speed and/or altitude indications, it is recommended to change only one flight parameter at a time i.e. speed, altitude or configuration.

## BELOW FL 250: FLYING THE BACK-UP SPEED SCALE (BUSS)

When below FL 250, if the flight crew cannot identify the affected ADR, or if speed indications are still unreliable, the flight crew turns all ADRs off and flies the aircraft using the BUSS.

### ACTIVATING THE BUSS

The flight crew turns all three ADRs off to activate the BUSS. When the flight crew turns all three ADRs off, the following occurs on both PFDs:
- The BUSS replaces the normal speed scale,
- The GPS altitude replaces the barometric altitude.

In addition, when the BUSS is active:
- The AP/FD and A/THR are inoperative,
- The STALL warning remains operative,
- The flight control law is ALTN LAW. The high angle-of-attack protection and VMO/MMO warning are lost,
- Cabin pressure must be controlled manually.

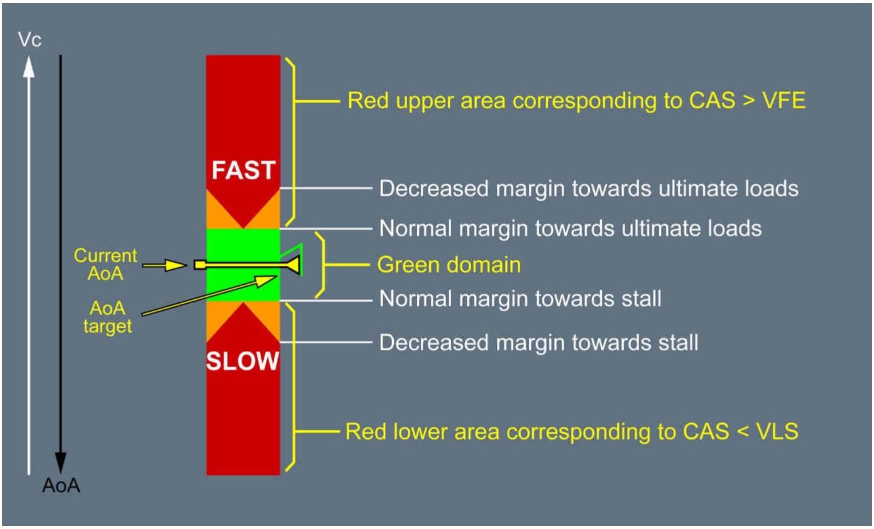
When the flight crew turns all three ADRs off, the NAV ADR 1+2+3 FAULT ECAM alert triggers. The flight crew must apply the associated ECAM actions, and then, as requested by ECAM, apply the "ALL ADR OFF" QRH procedure. This QRH procedure provides guidance to:
- Manually control the cabin pressure,
- Prepare the approach and landing.

### BUSS DESIGN

The BUSS is displayed on both PFDs. It is based on Angle Of Attack (AOA) information, and enables to easily and safely fly the aircraft without any valid airspeed indication. The BUSS enables to fly the aircraft in the entire flight domain while observing the design limits.

The BUSS scale is divided in three color-coded areas:
- In the green area, the aircraft has normal margin towards ultimate limits i.e. VMO/VFE for upper limit and stall for lower limit
- In the upper and lower amber areas, the aircraft has limited margin towards ultimate limits. Flying in the amber area is acceptable for a limited period of time but it should be avoided
- The red areas (FAST or SLOW) must be avoided.

The BUSS is tuned using the aircraft's aerodynamic model with speed brakes retracted.




When the BUSS is active:
- The altitude indications are based on GPS data. Two amber dashes cover the last two digits because the GPS altitude is less accurate than the barometric altitude
- The vertical speed indication is no longer available.

## FLYING TECHNIQUE

The PF adjusts the pitch and thrust, to maintain the AOA in the green area of the speed scale. For approach, the flight crew should perform a stabilized approach. The flight crew should change the aircraft configuration with wings level.

To retract/extend flaps, apply the following technique:
- Before **retracting** the next flaps configuration, fly the **upper** part of the green band.
- Before **extending** the next flaps configuration, fly the **lower** part of the green band.

This technique limits the excursion in the amber zones when changing the flaps configuration.

| | |
|---|---|
| **CAUTION** | When flying with the BUSS, do not use the speed brakes. |

Flying with speed brakes extended would affect the relationship between speed and AOA, and therefore the BUSS would provide erroneous data.

## DUAL RADIO ALTIMETER FAILURE

**Applicable to: 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

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSQ, B-HSR, B-HST, B-HSU**

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.

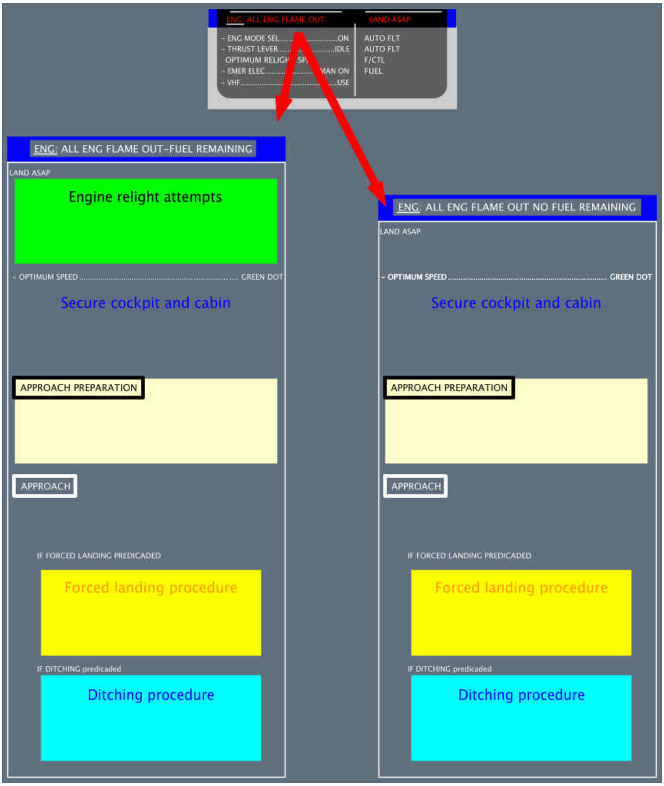
| Significant remaining systems in ALL ENGINES FLAME OUT | |
|---|---|
| FLY | PFD1, Alternate law |
| NAVIGATE | RMP1, VOR1 |
| COMMUNICATE | VHF1/HF1/ATC1 |

*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 procedures 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 s, the ECAM will order engine masters off for 30 s. 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




## ALL ENGINE FLAMEOUT

Criteria: P9907, SA
**Applicable to: B-HSO, B-HSP**

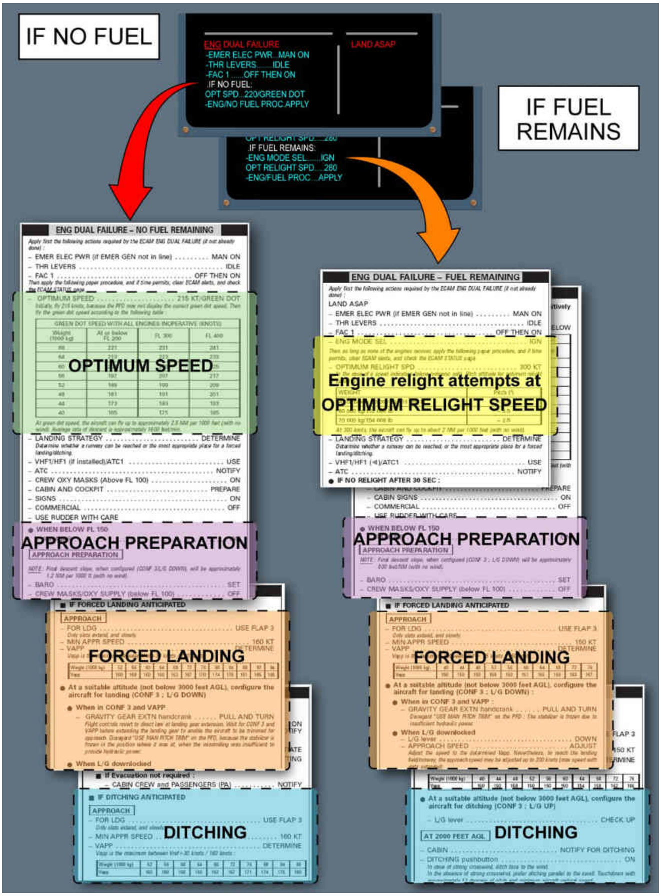
Following an all engine flame out, the flight deck indications change dramatically as the generators drop off line. The RAT is deployed to supply the emergency generator and pressurize the blue hydraulic circuit.
Control of the aircraft must be taken immediately by the left hand seat pilot, and a safe 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 provides the first immediate actions to be performed, then refers to two different QRH procedures: ENG DUAL FAILURE with FUEL REMAINING or ENG DUAL FAILURE with NO FUEL REMAINING procedures. Consequently, the flight crew must first apply the steps displayed on the ECAM, then apply the appropriate QRH procedure depending whether fuel is remaining or not. These QRH procedures are optimized to cope with each situation by providing corresponding OPERATING SPEEDS and required procedures until landing, including APPROACH PREPARATION, FORCED LANDING and DITCHING.

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 s, the ENG DUAL FAILURE with FUEL REMAINING QRH procedure orders engine masters off for 30 s. 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.


IF NO FUEL
ENG DUAL FAILURE
LAND ASAP
-EMER ELEC PWR...MAN ON
-THR LEVERS.......IDLE
-FAC 1......OFF THEN ON
.IF NO FUEL:
OPT SPD...220/GREEN DOT
-ENG/NO FUEL PROC APPLY
IF FUEL REMAINS
.IF FUEL REMAINS:
-ENG MODE SEL......IGN
OPT RELIGHT SPD.....280
-ENG/FUEL PROC....APPLY
ENG DUAL FAILURE – NO FUEL REMAINING
OPTIMUM SPEED
ENG DUAL FAILURE – FUEL REMAINING
Engine relight attempts at
OPTIMUM RELIGHT SPEED
APPROACH PREPARATION
APPROACH PREPARATION
FORCED LANDING
FORCED LANDING
DITCHING
DITCHING

# COCKPIT WINDSHIELD/WINDOW CRACKED

**Applicable to: ALL**

## 1 COCKPIT WINDOWS DESCRIPTION

*Refer to FCOM/DSC-25-40-10-10 Description*

## COCKPIT WINDSHIELD/WINDOWS DAMAGE DESCRIPTION

During flight, cockpit windows may be damaged due to:
- Impact with foreign objects
- Electrical arcing of the windows heating system
- Natural ageing of the heating film
- Moisture ingress
- Delamination
- Manufacturing quality defect
- Damage done at installation.

As per design, each structural ply (Inner ply or Middle ply) can sustain twice the maximum differential pressure of a standard flight.
Therefore, depending on the part of the windshield/window that is damaged, the structural integrity of the windshield/window may not be impacted.

## COCKPIT WINDOWS DAMAGE EVALUATION

In the case of a cockpit windshield/window cracking, the flight crew should evaluate the damage.

### STRUCTURAL INTEGRITY EVALUATION

| | |
|---|---|
| **WARNING** | The flight crew must be careful when touching the damaged window. Broken glass chips can cause cuts. |

The COCKPIT WINDSHIELD/WINDOW CRACKED procedure (*Refer to FCOM/COCKPIT WINDSHIELD/WINDOW CRACKED* procedure) requires the flight crew to check if the Inner ply is affected. To do so, the flight crew should touch the affected glass with a pen or a finger nail to check if the crack(s) is(are) on the cockpit side (Inner ply):
- If there is no crack on the cockpit side:
  The Inner ply is not damaged. Therefore the structural integrity is not affected. The current Flight Level can be maintained.
- If there are cracks on the cockpit side:
  The Inner ply is damaged. The structural integrity of the window may be altered. As the flight crew cannot easily identify if the Middle ply is also affected or not, the flight crew must descend to FL 230/MEA in order to reduce the $\Delta$P to 5 PSI.

*Refer to FCOM/COCKPIT WINDSHIELD/WINDOW CRACKED* procedure to get the full procedure.

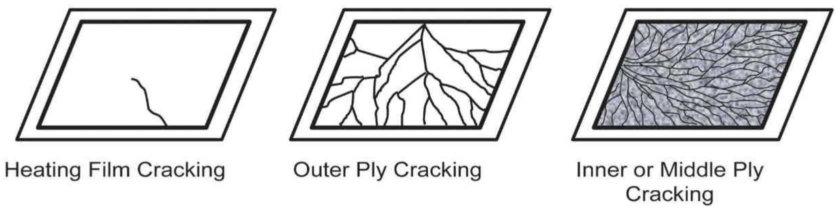
**ADDITIONAL VISUAL CLUES:**

In addition, visual clues can help the flight crew to assess which part of the window is affected by the crack.

| | |
|---|---|
| **CAUTION** | The visual clues given below are not sufficient to assess the structural integrity of the window. The flight crew must do a physical check of the Inner ply of the windshield as required by the COCKPIT WINDSHIELD/WINDOW CRACKED procedure (*Refer to FCOM/COCKPIT WINDSHIELD/WINDOW CRACKED* procedure) and apply the procedure accordingly. |

A heating film cracking looks like roughly a straight line across the window starting from a window edge. In most of the cases the line stops in the middle of the window.
An outer ply cracking usually shows a few broken lines that start from one edge of the windshield or from a foreign object impact, and go through the window to another edge.
A structural ply cracking (Inner ply or Middle ply) has a break pattern that covers the entire surface of the windshield. The small pieces of broken glass impair the visibility.

Typical Cockpit Window Damages




## EMERGENCY DESCENT

**Applicable to: ALL**

The emergency descent should only be initiated upon positive confirmation that cabin altitude and rate of climb is excessive and uncontrollable. The immediate actions of this procedure should be carried out by the fly 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 7 000 ft/min. To descend from FL 390 to FL 100, it takes approximately 4 min and 40 nm. The crew will be aware that terrain elevation, if displayed on the ND, is only representative of highest terrain in ARC mode - (*Refer to FCOM DSC -31-45-EGPWS*)
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 deactivate the mask microphone.
The following table details the SOP task sharing for an emergency descent.

2

| PF | PM |
|---|---|
| • An emergency descent will normally be used for the following:<br>- Depending on the severity, a depressurization,<br>- Rapid/explosive decompression,<br>- ECAM warning CAB PR EXCESS CAB ALT,<br>- An uncontrollable cargo/cabin smoke/fire, SMOKE/FUMES REMOVAL checklist.<br>• The IMMEDIATE ACTIONS are to be completed from memory.<br>• Use of the AP is **strongly** recommended. | |
| ANNOUNCE.................................... "Emergency Descent."<br>CREW OXYGEN MASK.............................................. ON | <br>CREW OXYGEN MASK.................................................. ON |
| • Both crew members don oxygen masks and establish communications. Avoid the continuous use of the interphone to minimize interference from oxygen masks breathing noise. | |
| **1 st LOOP (Memory Items and Initial actions):** | |
| Descend with AP engaged as follows:<br>- ALT knob, Turn and PULL *(Note 1)*<br>- HDG knob, Turn and PULL *(Note 2)*<br>- SPD/MACH knob, PULL and Turn *(Note 3)*<br>THR...................................................................... IDLE<br>*(If A/THR not engaged, retard the thrust levers to IDLE.)*<br>Read FMA.............................. "THR IDLE, OP DES, HDG."<br>SPD BRK...................................................... FULL *(Note 4)* | PA.................................. "Attention! Emergency Descent!"<br>SIGNS................................................................................ ON<br>Select seat belts and no smoking signs ON.<br>Monitor PF actions.<br>ANNOUNCE......................................................... "Check." |

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| | |
|---|---|
| ATC....."MAYDAY, MAYDAY, MAYDAY, Dragon XXX emergency descent to FL XXX metres, turning right heading XXX." | Use ECAM (if displayed) or locate EMER DESCENT checklist in QRH:<br>ENG MODE SEL.......... IGN<br>ATC.......... Notify<br>Notify ATC if PF has not done so. Select transponder to code A7700 if no contact with ATC.<br>If it is clear CAB ALT will exceed 14 000 ft, pax oxy mask deploy. Place hand on the MASK MAN ON guarded switch.<br>ANNOUNCE.........."Oxygen, Mask Man On, Confirm?" |
| Confirm the MASK MAN ON switch is correct.<br>ANNOUNCE.........."Confirmed." | Lift guarded switch and press to manually deploy pax oxygen masks. Confirm passenger SYS ON light illuminated. |
| **2 nd LOOP (Refine the FCU settings):** | |
| ALT.......... FL100 or MSA<br>HDG.......... Check heading is appropriate.<br>SPD..........Confirm speed is appropriate. | |

- Landing gear may be extended below 25 000 ft - speed must be reduced to VLO/VLE
- To save oxygen, set the oxygen diluter switch to the N position. If the diluter switch left at 100%, oxygen quantity may be insufficient to cover the entire emergency descent profile.
- The ECAM takes precedence over the QRH checklist. If there is no ECAM then the QRH checklist is to be used. If the QRH checklist is being actioned and the ECAM warning occurs then the QRH checklist is to be stopped and the ECAM is to be actioned.

| | |
|---|---|
| | ANNOUNCE....."Master Warning, Cabin Pressure Excess Cabin Altitude." |
| ANNOUNCE.........."Cabin Pressure Excess Cabin Altitude."<br>ANNOUNCE.......... "I have control, ECAM Actions," | ECAM Actions.......... READ and DO |
| OR<br>ANNOUNCE.......... "QRH Emergency Descent checklist." | Read EMER DESCENT checklist from QRH. |

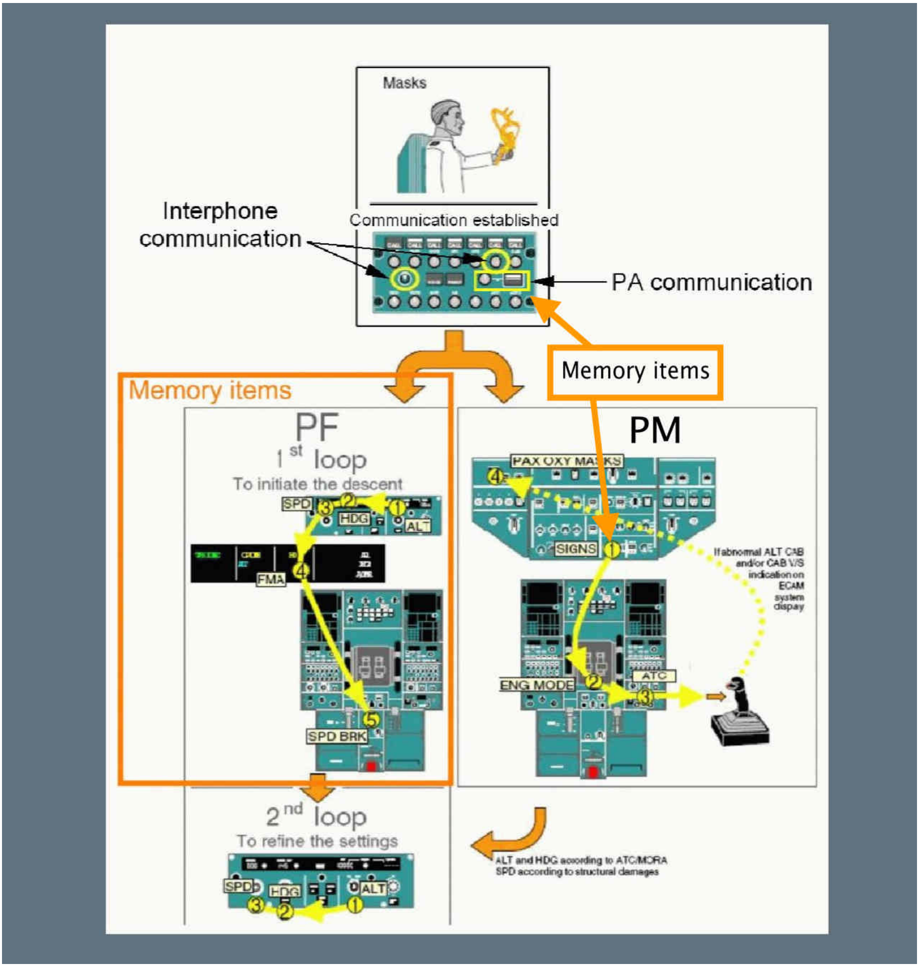
*Continued on the following page*

*Continued from the previous page*

- When 2 000 ft above level off altitude retract the speed brake.
- Notify the cabin crew, when a safe flight level has been reached and oxygen mask use can be terminated.

*Note:*
*1. Initiates descent with thrust idle.*
*2. Fly the aircraft off the airway.*
*3. If no structural damage, descend at the maximum appropriate speed. If structural damage is suspected, maintain the current IAS or reduce as appropriate. Pull the SPD/MACH knob, if a MACH number is indicated press the SPD/MACH pb to select the current IAS and adjust as appropriate. Use the flight controls with care.*
*4. Extension of the speed brakes will significantly increase VLS. At high flight levels to avoid autopilot disconnection and automatic retraction of the speed brakes, due to possible activation of the AoA protection, the speed brakes should be extended slowly while monitoring VLS.*

3




## OVERWEIGHT LANDING

Criteria: 32-1232, 32-1336, J0071, P5518, 321-200
**Applicable to: ALL 321**

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 CONF 1, deselect A/THR, decelerate to (or slightly below) VLS and select CONF 1 when below VFE. When established at CONF 1, 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 CONF 3, VLS CONF 1+F may be higher than VLS CONF 3 +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.
A normal approach is flown except that in the final stages of the approach, the target speed is VLS and the max V/S at touchdown is 360 ft/min. At main gear touchdown, select max reverse and after nosewheel touchdown, apply brakes if autobrake is not active.
Use the longest available runway and consider wind and slope effects. Where possible avoid landing in tailwinds, on runways with negative slope or on runways with less than normal braking conditions.
Do not carry excess airspeed on final approach. This is especially important when landing during an engine inoperative or other non-normal condition.
The flare and derotation technique as described in NO-160 applies.
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/min without damage. This means that no maintenance inspection is required if vertical speed is below 360 ft/min. If vertical speed exceeds 360 ft/min at touch down, a maintenance inspection is required.

# OVERWEIGHT LANDING

Criteria: 32-1232, 32-1247, 32-1291, 32-1336, J0071, P3924, P4808, P5518, P7721, P8440, 320-200
**Applicable to: ALL 320**

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 CONF 3, VLS CONF 1+F may be higher than VLS CONF 3 +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.
A normal approach is flown except that in the final stages of the approach, the target speed is VLS and the max V/S at touchdown is 360 ft/min. At main gear touchdown, select max reverse and after nosewheel touchdown, apply brakes if autobrake is not active.
Use the longest available runway and consider wind and slope effects. Where possible avoid landing in tailwinds, on runways with negative slope or on runways with less than normal braking conditions.
Do not carry excess airspeed on final approach. This is especially important when landing during an engine inoperative or other non-normal condition.
The flare and derotation technique as described in NO-160 applies.
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/min without damage. This means that no maintenance inspection is required if vertical speed is below 360 ft/min. If vertical speed exceeds 360 ft/min at touch down, a maintenance inspection is required.

# PILOT INCAPACITATION

Applicable to: ALL

## GENERAL

Pilot incapacitation is a real safety hazard which occurs more 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 to subtle incapacitation,
- If one crew member does 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 flying 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 will include involving cabin crew to restrain the incapacitated pilot, Volume 7.5.1 refers.
- Request assistance from any medically qualified passenger.
- Check if 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 seat.

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# SUPPLEMENTARY INFORMATION

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## SI-080 BRIEFING GUIDELINES



## SI-090 PFD/FMA CALLS AND FCU PROCEDURES



## SI-100 TOUCH AND GO-AROUND



## SI-110 LANDING PERFORMANCE

## SUMMARY OF HIGHLIGHTS

| Localization<br>Title | Toc<br>Index | ID | Reason |
|---|---|---|---|
| SI-010<br>COLD WEATHER OPERATIONS AND ICING CONDITIONS | B | 1 | **DU revised to improve antiskid deactivation wording.** |
| SI-070<br>RECOMMENDATIONS FOR WEATHER DETECTION | D | 1 | **Removal of the line of sight formula** |
| SI-080<br>EXAMPLE BRIEFINGS | E | 1 | Update of the technical wording |
| SI-080<br>EXAMPLE BRIEFINGS | E | 2 | Update of the technical wording |
| SI-110<br>General | A | 1 | **Update of the technical wording** |
| SI-110<br>Use of rCAM | A | 2 | Documentation update: Addition of "Use of rCAM" documentary unit |
| SI-110<br>PRINCIPLE | B | 3 | Documentation update: Addition of "PRINCIPLE" documentary unit |
| SI-110<br>VAPP Determination without failure | B | 4 | Documentation update: Addition of "VAPP Determination without failure" documentary unit |
| SI-110<br>Landing Distance without failure | B | 5 | Documentation update: Addition of "Landing Distance without failure" documentary unit |
| SI-110<br>Example of calculations without failure | B | 6 | Documentation update: Addition of "Example of calculations without failure" documentary unit |
| SI-110<br>Principle | C | 7 | Documentation update: Addition of "Principle" documentary unit |
| SI-110<br>VAPP Determination with failure | C | 8 | Documentation update: Addition of "VAPP Determination with failure" documentary unit |
| SI-110<br>Landing Distance with failure | C | 9 | Documentation update: Addition of "Landing Distance with failure" documentary unit |
| SI-110<br>Example of calculations with failure | C | 10 | Documentation update: Addition of "Example of calculations with failure" documentary unit |

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## GENERAL

Applicable to: 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

Applicable to: 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 3 mm of frost on the under side of the wing tank area is acceptable.)

### EXTERIOR INSPECTION

When icing conditions on ground 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 min)

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 |

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.

Refer to FCOM PRO-SUP-91-30 and Part A 8.2.3.

## 1 TAXI OUT

On contaminated runways, the taxi speed should be limited to 10 kt, and any action that could distract the flight crew during taxiing should be delayed until the aircraft is stopped. The Before Takeoff checklist should be performed either before taxi or when reaching the holding point.

The following factors should be taken into account:

- At speeds below 20 kt, Antiskid deactivates.
- 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. Refer to FCOM PRO-SUP-70.

For more details about this procedure, Refer to FCOM/SOP-09-AFTER START-Engine Anti Ice.

## TAKEOFF

When icing conditions exist at +3 °C and below, the takeoff must be preceded by an engine static run-up to 50% N1 or greater and stable engine operation checked before the start of the takeoff run. Refer to FCOM PRO-SUP-70.
If the aircraft has been either de-iced or anti-iced and the lower limit of the HOT has been exceeded, a Pre Takeoff Contamination Inspection of the upper wing surfaces from the cabin must be carried out within 5 mins prior to the commencement of takeoff. If evidence of ice, snow or frost accretion is observed, or any doubt exits over the conditions of the critical surfaces, the aircraft should return for de-icing/anti-icing.
If the anti-icing holdover time has expired, a Pre Takeoff Contamination Check must be conducted externally by Ground Crew. If it is not possible to conduct this check, or if it cannot be performed within 5 mins immediately prior to takeoff, the aircraft must return for de-icing/anti-icing.
Refer to Part A 8.2.3.

### CONTAMINATED RUNWAY

Takeoff from an icy runway is not recommended. The friction coefficient must be greater than 0.25 (ICAO), or equivalent.
Operations from contaminated runways require a higher level of attention. Slush, standing water, or deep snow reduces the aircraft takeoff performance due to increased rolling resistance and the reduction in tyre-to-ground friction. Refer to FCOM PER-TOF-CTA for recommended maximum depth of contaminant.
The use of FLEX thrust for takeoff is prohibited. During operations on contaminated runways, ensure that engine thrust advances symmetrically. This will help minimise potential directional control problems.
Before applying thrust, ensure the nose wheel is straight. Any tendency to deviate from the runway centreline must be immediately countered with rudder. Avoid over-controlling on the rudder, as this may induce lateral control difficulties.
Precipitation drag reduces the initial acceleration. A higher flap setting increases the RTOW for a particular runway, but reduces the second segment climb gradient.

## 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

The most common adverse weather encountered whilst holding is icing. When holding in icing conditions, maintain the clean configuration whenever possible. Use of engine anti-ice and total anti-ice increases fuel consumption as follows:

| FCOM PER-HLD-HLD | Engine Anti-ice | Total Anti-ice |
|---|---|---|
| A320-200 | + 3.5% | + 5.5% |
| A321-200 | + 3.0% | + 6.0% |

## APPROACH

### ICE ACCRETION

If severe icing conditions are anticipated (approximately 5 mm of ice accretion on the airframe), the approach speed increments should applied. Refer to FCOM PRO-SUP-30.

### BAROMETER INDICATIONS

In cold weather, the atmosphere differs from the International Standard Atmosphere (ISA) conditions. The parameters that the ADIRS computes are barometric and ISA-referenced. When the atmosphere differs from the ISA conditions, the altitude and FPA computed by the ADIRS, and the associated indications on PFD (altitude, VDEV) are not accurate.

When the temperature is lower than ISA:
- The true altitude of the aircraft is lower than the altitude that the ADIRS computes.
- The FPA that the aircraft actually flies, is less steep than the FPA that the ADIRS computes.

When required, apply corrections to the relevant procedural altitudes and to the FPA (if using selected vertical FPA mode). Refer to Part A 8.1.1.2.

A managed vertical profile (FINAL APP mode) may not be flown if the airport temperature is below any minimum Baro-VNAV authorised temperature published on the approach chart, or when low temperature corrections are applied to approach altitudes. If the temperature is below the approved limit, the approach may still be flown using selected vertical guidance (NAV/FPA) and the corrected procedural altitudes. In this case, the approach is flown to LNAV minima (MDA). Refer to Part A 8.1.1.2.
For Non Precision Approach in vertical managed mode refer to NO-120 Cold Weather Operations.

FPA Correction

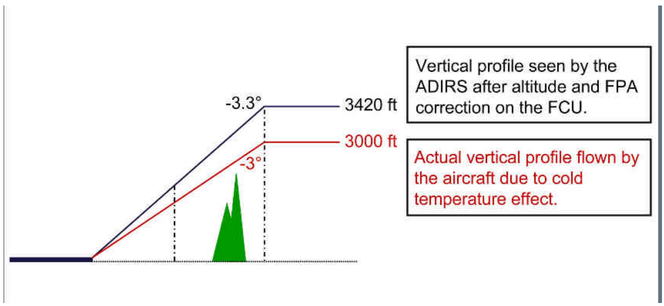
When the temperature is lower than ISA, the FPA the aircraft actually flies is less steep than the FPA the ADIRS (ISA referenced) computes.
In vertical selected mode FPA, to correct the FPA for this ISA deviation effect, the flight crew should select on the FCU a FPA slightly different from the FPA calculated by the FMS system.
In any case, the check 'altitude (corrected for temperature) versus distance' remains the reference.

Impact on the indications

The barometric indications on PFD, namely the altitude and the VDEV are not corrected in temperature and are therefore not accurate.

Example

| | |
|---|---|
| **EXAMPLE** | Airport outside temperature -20 °C ; Delta ISA = -35 °C.<br>Approach: FAF at 3 000 ft ; Final descent slope 3 °. |



## LANDING

### SLIPPERY OR CONTAMINATED RUNWAY LANDING PERFORMANCE

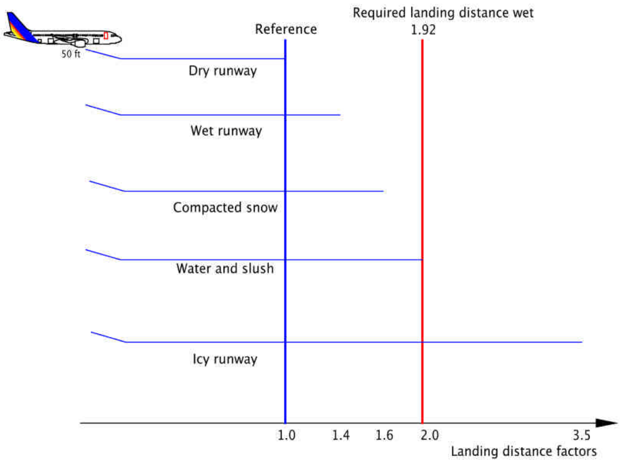
When landing on runways contaminated with ice, snow, slush or standing water, the reported braking action must be considered. Terms used include GOOD, MEDIUM, POOR, NIL and UNRELIABLE.
The braking performance associated with 'GOOD' is representative of a wet runway, while 'POOR' is representative of an ice covered runway. Exercise extreme caution to ensure adequate runway length is available when POOR braking action is reported.
Contaminated runway landing performance data is presented in FCOM PER-LDG.
Uniform contamination over the entire runway is assumed. This means a uniform depth for slush/standing water for a contaminated runway or a fixed braking coefficient for a slippery runway. The data cannot cover all possible slippery/contaminated runway combinations and does not consider factors such as rubber deposits or heavily painted surfaces near the end of most runways.
A term commonly used to describe runway conditions is coefficient of friction. The runway coefficient of friction is normally determined using vehicles towing measuring equipment. For a variety of reasons, the coefficient measured by the ground equipment may not necessarily relate to the coefficient the aircraft may experience on landing. Coefficient of friction values provide additional information to be taken into consideration when determining the runway conditions for landing. Evaluate these readings in conjunction with pilot reports and the physical description of the runway condition when planning the landing. Take special care in evaluating all the information available when braking action is reported as POOR, or if slush or standing water is present on the runway.
Unless emergency or operational circumstances dictate otherwise, the friction coefficient must be greater than 0.25 (ICAO), or equivalent, for landing.
When friction coefficients are in the order of 0.25 (ICAO), exercise extreme caution. Any crosswind component accepted must be fully considered. Refer to Part A 8.3.10, FCOM PRO-SUP-91-50 and the QRH NP.

### 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




## 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 (*Refer to NO-170 ROLL OUT*).

## CROSSWIND LIMITATIONS

Due to the potential directional control problems associated with landing on contaminated runways in crosswind conditions, the crosswind limitations are reduced. Refer to FCOM PRO-SUP-91-50 and the QRH NP.

## AUTOLANDS

The automatic ROLLOUT mode has not been demonstrated on snow covered or icy runways. The ROLLOUT mode relies on a combination of aerodynamic rudder control and nosewheel steering to maintain the runway centreline using localizer signals for guidance. On a contaminated runway, nosewheel steering effectiveness and therefore aircraft directional control capability, is reduced. Use the more restrictive of the autoland or contaminated runway landing crosswind limitations to determine the maximum permitted crosswind.
If an autoland is accomplished on a contaminated runway, be prepared to disengage the AP should ROLLOUT directional control become inadequate.

## LANDING TECHNIQUE SUMMARY

The following chart summarises the recommended procedures for landing on slippery or contaminated runways:

| PHASE | RECOMMENDED PROCEDURE | REMARKS |
|---|---|---|
| Approach | Fly a well-executed final approach with the aircraft positioned on glidepath, on runway centreline and at the speed recommended for existing conditions. | Go-around if approach stability criteria not met. |
| | Arm autobrake system by selecting MED. | Autobrake is recommended provided contamination is evenly distributed. |
| | With a crosswind, do not be misled by the relative bearing of the runway due to crab angle when breaking out of overcast. | |
| Flare | Do not float or allow drift to build up during the flare. | |
| | Drifting snow can lead to an illusion of aircraft drift. | Use runway lighting and markings as drift reference in drifting snow. |
| | With a strong crosswind, consider only a partial de-crab prior to touchdown. | A touchdown in a crab establishes main gear crab effect and actuates the auto spoilers and autobrakes more quickly. |
| Touchdown | Accomplish a positive touchdown as near to the centreline as possible in Zone A (refer to NO-160, Touchdown Point). | A positive touchdown improves wheel spin up on slippery runways. |
| | The aircraft should be flown positively onto the runway, even if the speed is excessive. | Deceleration on the runway is about three times greater than in the air. Do not allow the aircraft to float. |
| | If a long touchdown is likely, go-around. | |
| Deceleration Phase (Expedite All Items) | Select maximum reverse thrust. | |
| | Immediately lower the nose gear onto the runway and hold light forward sidestick pressure. | |
| | Check the speedbrakes deploy immediately after main gear touchdown. | |
| | The autobrake system begins symmetrical braking at ground spoiler deployment. | |
| | Without autobrake, use moderate-to-firm steady brake pedal pressure after nose gear touchdown. | Do not cycle brake pedals. Both main gear bogies must be in GND POS for antiskid operation. Antiskid is deactivated below 10 kt ground speed. |
| Rollout | Keep the wings level. | Improves directional control and traction. |
| | Maintain light forward sidestick pressure. | |
| | Use nosewheel steering with care. | |
| | Maintain directional control with rudder for as long as possible. | |

## 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 stopover is expected.

# TURBULENCE

Applicable to: 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.

## 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 nm upwind. Refer to SI-070 For additional information.

### 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:
- Reduce speed or Mach target
- Before the descent in DES mode, enter the wind data to improve the computation of the vertical profile and of the speed target range performed by the FMS
- 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 speed limit:
- Use the speedbrakes
- 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 the AP disconnection. When the AP is off, the flight crew should be aware of the pitch influence if the speedbrakes are used close to the ceiling.
- Before re-engaging the AP, adjust the pitch attitude so that it is appropriate for the speed target.

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.
It is important to consider the effect of increased 'g' on people who may be standing in the cabin.
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.

## CLEAR AIR TURBULENCE (CAT) CONSIDERATIONS

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 secure their harness, check that the seat belts signs are on and use all white lights in thunderstorms.
- Turbulence speeds are :
  - A320-200: 250 kt up to FL200, then 275 kt / M0.76.
  - A321-200: 270 kt up to FL200, then 300 kt / M0.76.
- It is not necessary to set the ENG START selector to IGN. In the case of an engine flameout, the igniters will trigger automatically.

The intensity of turbulence may be classified as follows:

| INTENSITY | AIRCRAFT REACTION | REACTION INSIDE AIRCRAFT |
|---|---|---|
| **LIGHT** | Turbulence that momentarily causes slight, erratic changes in altitude and/or attitude. | Occupants may feel a slight strain against seat belts or shoulder straps. Unsecured objects may be displaced slightly. Food service may be conducted and little or no difficulty is encountered in walking. |
| **MODERATE** | Similar to light turbulence but of greater intensity. Changes in altitude and /or attitude occur but the aircraft remains in positive control at all times. It usually causes variations in indicated airspeed. | Occupants feel definite strains against seat belts or shoulder straps. Unsecured objects are dislodged. Food service and walking are difficult. |
| **SEVERE** | Turbulence that causes large, abrupt changes in altitude and/or attitude. It usually causes large variations in indicated airspeed. Aircraft may be momentarily out of control. | Occupants are forced violently against seat belts or shoulder straps. Unsecured objects are tossed about. Food service and walking is impossible. |
| **EXTREME** | Turbulence in which the aircraft is violently tossed about and is practically impossible to control. It may cause structural damage. | |

## WINDSHEAR

**Applicable to: ALL**

### BACKGROUND INFORMATION

#### WINSHEAR PHENOMENON

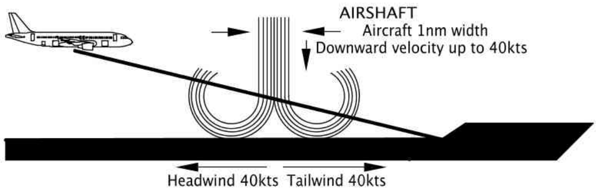
The windshear is mostly due to cool shaft of air, like a cylinder between 0.5 nm and 1.5 nm width that is moving downward. When the air encounters the ground:

- 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




## AWARENESS AND AVOIDANCE

Awareness of the weather conditions that cause windshear 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 moved away from the airport.

## STRATEGY TO COPE WITH WINDSHEAR

The windshear and microburst are hazardous phenomena for an aircraft at takeoff 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, 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.

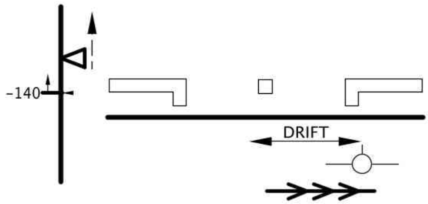
Increasing flight crew awareness (if available)

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 predictive capability to assess wind variations is performed by the Predictive Windshear System (PWS). The PWS operates automatically below 2 300 ft AGL, regardless of whether the radar is turned on or 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.

FPV and target speed - wind interpretation




Warning the flight crew

The "SPEED, 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 kt/second | -3 ° | VLS -7 kt |
| -1 kt/second | -4 ° | VLS -1 kt |

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

If a windshear encounter is likely, the takeoff should be delayed until the conditions improve, e.g. until a thunderstorm has cleared the airport. If the winds affecting the airport are not necessarily associated with a temporary short-term weather phenomenon, then choose the most favourable runway and thrust setting, i.e. TOGA thrust.
Before takeoff, use the weather radar and PWS to ensure the planned flight path is clear of any problem areas.
On aircraft fitted with PWS, an alert may be generated on the runway before takeoff, in which case the take-off should be delayed. The PWS is described in detail in FCOM DSC-34-60-30.
Additionally, after liftoff, the FMGEC reactive windshear warning system may be triggered in the event of a shear being experienced by the aircraft. The reactive windshear warning system is described in detail in FCOM DSC-22-40-60.
Selection of the TERR ON ND pb will inhibit the display of the WINDSHEAR AHEAD display on that pilot's ND.

Predictive windshear ("WINDSHEAR AHEAD" aural warning)

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 kt).

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 (WINDSHEAR, WINDSHEAR, WINDSHEAR aural warning) or windshear detected by pilot observation

On the takeoff roll, closely monitor airspeed and airspeed trend. Without PWS, windshear can be detected by significant and rapid speed variation on the PFD speed tape. If this occurs below V1, the Captain should reject the takeoff only if he considers that there is sufficient runway remaining to stop the aircraft. If a rejected takeoff is not possible, select TOGA thrust, continue the takeoff and apply the checklist actions from memory.

On receipt of a reactive "WINDSHEAR" warning, select TOGA thrust and apply the checklist actions from memory.

If windshear is encountered and the takeoff is continued, the PF calls "Windshear TOGA", implying that no configuration change will occur until clear of the shear. The following points should be stressed:

- If encountered above V1 but below VR, a normal rotation should be initiated no later than 2 000 ft before the end of the runway, even if airspeed is low.
- The configuration should not be changed until positively out of the shear as the operation of the landing gear doors induces additional drag.
- Follow the SRS, even if this requires the use of full back stick. As the speed begins to recover, the pilot can reduce back stick while still following SRS orders until well clear of the shear.
- The PM should call RA, RA trend and V/S and significant related trends.
- When clear of the shear, report the encounter to ATC.

## APPROACH

If severe windshear or downburst conditions are expected, consider either delaying the approach or diverting to another airport. Assess conditions for a safe landing by interpreting:

- The weather radar picture and PWS alerts.
- ATIS/actual wind velocity.
- Local terrain characteristics.
- ATC/pilot reports.

Selection of the TERR ON ND pb will inhibit the display of the WINDSHEAR AHEAD display on that pilot's ND.

### Predictive Windshear

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 choose the most favourable runway in conjunction with the most appropriate approach navaid (e.g. ILS or GPS) and consider using CONF 3 for landing. Should windshear be encountered, CONF 3 will allow better aircraft performance during the escape manoeuvre. However, with the decrease in drag associated with CONF 3, speed control during the approach will require close attention to avoid excessive speed on landing. This may also be exacerbated by using an increased VAPP. If the approach is continued, however, consider the following:

- The weather severity must be assessed with the radar display.
- Increasing VAPP, displayed on the PERF APP page, up to a maximum of VLS +15 kt. This is particularly important in gusty wind conditions.
- Managed speed should be used as it provides the 'GS mini' function.

- Engaging the AP for a more accurately flown approach.
- 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. For the description of the applicable technique, refer to NO-100 Final Approach.
- 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.

The checklist actions for predictive "WINDSHEAR AHEAD" warnings on approach allow that in the event that 'a positive verification is made that no hazard exists, the warning may be considered cautionary. This note to treat the predictive warning as cautionary is included only as an acknowledgement of the PWS system limitations. PWS technology relies on Doppler analysis of water particle movement, and the geographical situation associated with particular wind conditions may generate false warnings where no hazards exist. It should only be treated as cautionary on careful analysis and where an early positive verification can be made that no hazard exists.
The PWS is described in detail in FCOM DSC-34-60-30. Additionally, the FMGEC reactive windshear warning system may be triggered in the event of windshear being experienced by the aircraft.

Reactive Windshear

In case of the "WINDSHEAR, WINDSHEAR, WINDSHEAR" aural warning. Apply the checklist actions from memory. The PF calls "Windshear TOGA", implying that no configuration change will occur until clear of the shear. The following points should be stressed:

- If the AP is engaged, it should remain engaged. It will disengage if and when ALPHA PROT is reached.
- The configuration should not be changed until positively out of the shear, as the operation of the landing gear doors incurs additional drag.
- Follow the SRS, even if this requires the use of full back stick. As the speed begins to recover, the pilot can reduce back stick while still following SRS orders until well clear of the shear.
- The PM should call IAS, RA, V/S and significant related trends.
- When clear of the shear, report the encounter to ATC.

The reactive windshear warning system is described in detail in FCOM DSC-20-40-60.

# VOLCANIC ASH

Applicable to: 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 ft 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 smoothly apply 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.

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## GENERAL

**Applicable to: ALL**

Two flying references may be used on the PFD:

- The attitude
- The Flight Path Vector (FPV), sometimes refered to as 'the bird'.

The pilot selects the flight reference with the HDG/VS TRK/FPA p/b on the FCU.

## THE ATTITUDE

**Applicable to: ALL**

When HDG/VS is selected on the FCU, FPV 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, takeoff 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

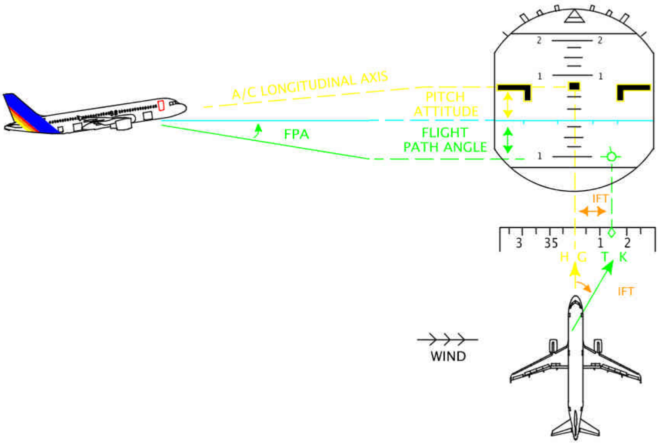
**Applicable to: ALL**

When TRK/FPA is selected on the FCU, the FPV is the flight reference with the TRK and FPA as basic guidance parameters. The FPV indicates performance and does not direct or command.
In dynamic manoeuvres, the FPV is directly affected by the aircraft inertia and has a delayed reaction. As a result, the FPV should not be used as a flight reference in dynamic manoeuvres.
The FPV 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, 'the bird'. The FPV 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 FPV 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 FPV in relation to the pitch scale.

Use of FPV




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 FPV, the pilot should first change attitude, and then check the result with reference to the FPV.

### NON-PRECISION APPROACH

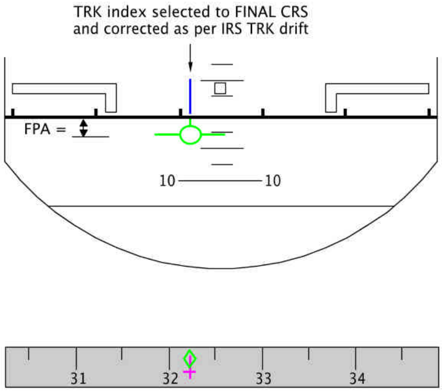
The FPV is particularly useful for non-precision approaches. The pilot can select values for the inbound track and final descent path angle on the FCU. Once established inbound, only minor corrections should be required to maintain an accurate approach path. The pilot can monitor the tracking and descent flight path, with reference to the track indicator and the FPV.
However, pilots should understand that the FPV only indicates a flight path angle and track, and does not provide guidance to a ground-based radio facility. Therefore, even if the FPV indicates the aircraft is flying with the correct flight path angle and track, this does not necessarily mean 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 FPV 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 FPV 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 FPV's tail is immediately below the horizon, and the bottom of the FPV is immediately above the 5 ° nose down marker.

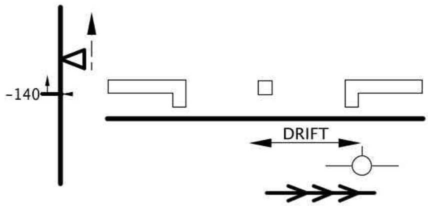
Use of FPV in final approach




## FINAL APPROACH

The FPV 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. The position of the FPV 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.
If the target approach speed symbol moves upward, this indicates there is headwind gust. If the FPV drifts to the right, this indicates there is wind from the left.

Bird and target speed- wind interpretation




## 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 FPV must be considered as not reliable, if altitude information is not reliable.

## GO-AROUND

**Applicable to: ALL**

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 FPV is automatically removed.

## GENERAL

**Applicable to: 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

**Applicable to: ALL**

### WITHOUT GPS PRIMARY

#### PRINCIPLE

Each FMS computes its own aircraft position from the three IRS (MIXIRS) position and a computed radio position.

The computed radio position is a combination between the available navaids:
- DME/DME
- VOR/DME
- LOC
- DME/DME-LOC
- VOR/DME-LOC

The FMS always uses the MIXIRS position and selects the most accurate source of radio position. To select this most accurate source, the FMS considers the estimated accuracy and integrity of each positioning equipment.

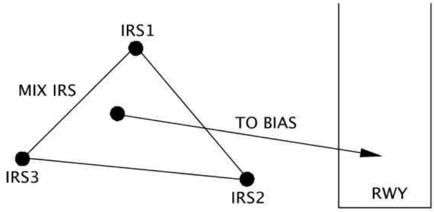
#### INITIALISATION

*Refer to NO-020 ADIRS INITIALIZATION*

#### TAKE-OFF

Each FMGC uses the MIXIRS 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 MIXIRS position and the FMS position is referred to as the TO BIAS. The TO BIAS is added to the MIXIRS position, for the subsequent FMS position.

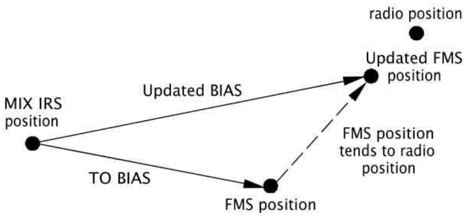
FMS position updating at take off




## IN FLIGHT

The original TO BIAS is continuously updated with the current radio aid.

updating BIAS principle




If the radio position is lost, the system uses the updated BIAS to determine the FMS position from the MIXIRS position.

## NAVIGATION ACCURACY

The FMS computes the Estimated Position Uncertainty (EPU). The EPU is an estimate of how much the FM position diverges (value with 95% of confidence on the computed position) , and depends on the navigation mode that the system uses.

The FMS compares the EPU with the Required Navigation Performance (RNP) to determine the level of navigation accuracy:

- If the EPU does not exceed the RNP, accuracy is HIGH
- If the EPU exceeds the RNP, accuracy is LOW.

The class of navigation accuracy is displayed continuously on the MCDU PROG page. The RNP is displayed in the REQUIRED field of the MCDU PROG page.

## 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

*Refer to NO-020 ADIRS INITIALIZATION*

### 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 GPIRS position is characterized by two parameters:
- Integrity
- Accuracy

The IRS continuously monitors the integrity and the accuracy of the GPIRS position. The GPIRS 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.
GPIRS accuracy is 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 GPIRS position fulfils both the integrity and the accuracy criteria, GPS PRIMARY is displayed on the MCDU PROG page.

## SUMMARY

<table>
<tr><th colspan="4">FM POSITION</th></tr>
<tr><td colspan="2">Flight phase</td><td>WITHOUT GPS PRIMARY</td><td>WITH GPS PRIMARY</td></tr>
<tr><td colspan="2">On groundbefore Takeoff</td><td>MIXIRS</td><td>GPIRS</td></tr>
<tr><td colspan="2">Takeoff</td><td colspan="2">Updated at runway threshold (shift) (1)</td></tr>
<tr><td rowspan="2">In flight</td><td>With RADIO</td><td>Tends to RADIO</td><td>GPIRS</td></tr>
<tr><td>Without RADIO</td><td>MIXIRS + BIAS</td><td>GPIRS</td></tr>
</table>

(1) *The FMS position update at take-off is inhibited with FMS2 when GPS PRIMARY is active.*

# USE OF FMS

**Applicable to: ALL**

The navigation accuracy is managed through several MCDU pages:

## PROG PAGE

This page indicates the GPS PRIMARY status.
The PROG page also displays in green the estimated navigation (EPU) accuracy that the FMS computes with the GPS or the radio position.
The EPU is compared to the required navigation accuracy displayed 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 from GPS PRIMARY or GPS PRIMARY LOST and 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. If the flight crew deselects the GPS, GPSPRIMARY lost is then displayed on MCDU and ND. The GPS can be reselected using the same prompt.

## PREDICTIVE GPS PAGE (IRS HONEYWELL ONLY)

The PREDICTIVE GPS page is accessible from PROG page. The GPS PRIMARY criteria depends on 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

Applicable to: ALL

### NAVIGATION ACCURACY INDICATIONS

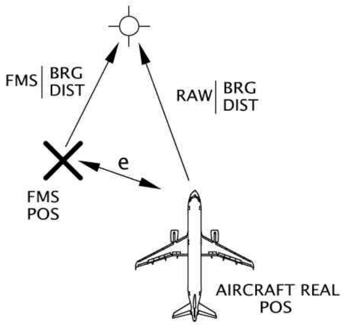
The navigation accuracy indications are available on the MCDU PROG page. The following guidelines apply:

- 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 min, before Top Of Descent, reaching TMA and IAF and whenever a navigation doubt occurs.
- The crew will use, IRS only, LOW and NAV ACCUR DOWNGRAD 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).

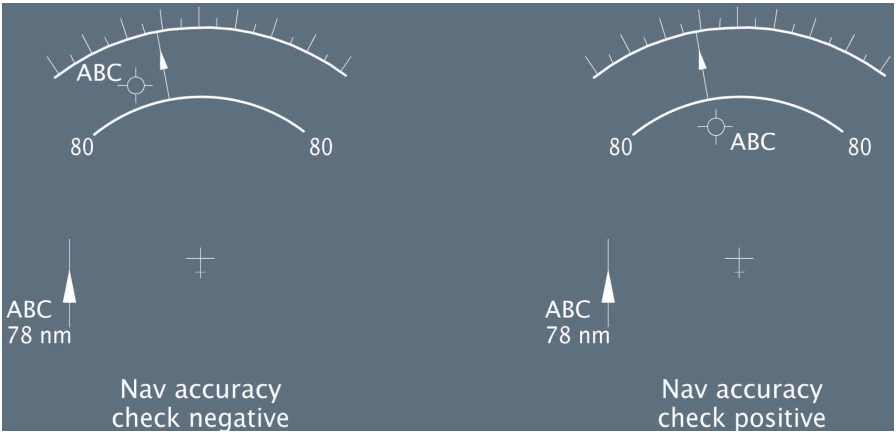
navigation accuracy cross check technique 1




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




## 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 PRIMARY LOST Or No GPS</td><td rowspan="2">Cruise</td><td>Navigation accuracy check positive(≤ 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">Approach (1)</td><td>Navigation accuracy check positive(≤ 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.*

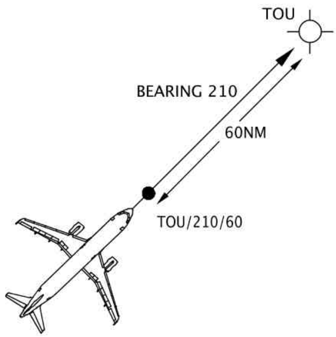
## POSITION UPDATE

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 ° error on bearing.

FM position update in flight




## RADIAL EQUIVALENCE

**Applicable to: B-HSD, B-HSE, B-HSG, B-HSI, B-HTD, B-HTE, B-HTF**

Aircraft fitted with legacy FMS display the radial equivalent of the REQUIRED (RNP) navigation performance on the PROG page.

For RNP requirements, the navigation position error is defined in terms of the XTK/ATK error. The legacy FMS computes an estimated accuracy that is a radial value (circle) around the estimated position and displays this equivalent value on the PROG page. To obtain the radial equivalent of a XTK/ATK (RNP) value, multiply the XTR/ATK by 1.22 as follows:
- Radial equivalent = XTR/ATK (RNP) x 1.22

For example, if an airspace or procedure specified an RNP of 0.3 nm, legacy FMS will display the radial equivalent value 0.37 nm on the PROG page (0.3 x 1.22), which equates to the specified RNP.

## WORLD GEODETIC SURVEY 1984 (WGS 84)

**Applicable to: ALL**

WGS 84 is the standard used for the accurate position reference used by the GPS system. There are some differences between WGS 84 and the more current geodetic survey systems but these differences are less than 2 cm. ICAO recommends that positions of all navigation references are made with respect to WGS 84 and, in most countries around the world, this recommendation has been complied with. There are some states, however, where the conversion to WGS 84 has not been carried out, leading to the possibility of navigation inaccuracies.

## USE OF GPS IN NON-WGS84 REFERENCE DATUM AIRSPACE

In non-WGS 84 airspace, the local datum (position basis) used to survey the navigation data base position information may result in significant position errors from a survey done using the WGS 84 datum. To the pilot, this means that the position of runways, airports, waypoints, or navigation aids, may not be as accurate as depicted on the map display and may not agree with the GPS position. Crews should consult official sources, e.g. Jeppesen, to determine the current status of airspace in which they operate.

A worldwide survey has been conducted which determined that using the FMS while receiving GPS position updating during enroute navigation did not affect the required navigation accuracy for SIDS and STARS, despite operating in non-WGS 84 airspace. However, this navigation position accuracy may not be adequate for approaches. Therefore, the aircraft flight manual requires the crew to inhibit GPS position updating while flying approaches in non-WGS 84 airspace 'unless other appropriate procedures are used'.

Provided operational approval has been received and measures to ensure their accuracy have been taken, RNAV approaches may be flown with GPS updating enabled. Options available may include surveys of the published approaches to determine if significant differences or position errors exist, developing special RNAV procedures complying with WGS 84 or equivalent, or inhibiting GPS updating.

For approaches based upon ground-based navigation aids such as ILS, VOR, LOC or NDB, the GPS updating need not be inhibited, provided that appropriate raw data is used as the primary navigation reference throughout the approach and missed approach. Aircraft primary lateral and vertical navigation modes may be used. Provided the FMS is not used as the primary means of navigation for approaches, this method can be used instead of inhibiting GPS updating.

# HONEYWELL ID CONVENTIONS

**Applicable to: ALL**

## UN-NAMED OCEANIC CONTROL AREA REPORTING POINTS

Positions in the Northern Hemisphere use the letters 'N' and 'E', while positions in the Southern Hemisphere use the letters 'S' and 'W'. Latitude always precedes longitude.

For longitude, only the last two digits of the three digit value are used.

Placement of the designator in the five character set indicates whether the first longitude digit is 0 or 1. The letter is the last character if the longitude is less than 100 ° and is the third character if the longitude is 100 ° or greater. 'N' is used for north latitude, west longitude; 'E' is used for north latitude, east longitude. 'S' is used for south latitude, east longitude. 'W' is used for south latitude, west longitude.

| | |
|---|---|
| **EXAMPLE** | N50° W040° becomes 5040N<br>N75° W170° becomes 75N70<br>N50° E020° becomes 5020E<br>N06° E110° becomes 06E10<br>S52° W075° becomes 5275W<br>S07° W120° becomes 07W20<br>S50° E020° becomes 5020S<br>S06° E110° becomes 06S10 |

## UN-NAMED TERMINAL AREA FIXES

### DME ARC PROCEDURES

Unnamed fixes along a DME arc procedure are identified by a five character designation with the first character being 'D'.
Characters from two to four indicate the radial on which the fix lies. The last character indicates the arc radius. The radius is expressed by a letter of the alphabet where A = 1 mile, B = 2 miles, C = 3 miles and so forth.

| | |
|---|---|
| **EXAMPLE** | EPH 252°/ 24 = D252X<br>EPH 145°/ 24 = D145X<br>GEG 006°/ 20 = D006T |

An unnamed waypoint along a DME arc with a radius greater than 26 miles is identified by the station identifier and the DME radius.

| | |
|---|---|
| **EXAMPLE** | CPR 338°/29 = CPR29<br>GEG 079°/30 = GEG30 |

## FIXES WITH ONE WORD NAMES

Waypoints that are located at fixes with names containing five or fewer characters are identified by the name.

| | |
|---|---|
| **EXAMPLE** | DOT, ACRA, ALPHA |

Names with more than five characters are abbreviated using the following rules sequentially until five characters remain:

- Delete double letters
- Keep the first letter, first vowel and last letter

- Delete other vowels starting from right to left
- Keep the last letter and then delete consonants from right to left

| | |
|---|---|
| **EXAMPLE** | KIMMEL becomes KIMEL<br>COTTON becomes COTON<br>RABBITT becomes RABIT |

| | |
|---|---|
| **EXAMPLE** | ADOLPH becomes ADLPH<br>BAILEY becomes BAILY<br>BURWELL becomes BURWL |

| | |
|---|---|
| **EXAMPLE** | ANDREWS becomes ANDRS<br>BRIDGEPORT becomes BRIDT<br>HORSBA becomes HORSA |

**FIXES WITH MULTI-WORD NAMES**

Use the first letter of the first word and abbreviate the last word using the above rules sequentially until a total of five characters remain.

| | |
|---|---|
| **EXAMPLE** | CLEAR LAKE becomes CLAKE<br>ROUGH ROAD becomes RROAD |

## GENERAL

**Applicable to: ALL**

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

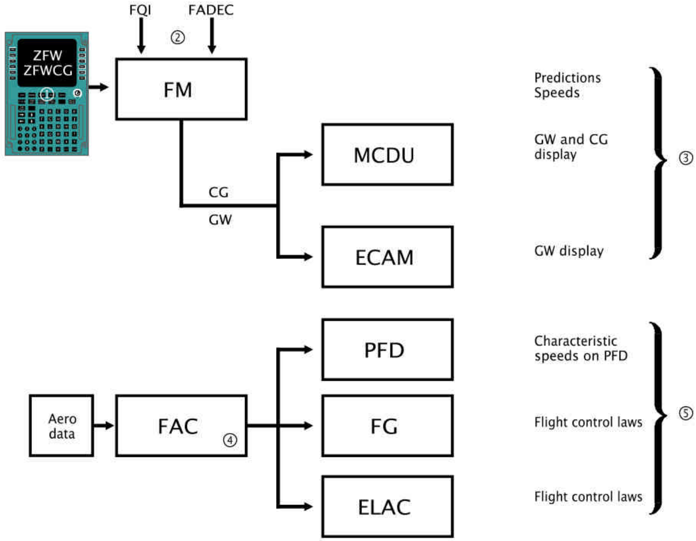
A ZFW or ZFWCG entry error in MCDU INIT B page induces calculation errors that are to be highlighted.

## TECHNICAL BACKGROUND

**Applicable to: ALL**

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.




<u>*Note:*</u> *1. On ground, FAC uses the GW FM computed.*
*2. In flight, at low altitude (below 15 000 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

**Applicable to: ALL**

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.

<u>Note:</u> *1. In flight, if the FM and FAC GW differ from a given threshold, a "CHECK GW" 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.

## OPERATIONAL RECOMMENDATIONS

**Applicable to: ALL**

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.

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## TECHNICAL BACKGROUND

**Applicable to: 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 TRAFFIC" | No evasive maneuver |
| Resolution Advisory (RA) | ■ ↑ -06 (r) | Collision threat | Preventive, e.g. "MONITOR V/S" | Do not alter your flight path and keep VS out of red sector |
| | | | Corrective, e.g. "CLIMB" | Smoothly and firmly (0.25 g) follow VSI green sector within 5 s |
| | | | Corrective, e.g. "CLIMB NOW" or "INCREASE CLIMB" | Smoothly and firmly (0.35 g) follow VSI green sector within 2.5 s |

## OPERATIONAL RECOMMENDATION

**Applicable to: ALL**

Refer to Part A 8.3.1.4 for company policy regarding TCAS.

The flight crew should select:

- ABV in climb (+9 900 ft / -2 700 ft)
- BELOW in cruise or in descent (+2 700 ft / -9 900 ft )
- TA, in the case of:
  - Engine failure
  - Flight with landing gear down
  - Operations at specific airports, and during specific procedures that an operator identifies as having a significant potential for unwanted and inappropriate RAs, e.g. closely spaced parallel runways, converging runways.

The flight crew should comply with the vertical speed limitations during the last 2 000 ft of a climb or descent. In particular the flight crew should limit vertical speeds to 1 500 ft/min during the last 2 000 ft of a climb or descent, especially when they are aware of traffic that is converging in altitude and intending to level off 1 000 ft above or below the flight crew's assigned altitude.

If a TA is generated:

- No evasive maneuver should be initiated on the basis of a TA only.

If a RA is generated:

- The flight crew must always follow the TCAS RA orders in the correct direction, even:
  - If the TCAS RA orders are in contradiction with 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.

| | |
|---|---|
| **CAUTION** | If a pilot does not follow a RA, he should be aware that the intruder may be TCAS equipped and may be maneuvering toward his aircraft in response to a coordinated RA. This could compromize safe separation. |

- The PF disconnects the AP, and smoothly and firmly follows the Vertical Speed Indicator (VSI) green sector within 5 s, 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 PM 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 PM 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.

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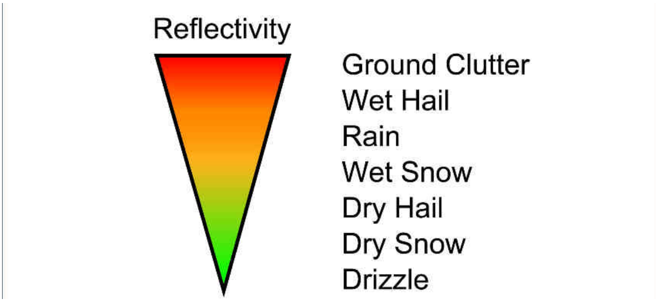
## GENERAL

Applicable to: ALL

The weather radar has two main functions:
- Weather detection
- Ground Mapping.

### WEATHER DETECTION

Weather detection is based on the reflectivity of the water droplets.
The intensity of the weather echo is linked 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).




The crew must be aware that 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).

### GROUND MAPPING

Ground mapping is the secondary function of the radar.
In MAP mode, the ND displays ground echoes in various colors depending on their altitude and intensity.

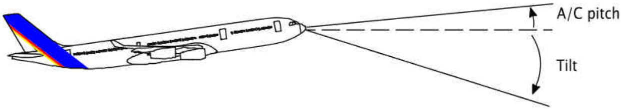
## WEATHER RADAR CONTROLS AND FUNCTIONS

Applicable to: ALL

The flight crew uses the following controls and functions to operate the radar

### TILT

Tilt refers to the angle between the antenna and the horizon.
The radar uses IRS data to stabilize its antenna. As a consequence, antenna tilt is independent from the aircraft's pitch and bank angles.




To ensure efficient weather monitoring, the flight crew must effectively manage the tilt, taking into account the flight phase and the ND range. Usually, the appropriate tilt value provides ground returns on the top of the ND.
At high altitude, a cell may have ice particles. Reflection of ice particles is weak. An incorrect tilt may lead to only scan the upper (less reflective) part of a cell. As a consequence, a cell may not be detected or may be underestimated.

## GAIN

The flight crew uses the GAIN knob to adjust the receiver for optimum sensitivity and to provide a better analysis of weather composition.
In standard operation, the flight crew should set the GAIN knob to AUTO.
It has two modes: AUTO and MANUAL. In AUTO the radar is calibrated to provide different colours based on specific rainfall rates. In MANUAL, gain is increased towards the MAX position and vice versa. Continuous use of Manual gain is not recommended as the radar colour presentation is not calibrated.

## DISPLAY MODES

The radar display modes are WX, WX/TURB and WAP. The radar system incorporates a Doppler Turbulence detection system that measures the variations in speed of droplets. If the measured speed variation exceeds the threshold of moderate to heavy turbulence, magenta is displayed within 40nm when the WX/TURB mode is used.
The WX/TURB mode is recommended when assessing or avoiding convective weather.

## PWS

The radar processor detects the Doppler frequency shift of returns from a microburst or windshear. As the radar scans across the windshear event, it will detect raindrops moving toward it at one range and away from it at a slightly greater range.
The difference in the range between the raindrops moving toward and away is the width of the base of the microburst or windshear. The severity of the event is measured by the speed of the relative movement of the droplets. If the severity of the windshear exceeds a preset threashold value, a predictive windshear alert is issued.
Refer to FCOM DSC-34-60-30 and SI-010 Windshear.

## WEATHER RADAR INTERPRETATION

**Applicable to: ALL**

Aircraft weather radars operate at higher frequencies. This helps provide:
- Improved reflectivity, which allows detection of smaller precipitive particles.
- Reduced beam width, which provides significant improvement in target resolution and definition. However, this makes selection of tilt and range control more critical.

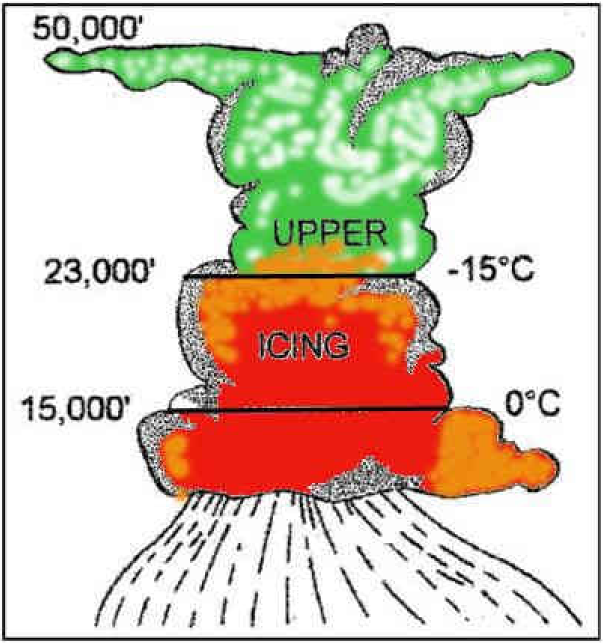
A disadvantage of the higher frequency is:
- Increased attenuation, which means the radar loses some ability to penetrate heavy precipitation.

### REFLECTIVITY

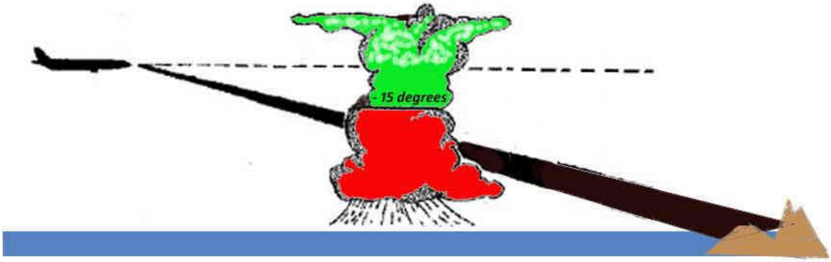
In order for a target to be displayed it must be radar reflective.

Storm cells have three sections:
- the upper level,
- the icing level, and
- the lower level.

The upper level is mostly moisture in a dry, frozen state and is basically non-reflective.
The icing level, which normally occurs from approximately 15 000 ft to 23 000 ft and ranges from 0 ° to –15 °, can be the most reflective area of the storm.
The lower level is from the surface to the icing level (typically around 15 000 ft), and as all the moisture is in a liquid state, this section of the storm is a good radar target.




Scanning a typical thunderstorm, as the radar antenna is tilted up, the return will tend to weaken and disappear as the water becomes ice and less reflective. The radar return will diminish rapidly at altitudes above the –15 ° level, but the threat to the aircraft does not! The top of the detectable precipitation may not be the top of the danger area or the top of the storm cell.
To find the best indication of storm intensity, the radar beam should be directed towards the bottom two sections of a storm; that is, where the temperature is warmer than -15 °. Directing the radar beam too high and receiving consequent poor returns from weather is termed 'over-scanning'. Over-scanning or setting the tilt too high is a common error which has resulted in aircraft damage and occupant injury.




## ATTENUATION

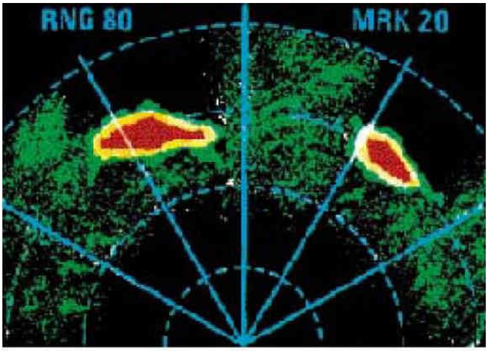
Attenuation means that, as a radar pulse is transmitted into the atmosphere, it is progressively absorbed and scattered and so becomes weaker the further it travels.

Weather radar is mostly affected by:

1. **Range attenuation:**
   The closer an aircraft is to a storm the less the attenuation. Hence, as the aircraft approaches a storm the image will rapidly amplify giving the appearance of a rapid intensification of a storm. This effect is counteracted by the Sensitivity Time Control (STC) function of the radar.

STC reduces image distortion and allows for a more accurate assessment of weather at short ranges.

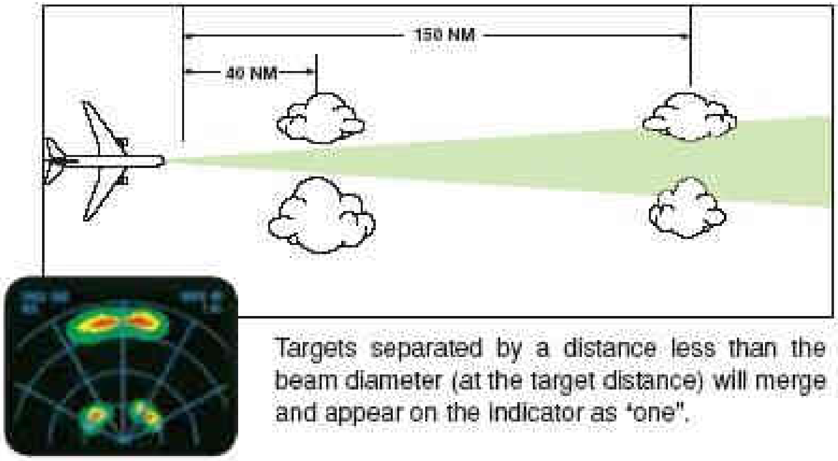
2. **Precipitation attenuation:**
   Rain absorbs and weakens return echoes and can prevent detection of the depth of the primary target or other weather behind.
   Characteristics of an attenuated display can include a bowing out of the backside of a storm cell (crescent shape with convex edge towards the aircraft), steep rain gradients at the rear of the cell, or a shadow behind a dense storm.




SHADOWED AREAS

## AZIMUTH RESOLUTION

The radar is unable to distinguish between two targets at the same range which are separated by less than a beam-width in azimuth. Consequently, as the range to target decreases, the beam width at their location becomes smaller than the distance between the targets and they will change from one return into two separate returns. This may give the impression that a solid band of weather across track has begun to split up into separate cells.

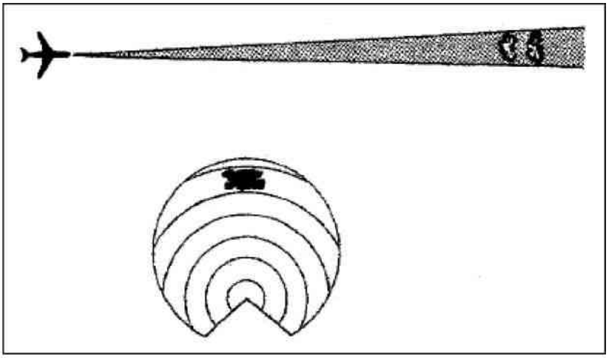



Targets separated by a distance less than the beam diameter (at the target distance) will merge and appear on the Indicator as "one".

## RANGE RESOLUTION

At higher display range settings, the radar energy pulse is approximately 1.5 nm long. Therefore, to be seen as two targets, two cells must be separated by greater than 1.5 nm in range.

At lower display range settings, the pulse is about 1 nm long. Thus two targets closer than 1 nm will appear as a single return.

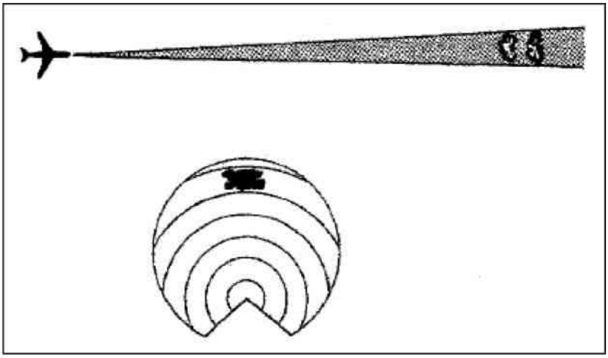


RANGE RESOLUTION

## DISPLAY INTERPRETATION

To make a sound interpretation of the displayed targets, pilots must combine their knowledge of radar and its limitations with the prevailing weather pattern, the geographic location and personal experience. Radar interpretation is very subjective. It is an art developed by proper training and frequent exposure.
The images on a radar screen are electronic pictures of rainfall patterns. Since radar does not directly detect turbulence, pilots must recognise the presence of rough air by correlating it with

rain. The radar Turbulence Mode assists pilots by using Doppler to detect the movement of moisture and to display that movement as turbulence if it exceeds a present threashold.



RANGE RESOLUTION

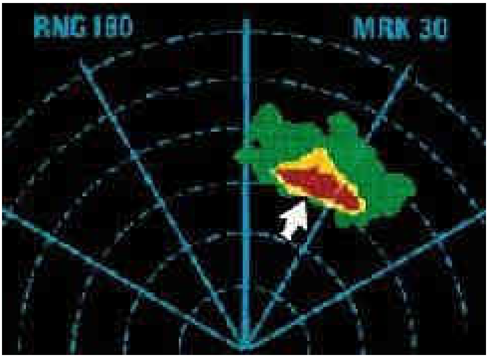
## COLOURS IN AUTO GAIN:

Modern digital radar displays show different levels of precipitation as different colours and, as long as the Gain control is in the 'AUTO' position, the colours can be correlated to the following table:

| RADAR DISPLAY and THUNDERSTORM LEVEL VERSUS RAINFALL RATE | | | | | |
|---|---|---|---|---|---|
| **DISPLAY LEVEL** | | **RAINFALL RATE (mm/hour)** | **STORM CATEGORY** | **MAPPING** | **GENERAL REMARKS (varies with altitude and radar tilt management)** |
| RED | 3 | >12 | Strong and above (3 - 6) | Cities and mountains | Strong returns with heavy rainfall. Severe turbulence, large hail and lightning possible. |
| YELLOW | 2 | 4 - 12 | Moderate (2) | Cities and mountains | Medium returns with less severe but still heavy rainfall. Moderate to severe turbulence, hail and lightning possible. |
| GREEN | 1 | 0.7 - 4 | Weak (1) | Ground | The weakest return, however, moderate rainfall possible. **Light to moderate turbulence** and lightning possible. No real hail threat. Wide areas are considered as precipitation without severe turbulence. |
| BLACK | 0 | <0.7 | - | Calm water or Radar Shadow | Very light or no returns. |
| MAGENTA (1) | - | No relationship | Not defined | Not used | Indicates **moderate to severe turbulence** based on doppler shift measurements. It can be associated with targets with no reflectivity display as well as returns displayed as green, yellow, or red. |

*Note: (1) Not affected by the position of the Gain control.*

When WX/TURB is selected, Magenta indicates moderate to severe turbulence within 40 nm. Steep contour gradients, that is, thin lines of colour, indicate the areas of greatest turbulence. Any storm return showing red contours or all levels of precipitation should be assumed to contain turbulence, even in the green areas.

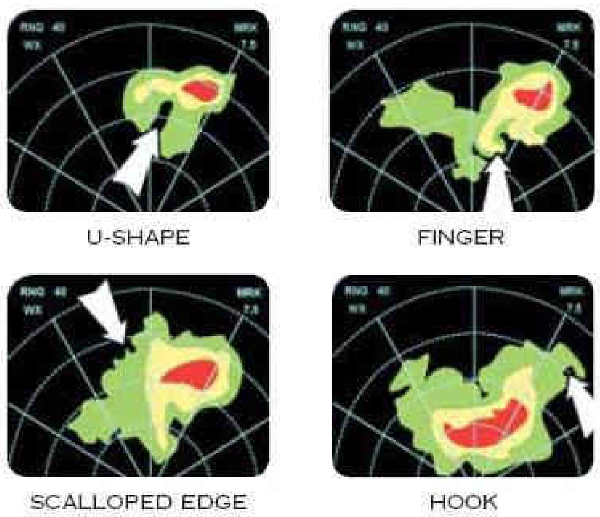



**SHAPE:**

Severe turbulence and hail activity may be indicated by irregularities in the radar returns such as:

- Fingers
- Hooks
- Scalloped edges
- U-shaped (horseshoe)
- Figure 6 formations

- Protrusions associated with large storms (diameters greater than 15 nm).
- Irregular shapes which are green in colour



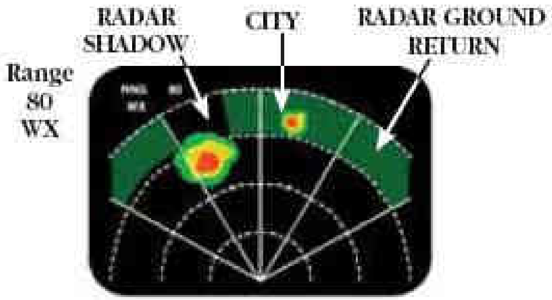

WEATHER SHAPES INDICATING HAIL ACTIVITY

The shape of a return can indicate turbulence and hail regardless of the displayed colour. Colour is dependent on reflectivity (rainfall rates).

**GROUND, CITY OR WEATHER:**

Progressive upward adjustment of the TILT control will change the shape, size and colour of ground returns and eventually cause them to disappear while weather returns will initially remain

relatively unchanged. Further adjustment will result in the weather return diminishing as the radar beam begins to over-scan the reflective precipitation.
Thunderstorms and mountains may cast radar shadows but cities do not.



## RECOMMENDATIONS FOR WEATHER DETECTION

Criteria: SA
**Applicable to: ALL 321, B-HSD, B-HSE, B-HSG, B-HSI, B-HSJ, B-HSK, B-HSL, B-HSM, B-HSN, B-HSO, B-HSP**

1

**Proper tilt and ND range, management are the key elements for effective weather radar operation:**

- First, the flight crew has to choose the ND range, depending on FL and detection requirement (long distance/short distance)
- Then, the flight crew adjusts tilt to maintain ground returns on top of the ND (except during takeoff, climb and approach).
- The following table provides a summary for the tilt and range management, a more detailed description is provided under Operational Recommendations.

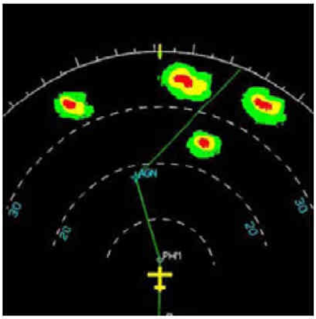
| Flight Phase | Detection and Monitoring | Comments |
|---|---|---|
| **TAXI** | Clear on parking area, set ND to lowest range. Tilt down then up. Check appearance/disappearance of ground returns. | Antenna tilt check (away from people) |
| **TAKEOFF** | If weather activity is suspected: slowly scan up to detect weather (Max 15 °up), otherwise: set tilt to 4 ° up | Enables to scan along the departure path |
| **CLIMB** | Adjust the ND range as required and decrease the tilt angle as the aircraft climbs | Avoids over scanning of weather |
| **LEVEL FLIGHT/CRUISE** | Depending on FL and detection requirement, adjust ND range.<br>Maintain the ground return on the top of the ND<br>Regularly scan the weather vertically by modifying the tilt<br>Once the scan is done, adjust the ground return back on the top of the ND. | In cruise, for efficient weather awareness, the following ranges can be selected:<br>- 160 nm for tactical decision making<br>- 40 nm/80 nm for effective weather detection.<br>Shorter ranges can be used to track/avoid closing weather. |
| **DESCENT** | During descent, tilt upward to maintain the ground return on the top of the ND. | - |
| **APPROACH** | Tilt 4 ° up | Avoids ground return |

<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.*

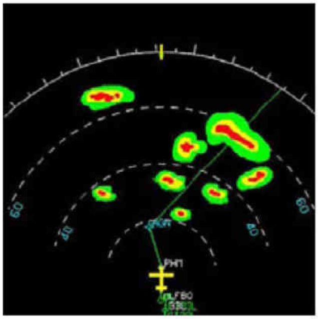
### RANGE MANAGEMENT

The flight crew should monitor the weather at long range, as well as at shorter ranges, in order to be able to efficiently plan course changes, and to avoid the blind alley effect.

Blind Alley Effect



ND Range = 40 NM



ND Range = 80 NM

The 160 nm ND range is primarily used for tactical decision making when multiple cell systems are present. The 40 nm and 80 nm ND ranges are primarily used for effective weather detection. In tropical regions rapidly growing narrow columnar towering cumulus or cumulonimbus clouds may not be readily visible on the 80 nm ND range, requiring regular checking using the 40 nm ND range. The flight crew should coordinate their use of ND ranges to ensure a variety of ranges are monitored, appropriate to the environment in which the aircraft is flying.

## TURBULENCE DETECTION

- The turbulence display is most effective when the ND is set on 40 nm (corresponds to the maximum turbulence detection range).
- **Closely spaced (or thin lines between) color gradations are usually associated with severe turbulence.**

# OPERATIONAL RECOMMENDATIONS FOR WEATHER DETECTION

Criteria: P7929, SA
**Applicable to: B-HSQ, B-HSR, B-HST, B-HSU**

| Flight Phase | Detection and Monitoring Procedure | Comments |
|---|---|---|
| **TAXI** | Clear on parking area, set ND to lowest range, Tilt down then up.<br>Check appearance/disappearance of ground returns. | Antenna tilt check (away from people) |
| **TAKEOFF** | If weather activity is suspected: slowly scan up to detect weather (Max 15 ° up) then select AUTO again. | Enables to scan along the departure path |
| **IN FLIGHT** | TILT sw on AUTO<br>GAIN knob on AUTO<br>Use TURB to isolate turbulence | Manual TILT and GAIN for weather analysis done.<br>In cruise, for efficient weather awareness, the following ranges can be selected:<br>- 160 nm on the PNF ND<br>- 80 nm on the PF ND.<br>Shorter ranges can be used to track/avoid closing weather. |

Note: *1. On Collins MULTISCAN radar, 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, to check correct radar operation, the flight crew can use temporarily manual tilt.*

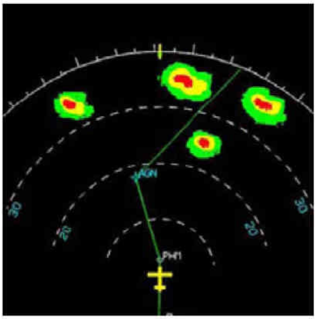
*2. On Honeywell Auto-Tilt radar, AUTO mode adjusts the tilt to get a minimum ground return on ND.*

*3. The flight crew monitors weather radar display in automatic tilt mode, and confirms any ambiguous or unexpected weather display using manual tilt according to standard techniques.*

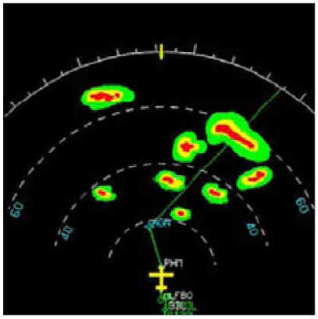
## RANGE MANAGEMENT

The flight crew should monitor the weather at long range, as well as at shorter ranges, in order to be able to efficiently plan course changes, and to avoid the blind alley effect.

Blind Alley Effect



ND Range = 40 NM



ND Range = 80 NM

## TURBULENCE DETECTION

- The turbulence display is most effective when the ND is set on 40 nm (corresponds to the maximum turbulence detection range).
- Closely spaced (or thin lines between) color gradations are usually associated with severe turbulence.

# WEATHER DATA ANALYSIS

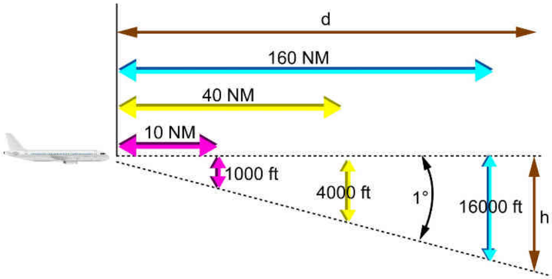
**Applicable to: ALL**

## EVALUATION OF CELL VERTICAL EXPANSION

When flying towards a cell, the flight crew can get an estimate of the vertical expansion of the cloud above/below the aircraft altitude with the following formula:

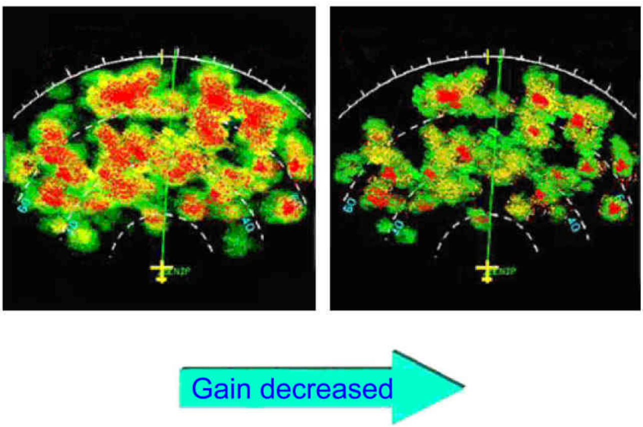
$$h(ft) \simeq d(NM) \times Tilt(\,^\circ\,) \times 100$$

Tilt represents the tilt selected so that the cell image disappears from the display.
For example, an echo disappearing at 40 nm with 1 ° tilt down has a top located 4 000 ft below the aircraft altitude.
The flight crew can increase the gain to make the frozen (less reflective) storms top more visible.




## SATURATED WEATHER RETURN

To assess the general weather conditions the flight crew may use manual gain. 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 storm cells. To recover optimum radar sensitivity once the cell assessment is done, the flight crew must reset the GAIN knob to AUTO.



## OPERATIONAL RECOMMENDATIONS

Applicable to: ALL

### WEATHER AVOIDANCE, ATC AND THUNDERSTORMS

- When deviating around enroute weather, be aware of the width of the airway and of its proximity to others.
- In the terminal area request headings from ATC rather than miles left or right of track. Generally, tell ATC what can be done, not what can't.
- When taking avoidance action continuously update the information on the entire situation; don't become focused on a particular target at close range.
- If possible avoid the downwind side of thunderstorms. Although the anvil does not appear on the radar due to poor reflectivity, the turbulence in this area is usually more intense.
- Remember the wind at the aircraft's current flight level might be different from that steering the thunderstorm. A thunderstorm will usually move in the direction of the mean wind between 5 000 ft and 30 000 ft.
- Thunderstorms build and dissipate rapidly, therefore do not attempt to plan a course between closely spaced echoes or try to climb/fly over cells.
- Don't attempt to fly in the clear air under a tilted thunderstorm or between thunderstorms that slant towards each other.
- At night, dimming flight deck lighting may allow visual identification of storms. However, the threat of temporary blindness from lightning flashes should be considered.
- Note that turbulence within a storm may not decrease with altitude and may be present with associated hail at all levels, even in the clear areas above and downwind of the cell.

### GENERAL

In order of priority, aircraft weather radar usage should be focussed on:
1. Avoiding potentially hazardous weather, and
2. Providing a comfortable journey for our passengers.

Crews should have a disciplined approach to radar handling and weather detection, particularly in IMC or at night.

### CREATING A PROTECTION ZONE

The aim is to establish a zone in front of the aircraft where no undetected weather exists and where none can subsequently intrude without being detected. A protection zone should be established and continuously maintained on every flight.
If crews cannot visually establish a protection zone, the radar tilt must be used as outlined below. On departure this should be achieved when passing approximately 20 000 ft. In the cruise, after a significant heading change, the protection zone must be re-established.

Even after the establishment of a protection zone, tilt must be actively used to evaluate weather once it has entered the zone. When an evaluation is complete, re-establish the protection zone.

When IMC or at night, use the following tilt management to create a protection zone:
1. Select the 40 nm range on the ND and set the antenna tilt control to at least –10 ° to ensure that a strong ground return (displayed as a multi-coloured stripe) is shown. This guarantees that targets in closer proximity are not being over-scanned.
2. Whilst observing for weather targets, gradually tilt the antenna up and move the ground stripe to the outer edge of the ND. The radar scans from one side to the other in around 4 s, so make the tilt adjustment slowly.
3. With the ground stripe at the outer edge of the 40 nm scale, select the 80 nm range and once again slowly tilt the antenna up to move the ground stripe out to the outer edge of the display.
4. Tilt should then remain so that solid ground returns remain visible at 80 nm or closer. **Never look at a black screen!**

When a storm cell or significant weather is observed entering the radar protection zone:
1. Consider using the Turbulence Mode if not already selected.
2. Calculate the time to the target. This will assist if the target later disappears from the display at short range.
3. Use radar tilt to ensure the beam examines the lower most reflective areas of the weather.
4. Assess the severity of the weather. Review colour, gradient, shape and change.
5. Assess the weather visually if possible.
6. Take avoidance action before the target is inside 40 nm.
7. If a target should disappear from the display at short range, avoidance action should be taken using last known position.
8. If targets become weak at short range, use of increased gain may overcome low reflectivity helping to retain a useful picture for avoidance action.

## AVOIDANCE DISTANCES

Any storm producing intense echoes should be avoided by at least 20 nm and two should be separated by at least 40 nm before attempting to fly between them. Prime indicators of severe turbulence and hail such as steep colour gradients and sharp edged or irregular shape cells (even the green returns) should be avoided by at least 20 nm.
Avoid thunderstorms laterally. Do not plan to over-fly cells as vertical development of thunderstorms may exceed aircraft climb performance.
When operating at normal cruise levels all cells which remain displayed inside 40 nm with normal tilt settings (-2 ° to -3 ° down), regardless of colour, should be avoided by at least 20 nm.
Magenta areas (TURB mode) should be avoided by similar distances – approximately 20 nm.
Cells exceeding 35 000 ft should be considered extremely hazardous and additional separation (in addition to the 20 nm) should be used.

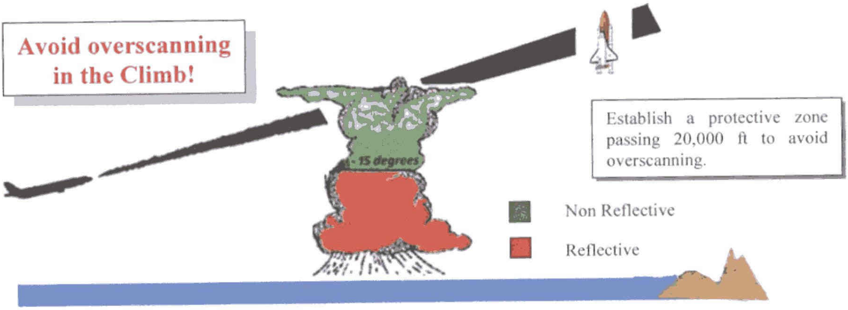
Hail may fall several miles from the nearest visible cloud and hazardous turbulence may extend to as much as 20 nm from the echo edge.
Tracking downwind of storms should normally be avoided but, if it appears to be the best option, turbulence can be expected 1 nm downwind for each 1 KT of wind at the current altitude! When assessing avoidance, remember, wind speed and direction can change significantly around active storm cells.

## RANGE MANAGEMENT

Priorities must be balanced between the requirement for ND information, such as waypoint display, and the need for an accurate weather picture. In IMC or at night, at least one ND should have a range suitable for early weather detection appropriate to the environment in which the aircraft is flying.
Shorter range displays (40 nm or less), WX/TURB mode and active tilt management should be used to evaluate weather as the range to target decreases.

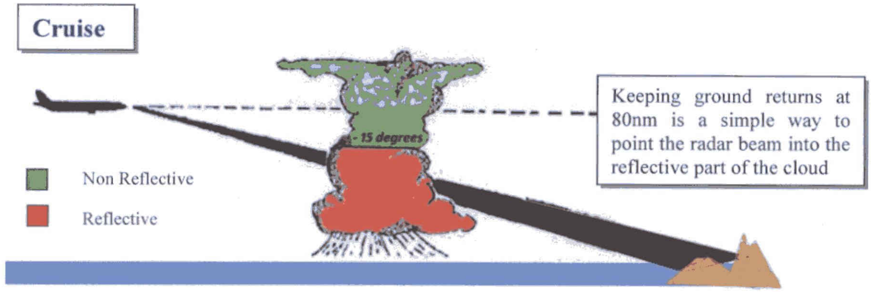
## TAKE OFF AND CLIMB

1. Pre-flight setup, refer to FCOM PRO-NOR-SOP-06.
2. For takeoff, a setting of +4 ° tilt should be used as this will display the most significant terminal area weather whilst reducing ground clutter.
3. Before takeoff, the tilt may be used to scan up to check the terminal area conditions but then it should be set back to +4 °.
4. During the initial climb to approximately 20 000 ft, reduce the tilt setting by about 1 ° for every 5 000 ft.
5. As altitude increases, tilt must be decreased to avoid over-scanning reflective precipitation. A useful approximation above 20 000 ft is to reduce the tilt setting by approcimately 1 ° for every 10 000 ft. At 40 000 ft a tilt setting of approximately -2 ° is required to maintain **ground returns** at 80 nm.
6. At approximately 20 000 ft a Protection Zone should be created and maintained. **To prevent over-scanning, ground returns should be maintained at 80 nm or less.** If a course change of 45 ° or more is required, the Protection Zone should be re-established.




## CRUISE

Continue to maintain the protection zone once in the cruise.
In IMC or at night, crews should ensure that at least one display is monitored in 40 nm or 80 nm for initial weather detection. Ranges greater than 160 nm are inappropriate for weather detection. The 80 nm range is recommended for timely avoidance planning. 40 nm or less should be used to provide enough detail to evaluate individual cells.
At normal cruise altitudes, the flight path is well above the most reflective part of a storm. **Make sure tilt and range are set so that storm cells are not over scanned and have solid ground returns at 80 nm or less.**

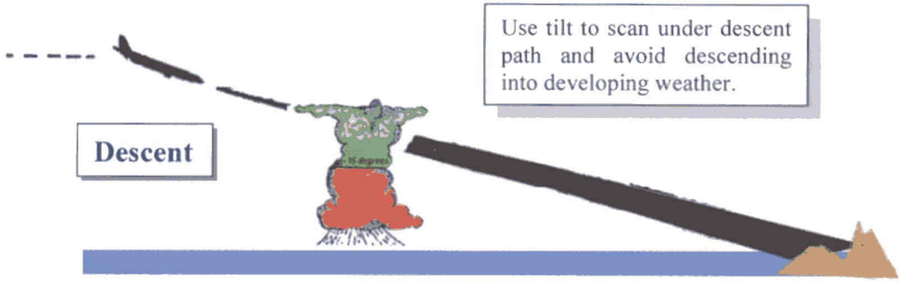



## DESCENT AND APPROACH

Assess the terminal area weather as soon as possible. An early decision on weather avoidance may help to avoid problems associated with precipitation attenuation or a saturated radar display from low level heavy rain.
Approaching the weather, shorter ranges should be used to improve the target resolution.

Tilt technique:

1. A short time before top of descent re-evaluate the protection zone for weather in and underneath the descent path.
2. If weather is present then tilt management should be used actively to assess severity throughout the descent.




3. During the initial descent, tilt will need to be reduced but **ground returns should be maintained at 80 nm or less.**
4. Below 15 000 ft, tilt may be increased to reduce ground clutter, but be careful to avoid overscanning any significant weather.
5. If flying towards mountainous areas or cities with strong returns it may be necessary to reduce the tilt to reduce ground clutter.
6. In the latter stages of the approach, a tilt setting of +2 ° to +4 ° will provide optimum target detection up to 40 nm whilst reducing excessive ground returns and the need for frequent tilt adjustment.

If the display has become saturated in heavy rain, reducing the gain may allow detection of stronger returns. This can be useful for locating embedded cells in the terminal area.

## GENERAL OPERATIONAL POINTS

- When the radar detects a weather target near its maximum range it should be considered as a severe storm.
- If the tilt is set too high you may be over-scanning the reflective part of the storm. Over-scanning or setting the tilt too high is a common error which has resulted in aircraft damage and occupant injury. Solid ground returns should be maintained at 80 nm or less when above 20 000 ft to avoid over-scanning.
- The antenna tilt should be adjusted regularly during climb and descent and each time the aircraft altitude is changed significantly; use ground returns as an aid.
- The radar returns from the lower most reflective levels of the thunderstorm should be assessed to predict the threat from the non-reflective levels above.
- At normal cruise altitudes larger tilt angles are required to paint cells inside of 40 nm due to the reduced reflectivity above the icing level.
- Returns on the radar display which transition rapidly from strong to weak within a few miles range may be heavy rain; the storm may appear shallow because heavy rain has attenuated the radar return.
- Never presume that an area directly behind heavy rainfall is clear; avoid penetrating shadowed areas.

## STORM 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 SI-010 Turbulence.

## MAPPING

The flight crew can use the MAP function to detect prominent terrain (mountain, city, and coastline).

The MAP function displays ground returns as follows:
- Black: water
- Green: ground
- Yellow and red: mountains and cities.

However, the flight crew must not use the weather radar as a terrain avoidance system.

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## C-TWO BRIEFING PROCEDURE

**Applicable to: ALL**

The briefing should be a thought provoking and relevant discussion.

Prior to commencing the briefing:
- The PF shall set up the aircraft and FM for the departure or arrival. All relevant data (such as ATIS, NOTAMs, Port Pages and Charts, etc) shall be reviewed.
- The PM shall cross-check the FM and review all relevant the data. Both pilots must cross-check the FM routing against the CFP and the relevant published procedures.

The briefing should take place once the set up and cross-check of the FM is complete. For departure briefings, there is no requirement to wait for the load-sheet or take-off data to be entered into the FM.

The following actions shall be completed before the briefing commences:
- FCOM procedures are complete (with the possible exception of load-sheet and/or take-off data entry as mentioned above).
- Navigation aids set-up is complete (modifications to radio aid selections may be required after an arrival briefing).
- Any PM questions about the set-up have been addressed (this can be achieved at the time or during the briefing).

"Are you ready for the briefing?" is typically the question that commences the briefing process.
A positive answer from the PM means that all required actions have been completed and checked and that any anomalies have been addressed.

*Note:* *Reference to FM includes FMGS or FMS.*

## C-TWO ACRONYM

**Applicable to: ALL**

Briefings will consist of five modules covered by the acronym 'C-TWO Plus':
- Chart
- Terrain
- Weather
- Operational
- Plus threats

Each module shall be discussed in every briefing.
The 'C' module identifies the procedure to be flown. The detail of the published procedure should have been 'self-briefed' during data entry and cross-checking. Therefore, the PF should consider experience, recency and training requirements when deciding how much to mention in this module.
The 'TWO' modules will consist of details that the PF considers relevant to the departure/arrival.
Incorporate briefing points that generate thought and awareness. Additional procedures should be

reviewed in unusual circumstances; for example, RTO with a thrust-reverser locked out, engine inoperative considerations when engine inoperative, missed approach considerations when there is an increased chance of a missed approach.
Every Departure and Arrival must be viewed in the context of THREATS, and STRATEGIES to overcome them.
The 'Plus' module will consist of relevant threats not previously covered during the brief. Identify specific threats and discuss strategies to deal with them. For example, track shortening onto 07L in HKG with an arrival through SIERRA could be a threat; proactive configuration management may be the strategy.
The PF should decide what is briefed in each module. The Commander shall ensure that all relevant details are adequately covered.
At the start of the briefing, the PF shall display the Airbus F-Plan page on the FM.
The PF commences the briefing by reading the RWY/SID/Departure Transition, or STAR/Type of Approach/RWY from the FM.
At all times, upon receipt of an ATC route clearance, it shall be cross checked against the FM route by the PF and PM.
For the remainder of the briefing, there is no further requirement to check the Legs/Flight Plan page as this should have been independently done at the pre-briefing stage by both pilots.
The PF shall call out the chart IDs of the required charts. The PM should check he is using the same charts.

## BRIEFING AIDE MEMOIRE

**Applicable to: ALL**

Flight Crew will be issued with a pocket size briefing card to assist with the briefing. This card shows the minimum briefing items required.

| FLIGHT CREW BRIEFING CARD |
|---|
| Arrival Briefing |
| **Chart** |
| From FM; Name of STAR, Type of App / RWY<br>From Chart; Chart ID's<br>Final profile altitude check<br>DA/DH/MDA<br>RVR / Visibility if limiting<br>Missed Approach initial actions<br>(i.e. Tracking and Altitude)<br>Navigation Aids for approach and go-around |
| **Terrain** |
| Relevant Terrain |
| Relevant Sector MSA |
| **Weather** |
| Relevant weather |
| **Operational** |
| Relevant operational considerations<br>Alternate<br>Relevant Fuel |
| **Threats** |
| Any other Relevant Threats? |

| Departure Briefing |
|---|
| **Chart** |
| From FM; Runway, Name of SID / Dep / Trans<br>From Chart; Chart ID's |
| **Terrain** |
| Relevant Terrain |
| Relevant Sector MSA |
| **Weather** |
| Relevant weather |
| **Operational** |
| Relevant operational considerations |
| **Threats** |
| Any other Relevant Threats? |
| Prior to briefing for departure and arrival<br>• Has the FM setup been checked against published procedures and CFP by PF and PM?<br>• Is the crew familiar with the airport?<br>• Is the crew familiar with the terrain?<br>• Does the weather pose a threat? |

## EXPANDED 'C-TWO PLUS' BRIEFING ITEMS

**Applicable to: ALL**

Items to be included in the 'C-TWO Plus' modules will differ for each flight. The required briefing items are shown on the Flight Crew Briefing Card. These and some suggested additional items are also listed below. This list is not exhaustive. Crews should identify and brief relevant, useful information.

## CHART

- RWY/SID/Departure Transition is read from the MCDU followed by the page number (mention RNAV if applicable).
- STAR/Type of Approach/RWY is read from the MCDU followed by the page numbers (mention RNAV if applicable).
- Final profile altitude check.
- DA/DH/MDA.
- RVR/visibility if limiting.
- Airfield elevation if 100 ft or greater (consider stabilised approach criteria).
- Missed approach initial actions; include track, altitude and, if applicable, speed.
- Navigation Aids for the approach and go-around (mention if one nav aid will be auto tuned).
- Metric/QFE usage.

## TERRAIN

Discuss relevant terrain. All crew members should have a clear mental model of the terrain in the vicinity of:

- The SID.
- The departure track.
- The descent track.
- The arrival procedure/potential vectoring.
- The approach.
- The missed approach.

If relevant terrain is not familiar to all crew, use information available, including:

- Enroute charts.
- Highest CFP MRA to TOC, or from TOD.
- Area charts or approach charts.
- Other runway approach charts if terrain more detailed.
- Relevant MSA.
- Minimum Vectoring Altitude Chart, if available.

## WEATHER

Discuss any weather conditions that may affect the arrival/departure including the following:

- Typhoons.
- Thunderstorms.
- Windshear.
- Turbulence.
- Wind/crosswind.
- Rain/runway contamination.
- Reduced visibility.

- Low cloud base.
- Use of wipers/rain repellent.
- Icing.
- Cold weather altimetry.
- Low visibility procedures.

## OPERATIONAL

Relevant considerations may be covered in point form or they may be covered by a question to determine familiarity, such as "There is a speed restriction and an engine out procedure, are you familiar with those procedures?"

Ensure familiarity with any relevant issues that may affect the arrival/departure including:

- NOTAMs.
- Port Page/chart warnings.
- De-icing/anti-ice requirements and holdover times.
- Runway conditions, if contaminated.
- Speed control.
- Configuration.
- Noise abatement requirements.
- Engine inoperative procedures on departure only.
- Engine inoperative procedures on arrival, if engine is inoperative.
- Low Visibility Procedures.
- Use of AP.
- Use of A/THR.
- Flight mode selection.
- Non-normal procedures.
- Crew duties.
- Holding.
- Landing weight.
- Autobrake/braking/exit strategy.
- Taxying requirements.
- Diversion plan and requirements.
- Extra fuel available.
- Low Transition Levels.

**PLUS**

Consider any threats not previously identified and discuss strategies to deal with them. Threats may include:

- ATC
  - Communications,
  - Tracking,
  - Procedural control,
  - Traffic density.
- Missed approach vital actions, if there is a high probability of a missed approach.
- Port Page information on FDAP occurrences.
- MEL items requiring crew action.
- Airport category.
- Autoland restrictions.
- Non-ILS appproaches
  - Vertical profile monitoring.
- Navaid Location.
- Offset localiser.
- Runway characteristics.
- Parallel runways.
- Runway change (only brief the relevant changes).
- Runway lighting.
- Night.
- Crew
  - Airport familiarity,
  - Experience levels,
  - FDP considerations,
  - Training flights,
  - Augmented crew,
  - Cabin preparation.
- And other appropriate threats.

## EXAMPLE BRIEFINGS

Applicable to: ALL

1 **DEPARTURE**

### HKG 25L CAVOK

- RWY 25L, BEKOL 2B, Chart 30-12. This is an RNAV departure.
- Significant terrain is out to our left, the relevant MSA is 4 300 ft.
- Weather, nil significant.
- Operationally, there is a speed restriction of 230 kt until established on track to RUMSY. We are required to cross BEKOL above FL157.
- Plus (additional threats are... ), there is a very short taxy. The SP is briefed.
  Any questions?

### HKG 07R CAVOK, AUTOTHRUST INOP

- RWY 07R, OCEAN 2A, Chart 30-10. This is an RNAV departure.
- Significant terrain to the right of the initial departure track, the relevant MSA is 4 300 ft.
- Weather, nil significant.
- Operationally, there is a speed restriction of 220 kt until passing PORPA. Autothrust is INOP requiring manual thrust (discuss), there is an engine out procedure off this runway; are you familiar with this?
- Any questions?

### TPE 23L CAVOK

- RWY 23L, AGENT 1M, Chart 30-1. Airfield elevation is 106 ft. This is an RNAV departure.
- Significant terrain well left of track and once in the right turn the departure is over water where the relevant MSA is 8 900 ft. Lower MSAs are published on chart 50–3.
- No weather considerations.
- Nil operational.
- Plus (additional threats are... ). ATC traffic density, possibly military traffic. There is a short taxy. The FA1 is briefed.
- Any questions?

### TPE 23L, CBS TO WEST, REVERSER INOP, WIP TAXIWAY EC

- RWY 23L, AGENT 1M, Chart 30-1. Airfield elevation is 106 ft. This is an RNAV departure.
- Significant terrain well left of track but once in the right turn the departure is over water where the relevant MSA is 8 900 ft. Lower MSAs are published on chart 50–3.
- Weather avoidance may be required on departure so both on WXR. Cabin crew will not be released until clear of weather.

- Operationally, EC is closed, expect to taxy via S6. We have engine reverser No.1 INOP; in the event of a rejected take off I will...
- Plus (additional threats are... ). ATC traffic density, possibly military traffic. There is a short taxy. The SP is briefed.
- Any questions?

## 2 ARRIVAL

### HKG, 07L, CAVOK

- SIKOU 4A arrival to ILS 07L, Charts 10-2W and 11-1. Check altitude of 1 290 ft at 4.0 DME IZSL, minimum 222 ft set (confirmed by PM), missed approach is initially runway heading, 5 000 ft, max speed is 230 kt. Navaids IZSL 111.1 inbound course 073, NLG, and SMT, LKC will be tuned later.
- There is significant terrain to the right of the final approach and missed approach tracks.
- The relevant MSA is 4 300 ft.
- Weather is not a factor.
- Nil operational.
- Macau fuel is 5.2 tonnes. We will arrive with 7.5 tonnes; therefore _____ minutes holding is available.
- Plus (additional threats are), coming from HKT at this time of night there could be significant track shortening. therefore early descent may be advisable.
  Any questions?

### HKG, 07L, THUNDERSTORMS AND MODERATE RAIN, VISIBILITY 2 000 M

- ELATO 5A arrival to ILS 07L, Charts 40-5 and 50-1. Check altitude of 1 290 ft at 4.0 DME IZSL, minimum 222 ft set (confirmed by PM), missed approach is initially runway heading, 5 000 ft, max speed is 230 kt. Navaids IZSL 111.1 inbound course 073, NLG, and SMT, LKC will be tuned later.
- We may be vectored over Lantau and there is significant terrain to the right of the final approach and missed approach tracks.
- The relevant MSA is 4 300 ft.
- Weather avoidance and possible windshear/ turbulence (discuss avoidance/recovery strategy).
- Operationally, this will be an automatic landing. We may need wipers on finals. In the event of a missed approach I will select TOGA…(discuss all MAP considerations). After landing I will be using max reverse.
- Shenzhen fuel is 6.2 tonnes. We will arrive with 9.5 tonnes; therefore ____ minutes holding is available.
- Plus (additional threats are... ), with all the weather around, I will get the cabin secured early.
- Any questions?

**TPE 05L, LVP IN FORCE, RVR 350 M**

- TONGA 1A RNAV arrival, Cat 2 ILS 05L, Charts 40-2 and 50-1, check altitude at 4.2DME ITIA of 1 430 ft, DH 108 ft (confirmed by PM), RVR required is touchdown 350 m, midpoint 150 m. Navaids ITIA, 111.1 inbound course 053. I will use APU and TIA.
  The relevant MSA for the approach is 2 500 ft, but rises to 8 800 ft.
  Weather (discuss).
- LVPs in force (discuss).
- Multiple speed control requirements are in force (discuss).
- In the event of a go-around I will..... (discuss all MAP considerations). KHH fuel is 10.3 tonnes. We will arrive with 12.7 tonnes; therefore _____ minutes holding is available.
- After touchdown, anticipated taxi via......
- Plus (additional threats are... ), strong tailwinds during descent, but expect rapid change to headwind during approach, therefore I will configure early and intercept the LOC with Flap 2 at F speed.
- Any questions?

**KMG 22, CAVOK.**

- LXI 1Z RNAV arrival, ILS 22, Charts 40-7 and 50-7, check altitude of 9 850 ft at 9.3 DME IKM, minimum 7 080 ft set (confirmed by PM), missed approach is initially runway heading, 2 700 m (8 900 ft) and expect higher from ATC. Navaids IKM, 108.5 inbound course 219. I will use XFA and XSJ on the VORs.
  The relevant MSA for the approach is 11 500 ft, with significant terrain in the vicinity of the airport.
- Weather is not a factor.
- Operationally, high airport elevation 6 903 ft, (discuss stabilised approach).
- Maximum speed during the base turn is 205 kt given the high TAS, I will configure early and intercept the LOC with Flap 2 at F speed.
- Plus (additional threats are... ) LOC is unusable beyond 30 ° either side of the front course. This is a known high FDAP event port caused by late configuration, therefore I will monitor configuration versus altitude and watch the DME to touchdown and Rad Alt. On descent, we will alert the cabin for landing at FL250 and FL150.
- Any questions?

## FLAP RETRACTION BRIEFING

**Applicable to: ALL**

After entering the takeoff performance data in the MCDU the PF shall brief the flap retraction strategy, including flap auto-retraction, when applicable. Operational issues such as close-in turns, speed restrictions, altitude/climb requirements and noise abatement must be considered.

An example of the flap retraction briefing follows:

- **A321, HKG07R, Config 1, Takeoff weight –** 86 000 kgs
  “Flap retraction brief – this will be a Flap 1 takeoff with an initial target speed on departure of 220 kts, GD is 239 kts.
  Passing the acceleration altitude I will let the flaps auto retract at 210 kts, once established on the track to RAMEN I will push for managed speed and then call for flap zero."

These are example briefings. There is absolutely no premium in learning them verbatim and then reciting them without thought to the actual operation.
The objective is for the PF to identify the restrictions affecting the flap retraction. The brief should be varied as circumstances dictate to ensure both pilots know, precisely, the sequence of the flap retraction procedure for the departure.

# PFD/FMA CHANGES TO BE CALLED

**Applicable to: ALL**

All changes on the FMA are to be called by the PF and cross-checked by the PM unless otherwise specified. The colour of armed lateral and vertical modes shall be included in the PF call. A/THR blue does not used to be called, however, failure of this mode to arm on takeoff or go-around should be called.
If any change has not been called, then the PM shall call the change. There is no competition to see who can be the first to call these changes; PM should allow reasonable time for the PF to call and not pre-empt him with every change.

The result of any action on the FCU shall be checked on the PFD/FMA, and any target changes are to be confirmed on the PFD/FMA and ND as appropriate. To achieve this, the PF shall call from the PFD, and the PM shall cross-check:

- All altitude/level targets. Any metric-to-feet conversion is to be completed independently by each pilot, set on the FCU, and the target called in both metric and feet.
- When a magenta database constraint is displayed on the PFD, the actual cleared altitude should be read from the FCU in addition to the magneta value on the FMA.
- Heading and speed targets (heading targets used to avoid weather need not be called).
- Initial VS/FPA targets (minor adjustments from the initial target need not be called).

FMA modes/targets are normally read from left to right across the FMA.
The effect on the flight path shall be monitored using raw data.
Examples of standard calls are shown below to demonstrate how FMA changes should be announced. (B) = Blue, (G) = Green and (W) = White.

## TAKE-OFF

| | | | |
|---|---|---|---|
| MAN FLX 50 (W) | SRS (G)<br>CLB (B) | RWY (G)<br>NAV (B) | 1 FD 2 (W) A/THR (B) |
| "Man Flex 50 SRS Runway." | | | |

## THRUST REDUCTION ALTITUDE AND ACCELERATION ALTITUDE

| | | | |
|---|---|---|---|
| THR CLB or<br>THR DCLB1(2) | CLB (G)<br>ALT (B) | NAV (G) | AP1 (W) 1FD2 (W) A/THR (W) |
| Initially above 30 ft, NAV will change to green. "NAV" then "Thrust Climb, Climb, Auto Thrust", or "Thrust D Climb 1 (2), Climb, Auto Thrust". When autopilot has been engaged, "Autopilot 1." | | | |

## CLB MODE, HEADING CLEARANCE RECEIVED

| | | | |
|---|---|---|---|
| THR CLB | OP CLB (G)<br>ALT (B) | HDG (G) | AP1 (W) 1FD2 (W) A/THR (W) |
| "Open Climb, Heading 060." | | | |

## INTERCEPTING FCU ALTITUDE

| | | | |
|---|---|---|---|
| SPEED | ALT* (G) | NAV (G) | AP1 (W) 1FD2 (W) A/THR (W) |
| "Speed Alt Star." | | | |

## MAINTAINING FCU ALTITUDE

| | | | |
|---|---|---|---|
| SPEED | ALT (G) | NAV (G) | AP1 (W) 1FD2 (W) A/THR (W) |
| "Alt." | | | |

## AT CRUISE LEVEL IN PROG PAGE

| | | | |
|---|---|---|---|
| MACH | ALT CRZ | NAV | AP1 (W) 1FD2 (W) A/THR (W) |
| "Alt Cruise." | | | |

## DESCENT

| | | | |
|---|---|---|---|
| THR IDLE | DES (G)<br>ALT (B) | NAV | AP1 (W) 1FD2 (W) A/THR (W) |
| "Thrust Idle, Descent, Alt Blue FL 230."<br>(ALT (B) displayed, FL 230 set on FCU and indicated blue on the bottom of the altitude scale of the PFD.) | | | |

## DES MODE, HEADING CLEARANCE RECEIVED

| | | | |
|---|---|---|---|
| THR IDLE | OP DES (G)<br>ALT (B) | HDG (G) | AP1 (W) 1FD2 (W) A/THR (W) |
| "Open descent, Heading 060." | | | |

## APPROACH

| | | | | |
|---|---|---|---|---|
| SPEED | ALT (G)<br>G/S (B) | HDG (G)<br>LOC (B) | CAT 3 DUAL<br>MDA xxx | AP1+2 (W) 1FD2 (W) A/THR (W) |
| "Glide Slope, LOC, Blue, CAT 3 Dual, Autopilot 1 and 2."<br>(Radar heading for ILS and Approach Mode has just been armed.) | | | | |
| SPEED | G/S* (G) | LOC (G) | CAT 3 DUAL<br>MDA xxx | AP1+2 (W) 1FD2 (W) A/THR (W) |
| "LOC, Glide Slope Star." | | | | |

## SETTING MISSED APPROACH ALTITUDE

| |
|---|
| "5,000 Blue"<br>(ALT (B) not displayed, 5000 set on FCU and indicated blue on the top of the altitude scale of the PFD.) |

## MISSED APPROACH

| | | | |
|---|---|---|---|
| MAN TOGA | SRS (G)<br>CLB (B) | GA TRK (G) | AP1+2 (W) 1FD2 (W) A/THR (B) |
| "Man TOGA, SRS, Go-around Track." | | | |

## LEVEL CLEARANCE (RECEIVED, BUT LEVEL CHANGE DELAYED)

| |
|---|
| As each clearance level is given, the PF sets it in the FCU ALT window. |
| "8900m, FL 291 Blue."<br>(ALT (B) not displayed, FL 291 (8900m) set on FCU and indicated blue on the top/bottom of the altitude scale of the PFD) |

## LEVEL CLEARANCE (RECEIVED DURING CLIMB/DESCENT)

| |
|---|
| As each clearance level is given, the PF sets it in the FCU ALT window. |
| "Alt Blue 8900m, FL 291."<br>(ALT (B) displayed, FL 291 (8900m) set on FCU and indicated blue on the top/bottom of the altitude scale of the PFD) |

## HEADING CLEARANCE

| |
|---|
| As each heading clearance is given, the PF sets it in the FCU HDG window. |
| "Heading 060." |

## SPEED CLEARANCE

| |
|---|
| As each speed clearance is given, the PF sets it in the FCU SPD/MACH window. |
| "Speed 250." |

## LEVEL AND HEADING CLEARANCE (RECEIVED DURING CLIMB/DESCENT)

| |
|---|
| As each clearance is given, the PF sets it in the appropriate FCU window. |
| "Heading 060, Alt Blue 8900m, FL 291." |

# CHECK CALLOUTS

**Applicable to: ALL**

“CHECK” is used in response to a call or announcement from the other pilot, once the item or parameter called has been checked.

# PF ACTIONS ON THE FCU

**Applicable to: ALL**

With the AP ON, the PF executes silently the necessary actions on the FCU and then reads the FMA.

Intentionally left blank

## GENERAL

**Applicable to: ALL**

The touch and go is primarily employed during approach and landing practice. It is not intended for landing roll and takeoff procedure training.

## APPROACH

**Applicable to: ALL**

Carry out a visual circuit as described in NO-140. Confirm the autobrake is not armed.

## LANDING

**Applicable to: ALL**

The trainee accomplishes a normal final approach and landing. After touchdown, the instructor selects Flaps 2, directs the trainee to, "Stand them up," disarms the ground spoilers and ensures all spoilers are retracted, and confirms the trim resets into the green band. The trainee moves the thrust levers to the vertical position to allow the engines to stabilise before TOGA is selected.
With the nose wheel on the ground, the pitch trim resets automatically to 4 ° UP.
This normally occurs 5 s after the pitch attitude is less than 2.5 °and if the ground spoilers are retracted.
When the engines are stabilised, the instructor calls, "Go." The trainee then selects TOGA and removes his hand from the thrust levers. At or above VAPP the instructor calls, "Rotate." The trainee rotates smoothly to approximately 15° of pitch. The thrust levers must always be moved to TOGA to engage the SRS.
Once airborne, if performance is excessive, the thrust levers may be moved to the CL detent. The aircraft may be slightly out of trim, but this should have little effect on the rotation. Once the aircraft is airborne, flight law blends in by 50 ft RA and the autotrim becomes active.

| | |
|---|---|
| **WARNING** | If reverse thrust is selected, a full stop landing must be carried out. |

Intentionally left blank

## GENERAL

Applicable to: ALL

1 **FACTORED LANDING DISTANCE**

The definition of the In-Flight Landing Distance is not deemed to include margins. It assumes a stabilized approach in outside conditions consistent with the computation assumptions.
In order to cover the variability in flying techniques and unexpected conditions at landing, the flight crew should apply an appropriate margin to the in-flight landing distances (either determined with or without failure).
It is Dragonair policy to apply a 15 % safety margin to the in-Flight Landing Distance. Under exceptional circumstances, the flight crew may disregard this margin.

**MEL CONSIDERATIONS**

Some MEL items affect the landing distance. For these items, the MEL provides a coefficient that the flight crew must apply on top of the In-Flight Landing Distance.
Even in the case of an in-flight failure, the flight crew must apply the MEL coefficients on top of the In-Flight Landing Distance.

**GENERAL FORMULA OF THE LANDING DISTANCE ASSESSMENT**

Taking the above into consideration, the flight crew should determine the landing distance (either with or without failure) following the below general formula:

$$\boxed{\text{Landing Distance} = \text{In-Flight Landing Distance} \times \text{Safety Margin} \times \text{MEL Coefficient}}$$

2 **USE OF THE RUNWAY CONDITION ASSESSMENT MATRIX (RCAM)**

**RCAM LOCATION**

Airbus provides the flight crew with the RCAM in:

- The Performance section of the FCOM (*Refer to FCOM/PER-LDG-DIS-MAT Runway Condition Assessment Matrix*), and
- The In-Flight Performance section of the QRH (*Refer to QRH/QRH-FPE-IFL*).

**INFORMATION PROVIDED BY THE RCAM**

The aim of the RCAM is to provide the flight crew with a combination of all available information (runway condition, contaminant type, reported braking action) in order to assess the realistic aircraft landing performance. The RCAM provides 6 braking performance levels:

- Dry
- Good
- Good to Medium

- Medium
- Medium to Poor
- Poor

The RCAM also provides the maximum crosswind value for each braking performance level.

### USE OF THE RCAM

In order to assess the landing performance, the flight crew determines a braking performance level using the RCAM.
The flight crew makes a primary assessment based on Runway Condition information (i.e. contaminant type, depth, temperature). This results in a primary braking performance level.
Then, the flight crew downgrades this primary braking performance level, if:

- A Reported Braking Action (RBA) is available and this RBA corresponds to a lower braking performance level,
- Complementary information is available and is related to a possible degradation of the Runway Condition or braking action.

In any case, the flight crew must not use an RBA or any other complementary information in order to upgrade a primary braking performance level that was based on Runway Condition information.

### CROSSWIND CONSIDERATIONS

The maximum crosswind value that the flight crew should retain is the one corresponding to the worse braking performance. This means that if the flight crew downgrades the braking performance assessment after considering additional information, they should also downgrade the maximum crosswind value.

## NORMAL OPERATIONS

Applicable to: ALL

3

### PRINCIPLE

In order to assess the landing performance without failure, the flight crew should follow the three main steps described below:

1. **Identify the Braking Action**with the RCAM,
2. **Determine the VAPP** by referring to the VAPP computation table without failure of the QRH,
3. **Calculate the Landing Distance** with the In-Flight Landing Distance tables without failure of the QRH.

4

## VAPP DETERMINATION WITHOUT FAILURE

When the flight crew has determined the Braking Action with the RCAM (*Refer to SI-110 Use of RCAM*), they should determine the Approach Speed (VAPP).

### GENERAL CONSIDERATIONS

The Approach Speed (VAPP) is defined by the flight crew to perform the safest approach.
It is function of the aircraft landing weight, slats/flaps configuration, headwind, use of autothrust, icing conditions and downburst.
In most cases, the FMGC provides a correct VAPP value on the MCDU PERF APPR page, when tower wind and FLAP3 or FLAP FULL landing configuration have been inserted.
The flight crew can insert a lower VAPP in the MCDU APPR page, down to VLS, if landing is performed without A/THR, without headwind, without downburst and without icing. They can insert a higher VAPP in case of strong suspected downburst, but this increment is limited to 15 kt above VLS. In case of strong or gusty crosswind greater than 20 kt, VAPP should be at least VLS +5 kt; the 5 kt increment above VLS may be increased up to 15 kt at the flight crew's discretion.
The flight crew should keep 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 ATC 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, provided that the F-PLN is correctly sequenced and inserted in the MCDU. When 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 (*Refer to NO-110 GROUND SPEED MINI*), even when the VAPP has been manually inserted.
As a general manner, the VAPP value is the sum of the VLS and the APPRroach CORRection (APPR COR):

$$\boxed{\mathrm{VAPP} = \mathrm{VLS} + \mathrm{APPR\ COR}}$$

### USE OF THE TABLE FOR COMPUTING VAPP WITHOUT FAILURE

#### VAPP Determination

The QRH provides in the In-Flight Performance chapter (QRH-FPE-IFL) the table for determining the VAPP without failure.
The flight crew should first determine the VLS as a function of the estimated aircraft weight at landing and of the landing configuration.
Then they should add the approach correction, which is the maximum of:

- 5 kt if the A/THR is ON, or
- 5 kt in case of ice accretion, or
- 1/3 of the headwind component value reported by the ATC. This correction should be limited to 15 kt.

Note: *This means that when using the A/THR with ice accretion but without headwind, APPR COR equals to 5 kt.*

Correction of the Landing Distance

The flight crew should take into account the effect of the aircraft ground speed at landing (due to VAPP) in the landing distance computation by applying the SPD correction:

- If APPR COR is not due to headwind (APPR COR >1/3 headwind component), the flight crew determines the SPD correction: SPD = APPR COR,
- If APPR COR is due to headwind (APPR COR = 1/3 headwind component), the flight crew does not determine SPD.

If the flight crew decides to increase the VAPP (in order to cover strong or gusty crosswind conditions for example), they should take into account this additional increase in the landing distance assessment by using the SPD correction.

## 5 LANDING DISTANCE WITHOUT FAILURE

In order to determine the landing distance, the flight crew should refer to the landing distance table of the QRH for the braking action that they determined with the RCAM (Dry, Good, Good to Medium, etc…).
The QRH provides two tables for each braking action: one for landing in **CONF FULL** and one for landing in **CONF 3.**

### REFERENCE LANDING DISTANCE

The flight crew should determine the **reference landing distance** (REF DIST) depending on the braking mode (manual braking, autobrake LOW or autobrake MED).
The QRH provides **reference landing distances** for a given aircraft weight, landing at sea level, in ISA conditions, without wind, on runway with no slope, without reverse thrust, in manual landing and at a VAPP equal to the VLS of the corresponding configuration.

### CORRECTIONS TO BE APPLIED TO THE REFERENCE LANDING DISTANCE

When the flight crew has determined the reference landing distance, they apply, when relevant, the corrections for each parameter having an effect on the landing distance:

- **WEIGHT**: weight correction to cover the difference between the actual landing weight and the fixed weight relative to the reference landing distance,
- **SPD**: speed correction calculated during the VAPP determination,
- **ALT**: altitude correction to cover the landing airport elevation,
- **WIND**: tailwind correction (the headwind is not taken into account),
- **TEMP**: temperature correction for temperatures above ISA conditions,
- **SLOPE**: downward slope correction of the runway (the upward slope effect is not taken into account),
- **REV**: reverse thrust correction to take into account the benefit of each available thrust reverser.

### ADDITIONAL CORRECTIONS

The QRH provides specific corrections to cover the case of a landing in **overweight** and the case of a landing with the **autoland.**
The flight crew should apply, when relevant, the additional corrections on top of the corrections for the other parameters having an effect on the landing distance.

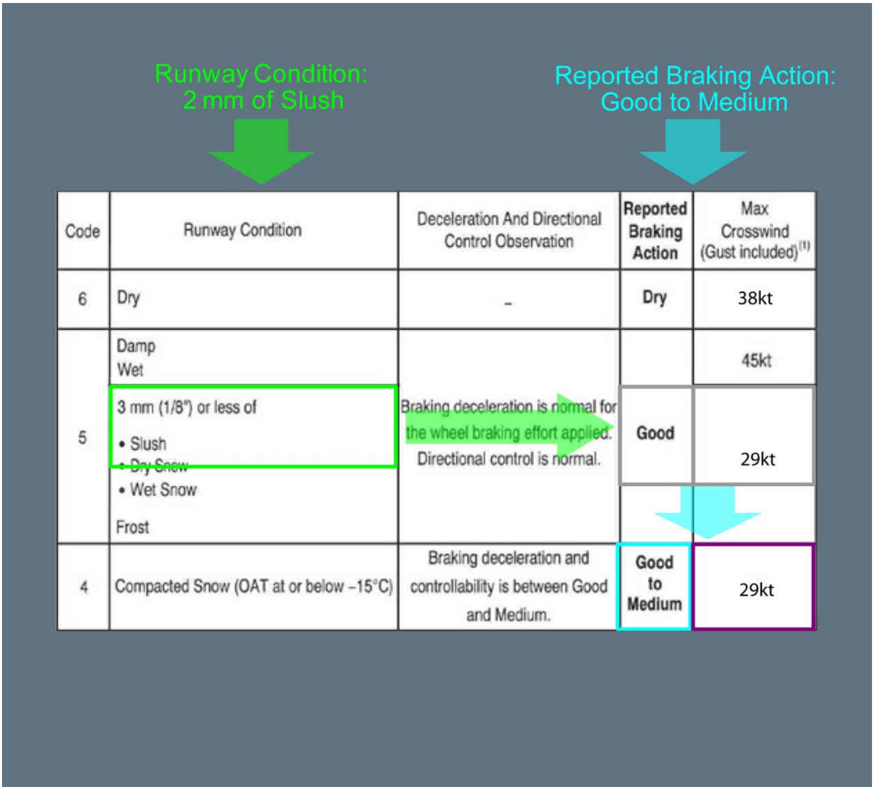
6

## EXAMPLE OF LANDING PERFORMANCE ASSESSMENT WITHOUT FAILURE

### LANDING DATA

- **Aircraft:** A320
- **Runway Condition:** 2 mm of slush
- **Reported Braking Action:** Good to Medium
- **Runway Slope:** 1% UP
- **Wind / OAT:** 12 kt headwind / -5 °C
- **Airport Pressure Altitude:** Sea Level
- **Estimated Landing Weight:** 58 t
- **Landing Configuration:** CONF FULL
- **Autothrust:** ON
- **Autobrake:** MED
- **Thrust Reversers:** use of all thrust reversers

## STEP 1: IDENTIFY THE BRAKING ACTION




| Code | Runway Condition | Deceleration And Directional Control Observation | Reported Braking Action | Max Crosswind (Gust included)[1] |
|---|---|---|---|---|
| 6 | Dry | – | Dry | 38kt |
| 5 | Damp<br>Wet | | | 45kt |
| | 3 mm (1/8") or less of<br>• Slush<br>• Dry Snow<br>• Wet Snow<br>Frost | Braking deceleration is normal for the wheel braking effort applied. Directional control is normal. | Good | 29kt |
| 4 | Compacted Snow (OAT at or below −15°C) | Braking deceleration and controllability is between Good and Medium. | Good to Medium | 29kt |

## STEP 2: DETERMINE THE VAPP

| VLS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Weight (T) | 42 | 46 | 50 | 54 | 58 | 62 | 66 | 70 | 74 | 78 |
| VLS CONF FULL (kt) (=VREF) | 109 | 114 | 119 | 123 | 128 | 132 | 136 | 140 | 144 | 148 |
| VLS CONF3 (kt) | 113 | 118 | 123 | 128 | 133 | 137 | 141 | 145 | 149 | 153 |

*For CG < 25%, add 2kt to VLS CONF FULL and VLS CONF 3*

+

VLS (FULL, 58T) = 128kt

**APPR**oach **COR**rection

APPR COR = MAX of:

- 5kt in case of A/THR ON
- 5kt in case of Ice Accretion in CONF FULL
  10kt in case of Ice Accretion in CONF 3
- 1/3 Headwind component (MAX = 15kt)

5kt

APPR COR (A/THR) = 5kt

4kt

⇩

**VAPP**

VAPP = VLS + APPR COR

VAPP = 133kt

⇩

**LANDING DISTANCE CORRECTION** (**SPD** column in Landing Distance table)

- If APPR COR > 1/3 Headwind component:
  Correct the landing distance (**SPD** column) with **SPD** = **APPR COR**
- If APPR COR = 1/3 Headwind component:
  No **SPD** column correction in the Landing Distance table

SPD = APPR COR = 5kt

## STEP 3: CALCULATE THE LANDING DISTANCE

### LANDING DISTANCE - GOOD TO MEDIUM

CONF FULL

| Corrections on Landing Distance (m) | | WEIGHT | | SPD | ALT | WIND | TEMP | SLOPE | REV |
|---|---|---|---|---|---|---|---|---|---|
| Braking Mode | REF DIST (m) for 66T | Per 1T BELOW 66T | Per 1T ABOVE 66T | Per 5kt | Per 1000ft above SL | Per 5kt TW | Per 10°C ABOVE ISA | Per 1% Down Slope | Per Thrust Reverser Operative |
| Maximum MANUAL | 1 660 | - 10 | + 40 | + 90 | + 60 | + 190 | + 60 | + 70 | - 70 |
| AUTOBRAKE MED | 1 700 | - 20 | + 40 | + 90 | + 60 | + 190 | + 60 | + 70 | - 70 |
| AUTOBRAKE LOW | 1 970 | - 20 | + 50 | + 140 | + 70 | + 210 | + 70 | + 50 | - 10 |

REF DIST (66T) = **1700 m**

WEIGHT correction (58T) = - 20 x 8 **= - 160 m**

SPD correction (SPD = 5kt) **= + 90 m**

ALT correction (Sea Level): No correction

WIND correction (12kt headwind): No correction

TEMP correction (ΔISA = -20°C): No correction

SLOPE correction (1% UP): No correction

REV correction = - 70 x 2 **= - 140 m**

**Landing Distance = 1490 m**

## ABNORMAL OPERATIONS

**Applicable to: ALL**

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### PRINCIPLE

In order to assess the landing performance with failure, the flight crew should follow the three main steps described below:

1. **Identify the Braking Action** with the RCAM,
2. **Determine the VAPP** by referring to the VAPP computation table with failure of the QRH,
3. **Calculate the Landing Distance** with the In-Flight Landing Distance tables with failure of the QRH.

Due to the low probability of having several in-flight failures leading to an increase of the landing distance, the Airbus Operational Documentation for the landing performance assessment does not address the combination of in-flight failures of different systems.

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## VAPP DETERMINATION WITH FAILURE

When the flight crew has determined the Braking Action with the RCAM (*Refer to SI-110 Use of RCAM*), they should determine the Approach Speed (VAPP).

### GENERAL CONSIDERATIONS

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 flight crew needs to calculate the VAPP in advance.
The appropriate VLS is not necessarily available at that time on the PFD, because the landing configuration is not yet established.
As a general manner, the VAPP is the sum of the reference speed (VREF), defined as the VLS in CONF FULL and of the effect of the failure on the reference speed (ΔVREF) and of the approach correction (APPR COR):

$$\boxed{\mathrm{VAPP} = \mathrm{VREF} + \Delta\mathrm{VREF} + \mathrm{APPR\ COR}}$$

The Airbus recommendation is to limit the sum (ΔVREF + APPR COR) to 20 kt in order not to increase indefinitely the approach speed as it has a direct impact on the landing distance.
As a result, for a failure, which increases the reference speed by more than 20 kt, there is no approach correction. This also results in the display of N/A in the landing distance tables in the column for the speed correction (SPD), since the reference landing distance already takes into account the effect of the failure in the increased approach speed.

## USE OF THE TABLE FOR COMPUTING VAPP WITH FAILURE

### VAPP Determination

The QRH provides in the In-Flight Performance chapter (QRH-FPE-IFL) the table for determining the VAPP with failure.
The flight crew should first determine the VREF as a function of the estimated aircraft weight at landing.
Then they should take into account the effect of the failure by referring to the applicable landing distance table (*Refer to SI-110 Landing Distance with failure*), which provides for each failure the ∆VREF and the FLAPS lever position for landing.
Finally they should determine the approach correction (APPR COR) depending on the value of the ∆VREF and the FLAPS setting:

- For a ∆VREF value lower than 10 kt, the flight crew should add the APPR COR value, which is the maximum of:
  - 5 kt if the A/THR is ON, or
  - 5 kt in case of ice accretion, or
  - 1/3 of the headwind component value reported by the ATC. This correction should be limited to 15 kt.

  Note: *This means that when using the A/THR with ice accretion but without headwind, APPR COR equals to 5 kt.*
- For a ∆VREF value between 10 kt and 20 kt, the flight crew should add an APPR COR value equal to 1/3 of the headwind component value reported by the ATC. This correction should be limited to 15 kt,
- For a ∆VREF value greater than 20 kt, the flight crew should not add any APPR COR.

### Correction of the Landing Distance

The flight crew should take into account the effect of the aircraft ground speed at landing (due to VAPP) in the landing distance computation by applying the SPD correction:

- If APPR COR is not due to headwind (APPR COR >1/3 headwind component), the flight crew determines the SPD correction: SPD = APPR COR,
- If APPR COR is due to headwind (APPR COR = 1/3 headwind component), the flight crew does not determine SPD.

If the flight crew decides to increase the VAPP (in order to cover strong or gusty crosswind conditions for example), they should take into account this additional increase in the landing distance assessment by using the SPD correction.

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## LANDING DISTANCE WITH FAILURE

In order to determine the landing distance, the flight crew should refer to the landing distance table of the QRH for the **aircraft system affected by the failure.**
For each aircraft system, the QRH provides tables for the associated braking action (Dry, Good, Good to Medium, etc…).

### REFERENCE LANDING DISTANCE

For each possible landing configuration, the tables provide, when relevant, the associated effect of the failure on the reference speed (ΔVREF), which must be taken into account in the VAPP determination (*Refer to SI-110 VAPP Determination with failure*)
The QRH provides **reference landing distances** for a given aircraft weight landing at sea level, in ISA conditions, without wind, on runway with no slope, without reverse thrust, in manual landing and at a VAPP equal to the sum (VREF + ΔVREF).

### CORRECTIONS TO BE APPLIED TO THE REFERENCE LANDING DISTANCE

When the flight crew has determined the reference landing distance, they apply, when relevant, the corrections for each parameter having an effect on the landing distance:

- **WEIGHT**: weight correction to cover the difference between the actual landing weight and the fixed weight relative to the reference landing distance,
- **SPD**: speed correction calculated during the VAPP determination,
- **ALT**: altitude correction to cover the landing airport elevation,
- **WIND**: tailwind correction (the headwind is not taken into account),
- **TEMP**: temperature correction for temperatures above ISA conditions,
- **SLOPE**: downward slope correction of the runway (the upward slope effect is not taken into account),
- **REV**: reverse thrust correction to take into account the benefit of each available thrust reverser.

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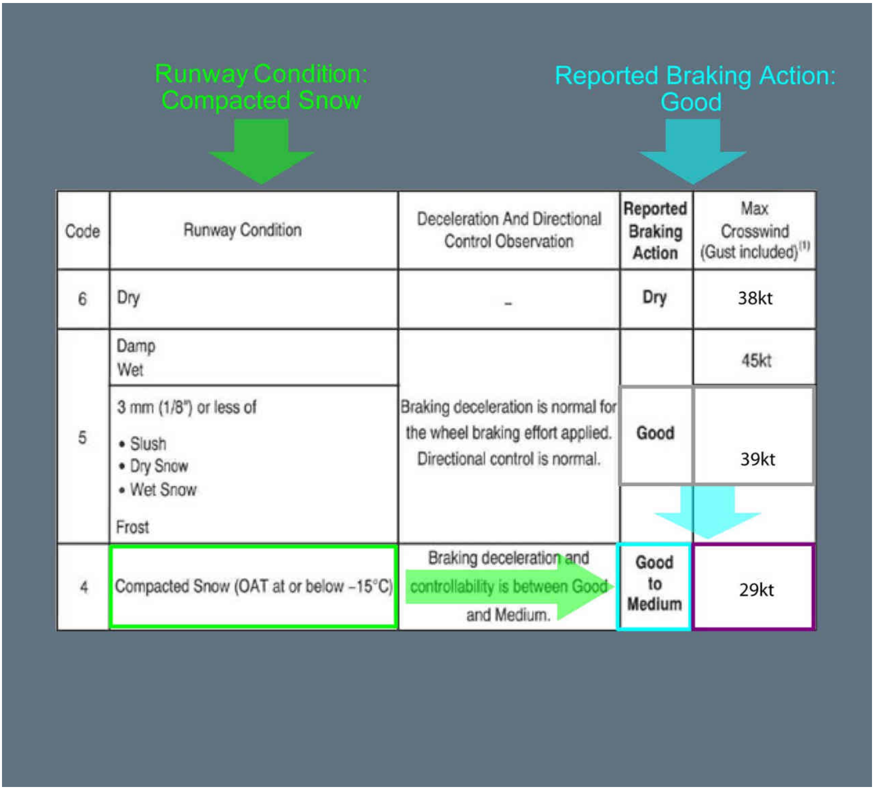
## EXAMPLE OF LANDING PERFORMANCE ASSESSMENT WITH FAILURE

### LANDING DATA

- **Aircraft:** A320
- **Runway Condition:** Compacted Snow
- **Reported Braking Action:** Good
- **Wind / OAT:** 12 kt headwind / -15 °C
- **Airport Pressure Altitude:** 1 000 ft
- **Estimated Landing Weight:** 62 t

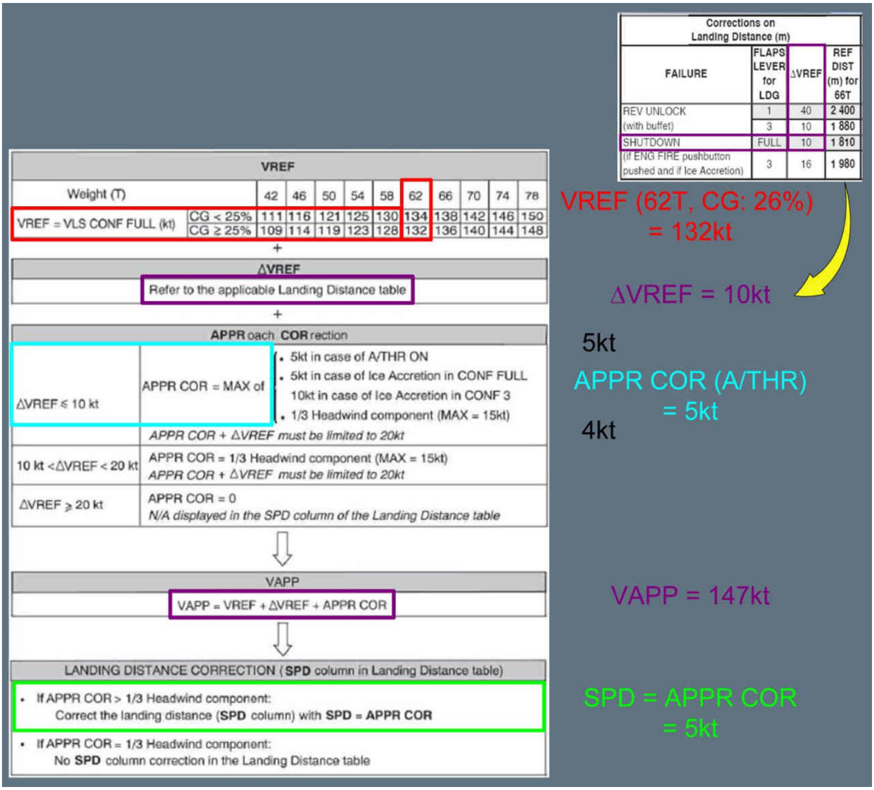
- **Autothrust:** ON
- **In-Flight Failure:** ENG 1 SHUTDOWN (no damage)
- **Thrust Reversers:** use of all available thrust reversers

## STEP 1: IDENTIFY THE BRAKING ACTION




| Code | Runway Condition | Deceleration And Directional Control Observation | Reported Braking Action | Max Crosswind (Gust included)[(1)] |
|---|---|---|---|---|
| 6 | Dry | - | Dry | 38kt |
| 5 | Damp<br>Wet | Braking deceleration is normal for the wheel braking effort applied. Directional control is normal. | | 45kt |
| | 3 mm (1/8") or less of<br>• Slush<br>• Dry Snow<br>• Wet Snow<br>Frost | | Good | 39kt |
| 4 | Compacted Snow (OAT at or below -15°C) | Braking deceleration and controllability is between Good and Medium. | Good to Medium | 29kt |

## STEP 2: DETERMINE THE VAPP



## STEP 3: CALCULATE THE LANDING DISTANCE

ENGINE SYSTEM

GOOD TO MEDIUM

| Corrections on Landing Distance (m) | | | | WEIGHT | | SPD | ALT | WIND | TEMP | SLOPE | REV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FAILURE | FLAPS LEVER for LDG | ΔVREF | REF DIST (m) for 66T | Per 1T BELOW 66T | Per 1T ABOVE 66T | Per 5kt | Per 1000ft above SL | Per 5kt TW | Per 10°C ABOVE ISA | Per 1% Down Slope | Per Thrust Reverser Operative |
| REV UNLOCK (with buffet) | 1 | 40 | 2 400 | - 20 | + 40 | N/A | + 90 | + 200 | + 80 | + 90 | - 120 |
| | 3 | 10 | 1 880 | - 20 | + 40 | + 100 | + 70 | + 200 | + 70 | + 80 | - 90 |
| SHUTDOWN (if ENG FIRE pushbutton pushed and if Ice Accretion) | FULL | 10 | 1 810 | - 20 | + 40 | + 100 | + 70 | + 190 | + 70 | + 70 | - 80 |
| | 3 | 16 | 1 980 | - 20 | + 40 | + 100 | + 70 | + 190 | + 70 | + 80 | - 90 |

FLAPS LEVER for LDG: CONF FULL

REF DIST (66T) **= 1810 m**

WEIGHT correction (62T) = - 20 x 4 **= - 80 m**

SPD correction (SPD = 5kt) **= + 100 m**

ALT correction (1000ft) = + 70 x 1 **= + 70 m**

REV correction = - 80 x 1 **= - 80 m**

**Landing Distance = 1820 m**

# PREVENTING IDENTIFIED RISKS

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## PIR-PLP PRELIMINARY PAGES



## PIR-010 PREVENTING IDENTIFIED RISKS

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## INTRODUCTION

**Applicable to: ALL**

The aim of this chapter is to highlight some of the risks encountered by flight crews, in order to improve:
- Flight crewmembers' awareness of these risks
- Risk management.

These risks are categorized according to either:
- Flight phases, for the risks related to normal operations, or
- ATA chapters, for the risks more specifically related to the flight crews' interaction with systems, or to system failures.

For each risk, the following table provides:
- The flight phase or ATA chapter related to the risk
- A description of the risk
- A description of the consequences, if the flight crew does not correctly manage the risk
- The type of consequences (who or what is affected by the risk), illustrated by one of these 6 symbols:
  - "CONTROL": Aircraft handling or control may be affected
  - "NAV": Navigation may be affected
  - "GROUND PERSONNEL": Possibility of injury to ground personnel
  - "FLIGHT": it may not be possible to complete the flight, there may be a risk of diversion.
  - "AIRCRAFT": Possibility of damage to the aircraft
  - "PAX": Possibility of injury to passengers.
- A reference to the FCTM chapter, section, and/or paragraph, where the related explanations and recommendations (for prevention and/or recovery) are located.

### RISK SYMBOLS

| CONTROL | NAV | GROUND PERSONNEL | FLIGHT | AIRCRAFT | PAX |
|---|---|---|---|---|---|
|  |  |  |  |  |  |

## PREVENTING IDENTIFIED RISKS

## NORMAL OPERATIONS

**Applicable to: ALL**

| **Flight Phase** | **Risk** | **Consequences** | | **Refer toFCTM** |
|---|---|---|---|---|
| PREP | During takeoff briefing, the flight crew does not check that the FMS SID (including the constraints) is correct. | Erroneous trajectory | NAV | *Refer to NO-020 COCKPIT PREPARATION* |
| TAKEOFF | The flight crew calls out "THRUST SET" before reaching N1 value | Engine check not valid | | *Refer to NO-050 TAKEOFF ROLL* |
| CLIMB /DESC | The flight crew uses the V/S knob without setting a target | Climb or descent does not stop | | |
| DESC | In managed descent, the flight crew uses the speed brakes, in an attempt to descend below the computed profile | Unless the aircraft is above the computed profile, the autothrust increases thrust to remain on the computed profile. The expected increased rate of descent will not be reached. In addition, fuel consumption will increase | NAV | *Refer to NO-090 GUIDANCE AND MONITORING* |
| DESC | The flight crew does not set the TERR ON ND switch to ON | Reduced situational awareness | NAV | *Refer to NO-090 PREFACE* |
| APPR | The flight crew activates approach phase without crosschecking with each other | The other flight crewmember may perceive the speed change as undue, and may react to it | NAV | |
| APPR | The flight crew clears the F-PLN using the DIR TO or DIR TO RAD IN functions, although the aircraft is in radar vectoring | NAV mode is armed. If this mode setting is not relevant, it may lead to an erroneous trajectory | NAV | *Refer to NO-110 INITIAL APPROACH* and *Refer to NO-110 INTERMEDIATE APPROACH* |
| APPR | The flight crew does not sufficiently monitor raw data | Any erroneous computation leads to an erroneous trajectory | NAV | *Refer to NO-110 FINAL APPROACH* *Refer to NO-130 FINAL APPROACH* |
| ILS APPR | Glide slope interception from above: G/S not rearmed | The aircraft descends through the glide slope axis, without intercepting it | NAV | *Refer to NO-120 FINAL APPROACH* |

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| Flight Phase | Risk | Consequences | | Refer toFCTM |
|---|---|---|---|---|
| NPA APPR | When the aircraft reaches the minimum altitude, the flight crew sets the bird to ON and the AP to OFF, but does not set the FDs to OFF. | The FDs orders may not be correct below the minima. | | *Refer to OP-030 AUTOPILOT/FLIGHT DIRECTOR* *Refer to NO-120 REACHING THE MINIMA.* |
| GO AROUND | When the flight crew initiates the Go-around, PF does not set the thrust levers to theTOGA detent, the full forward thrust lever position. | Landing/approach modes remain engaged. The primary F-PLN becomes PPOS-DISCONT. | | *Refer to NO-180 AP/FD GO-AROUND PHASE ACTIVATION* |

## SYSTEM OPERATIONS / FAILURES

**Applicable to: ALL**

| ATA | Risk | Consequences | Csqce type | Refer to FCTM |
|---|---|---|---|---|
| 22 | The flight crew uses the instinctive disconnect pushbutton on the thrust levers to disconnect autothrust, without reducing the Throttle Lever Angle (TLA) | Immediate and undue speed increase | | *Refer to OP-030 AUTOTHRUST (A/THR) Description* |
| 22 | Alpha floor/TOGA LOCK, with no disconnection of autothrust | TOGA thrust is maintained, with an undue speed increase, and may lead to overspeed | | *Refer to OP-030 AUTOTHRUST (A/THR) Description* |
| 22 | The flight crew does not use the correct knob to change heading or speed | Trajectory not correct | | |
| 22 | The flight crew does not sequence the F/PLN | Erroneous computation (e.g. time, fuel) and trajectory | NAV | *Refer to NO-130 INTERMEDIATE APPROACH* |

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| ATA | Risk | Consequences | Csqce type | Refer to FCTM |
|---|---|---|---|---|
| 27 | The flight crew does not select the speed after slat or flap failure | **At takeoff:** When flaps/slats are locked, if the flight crew does not select the current speed, the aircraft continues to accelerate and possibly exceeds MAX Speed |  | *Refer to AO-027 ABNORMAL FLAPS/SLATS CONFIGURATION* |
| | | **In approach:** When flaps/slats are locked, if the flight crew does not select the current speed, the aircraft continues to decelerate down to a speed that is not consistent with the real aircraft configuration |  | |
| 27/32 | In the case of flight with slats/flaps extended or landing gear extended, the flight crew takes into account the FMS predictions | Erroneous computation (i.e. time, fuel), because the FMS does not take into account the abnormal configuration |  | *Refer to AO-027 ABNORMAL FLAPS/SLATS CONFIGURATION* |
| 28 | The flight crew does not check fuel before fuel crossfeed | Fuel loss |  | *Refer to AO-028 FUEL LEAK* |
| 34 | Error in the use of RMP | Loss of transmission to ATC due to an erroneous manipulation (particularly when SEL is on) |   | |
| 34 | The flight crew performs the TCAS procedure, but does not set the FDs to OFF | The autothrust mode remains in THR CLB or THR DES, which are not the appropriate modes. This may lead to flight control protection activation |  | *Refer to SI-060 OPERATIONAL RECOMMENDATIONS* |
| 34 | The flight crew selects ADR to OFF using the ADIRS rotary selector, instead of the ADR pushbutton | Irreversible loss of redundancy (the associated IR is lost, and cannot be recovered until the end of the flight) |   | *Refer to AO-034 ADR/IRS FAULT* |
| 70 | In the case of an engine failure after takeoff, the flight crew does not stabilize the aircraft on the flight path before performing ECAM actions | Performing the ECAM actions before the aircraft is stabilized on the flight path, reduces efficiency due to the PF's high workload, and may lead to a trajectory error |  | *Refer to AO-020 ENGINE FALIURE AFTER V1* |

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| ATA | Risk | Consequences | Csqce type | Refer to FCTM |
|---|---|---|---|---|
| 70 | In the case of an engine failure in cruise, the flight crew presses the EO CLR key on the MCDU | Pressing the EO CLR key on the MCDU is an irreversible action that leads to the loss of single engine computation (discrepancy between the computation and real aircraft status) |  | *Refer to AO-020 ENGINE FALIURE DURING CRUISE* |
| 80 | For EMERGENCY DESCENT, the flight crew turns but does not pull the knobs, or does both, but not in the correct sequence, with no FMA crosscheck | The flight crew does not detect that the descent is not engaged. Delayed descent leads to limited oxygen for passengers |  | *Refer to OP-030 AUTOPILOT/FLIGHT DIRECTOR* |

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