AIRBUS

A318/A319/A320/A321

HATS

Hellenic Air Training Services

FLIGHT CREW TECHNIQUES MANUAL

DO NOT USE FOR FLIGHT

ISSUE DATE: 02 FEB 17

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Issue date: 02 FEB 17

This is the FLIGHT CREW TECHNIQUES MANUAL at issue date 02 FEB 17 for the A318/A319/A320/A321 and replacing last issue dated 06 DEC 16

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FILING INSTRUCTIONS

Please incorporate this revision as follow:

Localization Subsection Title	Remove	Insert Rev. Date
PLP-LESS **LIST OF EFFECTIVE SECTIONS/SUBSECTIONS**	ALL	02 FEB 17
PLP-AAT **AIRCRAFT ALLOCATION TABLE**	ALL	02 FEB 17
PLP-LOM **LIST OF MODIFICATIONS**	ALL	02 FEB 17
OP-PLP-SOH **SUMMARY OF HIGHLIGHTS**	ALL	02 FEB 17
OP-030 **AP / FD / A/THR**	ALL	02 FEB 17
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NO-020 **Pre Start**	ALL	02 FEB 17
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NO-050 **Takeoff**	ALL	02 FEB 17
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AO-090 **Miscellaneous**	ALL	02 FEB 17
SI-PLP-SOH **SUMMARY OF HIGHLIGHTS**	ALL	02 FEB 17
SI-020 **Flying Reference**	ALL	02 FEB 17

PRELIMINARY PAGES

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M[1]	Localization	Subsection Title	Rev. Date
	PLP-LETDU	LIST OF EFFECTIVE TEMPORARY DOCUMENTARY UNITS	10 MAR 16
	IN	General Information	07 JUN 16
	OP-010	INTRODUCTION	10 MAR 16
	OP-020	Flight Controls	25 APR 16
E	OP-030	AP / FD / A/THR	02 FEB 17
	OP-040	ECAM	10 MAR 16
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R	NO-020	Pre Start	02 FEB 17
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(1) Evolution code : N=New, R=Revised, E=Effectivity, M=Moved

GENERAL INFORMATION

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FCTM PURPOSE

FOREWORD

The Flight Crew Techniques Manual (FCTM) is published as a supplement to the Flight Crew Operating Manual (FCOM) and is designed to provide pilots with practical information on how to operate the Airbus aircraft. It should be read in conjunction with the FCOM . In the case of any conflict, the FCOM is the over-riding authority.
Airline training policy may differ in certain areas. Should this be the case, the airline training policy is the over-riding authority.

COMMENT - QUESTIONS - SUGGESTIONS

For any questions or comments related to this manual, the Operator's Flight Operations Management may contact the Airbus Flight Operations & Training support department.

Ident.: IN-010-00016017.0001001 / 06 JUN 16

A

Abbreviation	Term
A>B	A is greater than B
A≥B	A is greater than or equal to B
A<B	A is less than B
A≤B	A is less than or equal to B
A/BRK	Autobrake
A/C	Aircraft
A/P	Autopilot
AP	Autopilot
A/S	Airspeed
A/SKID	Anti-skid
A/THR	Auto Thrust
AA	Airworthiness Authorities
AB	Abort
ABCU	Alternate Braking Control Unit
ABN	Abnormal
ABV	Above
AC	Alternating Current
ACARS	ARINC Communication Addressing and Reporting System
ACAS	Airbrone Collision Avoidance System
ACCEL	Acceleration

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Abbreviation	Term
ACC	Active Clearance Control
ACCU	Accumulator
ACP	Audio Control Panel
ACSC	Air Conditioning System Controller
ACT	Additional Center Tank
ADF	Automatic Direction Finder
ADIRS	Air Data Inertial Reference System
ADIRU	Air Data Inertial Reference Unit
ADM	Air Data Module
ADR	Air Data Reference
ADS-B	Automatic Dependent Surveillance-Broadcast
ADV	Advisory
AEVC	Avionic Equipment Ventilation Controller
AFM	Airplane Flight Manual
AFS	Auto Flight System
AGL	Above Ground Level
AIDS	Aircraft Integrated Data System
AIL	Aileron
AIME	Autonomous Integrity Monitoring Extrapolation
AIU	Audio Interface Unit
ALT	Altitude
ALTN	Alternate
AMI	Airline Modifiable Information
AMU	Audio Management Unit
ANT	Antenna
AOA	Angle of Attack
AOC	Airline Operational Control
APP	Approach
APPR	Approach
APPU	Assymetry Position Pick-off Unit
APU	Auxiliary Power Unit
AR	Authorization Required
ARINC	Aeronautical Radio Incorporated
ARN	Aircraft Registration Number
ARP	Aerospace Recommended Practice
ARPT	Airport
ASAP	As Soon As Possible
ASI	Air Speed Indicator
ASP	Audio Selector Panel
ATC	Air Traffic Control

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Abbreviation	Term
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network
ATE	Automatic Test Equipment
ATIS	Airbus Technical Information System
ATS	Auto Thrust System
ATSAW	Airbrone Traffic Situational Awareness
ATSU	Air Traffic Service Unit
ATT	Attitude
AUTO	Automatic
AVNCS	Avionics
AWY	Airway

B

Abbreviation	Term
B/C	Back Course
BARO	Barometric
BAT	Battery
BCL	Battery Charge Limiter
BCDS	Bite Centralized Data System
BCU	Backup Control Unit
BDDV	Brake Dual Distribution Valve
BITE	Built-In Test Equipment
BIU	BITE Interface Unit
BFE	Buyer Furnished Equipment
BFO	Beat Frequency Oscillator
BMC	Bleed Monitoring Computer
BNR	Binary
BRG	Bearing
BRK	Brake
BRT	Bright
BSCU	Braking Steering Control Unit
BTC	Bus Tie Contactor
BTL	Bottle
BUS	Busbar

C

Abbreviation	Term
C/B	Circuit Breaker
CB	Circuit Breaker
C/L	Checklist

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Abbreviation	Term
CL	Checklist
CAB	Cabin
CAPT	Captain, Capture
CAS	Calibrated Airspeed
CAT	Category
CBMS	Circuit Breaker Monitoring System
CCD	Cursor Control Device
CDL	Configuration Deviation List
CDLS	Cockpit Door Locking System
CDSS	Cockpit Door Surveillance System
CDU	Control Display Unit
CF	Cost of Fuel
CFDIU	Centralized Fault Display Interface Unit
CFDS	Centralized Fault Display System
CG	Center of Gravity
CHAN	Channel
CHG	Change
CHK	Check
CI	Cost Index
CIDS	Cabin Intercommunication Data System
CKPT	Cockpit
CLB	Climb
CLR	Clear
CLSD	Closed
CM1(2)	Crewmember 1 (left seat) or 2 (right seat)
CM1	Crewmember 1 (left seat)
CM2	Crewmember 2 (right seat)
CMPTR	Computer
CMS	Constant Mach Segment
CMS	Centralized Maintenance System
CNSU	Cabin Network Server Unit
CO	Company
CO RTE	Company Route
COND	Conditioning
CONF	Configuration
CONT	Continuous
CPC	Cabin Pressure Controller
CPCU	Cabin Pressure Controller Unit
CPDLC	Controller-Pilot Data Link Communication
CRC	Continuous Repetitive Chime

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Abbreviation	Term
CRG	Cargo
CRS	Course
CRT	Cathode Ray Tube
CRZ	Cruise
CSAS	Conditioned Service Air System
CSCU	Cargo Smoke Control Unit
CSD	Constant Speed Drive
CSM/G	Constant Speed Motor/Generator
CSTR	Constraint
CT	Cost of Time
CTL	Control
CTL PNL	Control Panel
CTR	Center
CVR	Cockpit Voice Recorder

D

Abbreviation	Term
DA	Drift Angle
DAC	Digital to Analog Converter
DAR	Digital AIDS Recorder
DC	Direct Current
DCDU	Datalink Control and Display Unit
DCL	Digital Cabin Logbook
DDRMI	Digital Distance and Radio Magnetic Indicator
DECEL	Deceleration
DES	Descent
DEST	Destination
DET	Detection, Detector
DFA	Delayed Flap Approach
DFDR	Digital Flight Data Recorder
DH	Decision Height
DIR	Direction
DIR TO	Direct To
DISC	Disconnect
DISCH	Discharge
DIST	Distance
DITS	Digital Information Transfer System
DIV	Diverter
DMC	Display Management Computer
DME	Distance Measuring Equipment

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Abbreviation	Term
DMU	Data Management Unit (Aids)
DN	Down
DPO	Descent Profile Optimization
DSDL	Dedicated Serial Data Link
DTG	Distance To Go
DTO	Derated Takeoff
DU	Display Unit
DU	Documentary Unit

E

Abbreviation	Term
EWD	Engine/Warning Display
ECAM	Electronic Centralized Aircraft Monitoring
ECAS	Emergency Cockpit Alerting System
ECB	Electronic Control Box (APU)
ECM	Engine Condition Monitoring
ECON	Economic
ECP	ECAM Control Panel
ECS	Environmental Control System
ECU	Engine Control Unit
EDP	Engine-Driven Pump
EEC	Electronic Engine Computer
EFB	Electronic Flight Bag
EFCS	Electronic Flight Control System
EFIS	Electronic Flight Instruments System
EFOB	Estimated Fuel On Board
EGPWS	Enhanced Ground Proximity Warning System
EGT	Exhaust Gas Temperature
EIS	Electronic Instruments System
EIU	Engine Interface Unit
ELAC	Elevator Aileron Computer
ELEC	Electrics
ELT	Emergency Locator Transmitter
ELEV	Elevator
ELV	Elevation
EMER	Emergency
EMER GEN	Emergency Generator
ENG	Engine
EO	Engine-Out
EOSID	Engine-Out Standard Instrument Departure

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Abbreviation	Term
EPE	Estimated Position Error (equal to EPU)
EPR	Engine Pressure Ratio
EPU	Emergency Power Unit
EPU	Estimated Position Uncertainty (equal to EPE)
EROPS	Extended Range Operation
ESS	Essential
EST	Estimated
ETA	Estimated Time of Arrival
ETE	Estimated Time Enroute
ETOPS	Extended Twin Operations
ETP	Equal Time Point
EVMU	Engine Vibration Monitoring Unit
E/WD	Engine/Warning Display
EXP	Expedite
EXT PWR	External Power
EXTN	Extension

F

Abbreviation	Term
F	Fuel
FAA	Federal Aviation Administration
FAP	Forward Attendant Panel
F/C	Flight Crew
F/O	First Officer
FO	First Officer
FAC	Flight Augmentation Computer
FADEC	Full Authority Digital Engine Control System
FAF	Final Approach Fix
FAP	Forward Attendant Panel
FAR	Federal Aviation Regulations
FAV	Fan Air Valve
FCDC	Flight Control Data Concentrator
FCMS	Fuel Control and Monitoring System
FCOM	Flight Crew Operating Manual
FCU	Flight Control Unit
FD	Flight Director
FDIMU	Flight Data Interface and Management Unit
FDIU	Flight Data Interface Unit
FDU	Fire Detection Unit
FEP	Final End Point

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Abbreviation	Term
FF	Fuel Flow
FG	Flight Guidance
FGC	Flight Guidance Computer
F-G/S	FLS Glide Slope
FIDS	Fault Isolation and Detection System
FL	Flight Level
FLHV	Fuel Lower Heating Value
F-LOC	FLS Localizer
FLP	Flap
FLS	FMS Landing System
FLT	Flight
F/CTL	Flight Control
FLT CTL	Flight Control
FLXTO	Flexible Takeoff
FM	Flight Management
FMA	Flight Mode Annunciator
FMGC	Flight Management and Guidance Computer
FMGS	Flight Management and Guidance System
FMS	Flight Management System
FNL	Final
FOB	Fuel On Board
FOM	Figure Of Merit
FPA	Flight Path Angle
F-PLN	Flight Plan
FPD	Flight Path Director
FPPU	Feedback Position Pick-off Unit
FPV	Flight Path Vector
FQI	Fuel Quantity Indication
FQU	Fuel Quantity Unit
FREQ	Frequency
FRT	Front
FRV	Fuel Return Valve
FU	Fuel Used
FWC	Flight Warning Computer
FWD	Forward
FWS	Flight Warning System

G

Abbreviation	Term
G/S	Glideslope
GA	Go-Around
GAPCU	Ground and Auxiliary Power Control Unit
GBAS	Ground Based Augmentation System
GCU	Generator Control Unit
GDU	Group of Documentary Unit
GEN	Generator
GES	Ground Earth Station
GLC	Generator Line Contactor
GLS	GBAS Landing System
GLS	GNSS Landing System
GMT	Greenwich Mean Time
GND	Ground
GND TEMP	Ground Temperature
GPCU	Ground Power Control Unit
GPIRS	Global Positioning and Inertial Reference System
GPS	Global Positioning System
GPWS	Ground Proximity Warning System
GRND	Ground
GRP	Geographic Reference Point
GRVTY	Gravity
GS	Ground Speed
GW	Gross Weight

H

Abbreviation	Term
HC	Harness Connector
HCU	Hydraulic Control Unit
HDG	Heading
HDG/S	Heading Selected
HDL	Handle
HF	High Frequency
HI	High
HLD	Hold
HM	Holding Pattern with a Manual Termination
HMU	Hydrau-Mechanical Unit
HMS	Heat Management System
HP	High Pressure
HPA	Hectopascal

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Abbreviation	Term
HPV	High Pressure Valve
HUD	Head Up Display
HYD	Hydraulic

I

Abbreviation	Term
I/O	Inputs/Outputs
I/P	Input or Intercept Profile
IAF	Initial Approach Fix
IAS	Indicated Airspeed
IATA	International Air Transport Association
ICAO	International Air Transport Organization
IDENT	Identification
IDG	Integrated Drive Generator
IFE	In Flight Entertainment
IFR	Instrument Flight Rules
IGGS	Inert Gas Generation System
IGN	Ignition
ILS	Instrument Landing System
IM	Inner Marker
IMM	Immediate
INB	Inbound
INBO	Inboard
INCREM	Increment
INIT	Initialization
INOP	Inoperative
INR	Inner
INST	Instrument
INTCP	Intercept
INV	Inverter
IP	Intermediate Pressure
IPC	Intermediate Pressure Check valve
IPPU	Instrumentation Position Pick-off Unit
IR	Inertial Reference
IRS	Inertial Reference System
ISA	International Standard Atmosphere
ISDU	Initial System Display Unit
ISIS	Integrated Standby Instrument System
ISOL	Isolation
ISPSS	In Seat Power Supply System

J

Abbreviation	Term

K

Abbreviation	Term

L

Abbreviation	Term
L/G	Landing Gear
LAF	Load Alleviation Function
LAT	Latitude
LAT REV	Lateral Revision
LAV	Lavatory
LCD	Liquid Crystal Display
LCN	Load Classification Number
LDA	Landing Distance Available
	Localizer Directional Aid
LDG	Landing
LDS	Laptop Docking Station
LED	Light Emiting Diode
LEDU	List of Effective Documentary Units
LEOEB	List of Effective Operations Engineering Bulletins
LESS	List of Effective Section/Subsections
LF	Low Frequency
LGCIU	Landing Gear Control Interface Unit
LGPIU	Landing Gear Position Indicator Unit
LH	Left-Hand
LIM	Limitation
LIS	Localizer Inertial Smoothing
LK	Lock
LL	Latitude/Longitude
LLS	Left-Line Select key
LO	Low
LOC	Localizer
LONG	Longitude
LP	Low Pressure
LRRA	Low Range Radio Altimeter
LRU	Line Replaceable Unit
LS	Loudspeaker
LSK	Line Select Key
LT	Light

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Abbreviation	Term
LTS	Load and Trim Sheet
LVL	Level
LVL/CH	Level Change
LVR	Lever
LW	Landing Weight

M

Abbreviation	Term
MABH	Minimum Approach Break-off Height
MAC	Mean Aerodynamic Chord
MAG	Magnetic
MAG DEC	Magnetic Declination
MAG VAR	Magnetic Variation
MAINT	Maintenance
MAN	Manual
MAP	Missed Approach Point
MAX	Maximum
MAX CLB	Maximum Climb
MAX DES	Maximum Descent
MAX END	Maximum Endurance
MC	Master Caution
MCDU	Multipurpose Control and Display Unit
MCT	Maximum Continuous Thrust
MCU	Modular Concept Unit
MDA	Minimum Descent Altitude
MDDU	Multifunction Disk Drive Unit
MDH	Minimum Descent Height
MECH	Mechanic
MEA	Minimum En Route Altitude
MED	Medium
MEL	Minimum Equipment List
MFA	Memorized Fault Annunciator
MIN	Minimum
MKR	Marker
MLA	Maneuver Load Alleviation
MLS	Microwave Landing System
MLW	Maximum Landing Weight
MM	Middle Marker
MMEL	Master Minimum Equipment List
MMO	Maximum Operating Mach

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Abbreviation	Term
MMR	Multi Mode Receiver
MN	Mach number
MORA	Minimum Off Route Altitude
MRIU	Maintenance and Recording Interface Unit
MSA	Minimum Safe Altitude
MSG	Message
MSL	Mean Sea Level
MSU	Mode Selector Unit
MTBF	Mean Time Between Failure
MTOW	Maximum Takeoff Weight
MZFW	Maximum Zero Fuel Weight

N

Abbreviation	Term
N/A	Not Applicable
NA	Not Applicable
N1	Low Pressure Rotor Speed (in %)
N2	High Pressure Rotor Speed (in %)
NACA	National Advisory Committee for Aeronautics
NAI	Engine Nacelle Anti-Ice
NAV	Navigation
NAVAID	Navigation Aid
NCD	Non Computed Data
ND	Navigation Display
NDB	Non Directional Beacon
NLG	Nose Landing Gear
NORM	Normal
NW	Nosewheel
NWS	Nosewheel Steering

O

Abbreviation	Term
O/P	Output
OANS	On-board Airport Navigation System
OAT	Outside Air Temperature
OBRM	On Board Replaceable Module
OEB	Operations Engineering Bulletin
OFF/R	Off Reset
OFST	Offset
OIS	Onboard Information System

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Abbreviation	Term
OIT	Onboard Information Terminal
OM	Outer Marker
OP	Open
OPP	Opposite
OPS	Operations
OPT	Optimum
OUTB	Outbound
OUTR	Outer
OVBD	Overboard
OVHD	Overhead
OVHT	Overheat
OVRD	Override
OVSPD	Overspeed
OXY	Oxygen

P

Abbreviation	Term
P/N	Part Number
PN	Part Number
PA	Passenger Address
P-ALT	Profile Altitude
PAX	Passenger
PBE	Protective Breathing Equipment
P-CLB	Profile Climb
PCU	Power Control Unit
P-DES	Profile Descent
PDB	Performance Data Base
PDU	Pilot Display Unit
PERF	Performance
PES	Passenger Entertainment System
PF	Pilot Flying
PFC	Porous Friction Course
PFD	Primary Flight Display
PHC	Probes Heat Computer
P-MACH	Profile Mach
PM	Pilot Monitoring
PNL	Panel
POB	Pressure Off Brake
POS	Position
PPOS	Present Position

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Abbreviation	Term
PPU	Position Pick-off Unit
PR	Pressure
PRED	Prediction
PRESS	Pressure, Pressurization
PROC	Procedure
PROC T	Procedure Turn
PROF	Profile
PROG	Progress
PROTEC	Protection
P-SPEED	Profile Speed
PSL	Product Structure Level
PSU	Passenger Service Unit
PT	Point
PTR	Printer
PTT	Push To Talk
PTU	Power Transfer Unit (Hydraulic)
PVI	Paravisual Indicator
PWR	Power
PWS	Predictive Windshear System

Q

Abbreviation	Term
QAR	Quick Access Recorder
QFE	Field Elevation Atmosphere Pressure
QFU	Runway Heading
QNE	Sea Level Standard Atmosphere Pressure (1013 hPa)
QNH	Sea Level Atmosphere Pressure
QRH	Quick Reference Handbook
QT	Quart (US)
QTY	Quantity

R

Abbreviation	Term
R/I	Radio/Inertial
RA	Radio Altimeter
RA	Resolution Advisory
RACC	Rotor Active Clearance Control
RAD	Radio
RAIM	Receiver Autonomous Integrity Monitoring
RAT	Ram Air Turbine

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Abbreviation	Term
RATC	Remote ATC Box
RCDR	Recorder
RCL	Recall
RCVR	Receiver
REAC	Reactive
REC	Recommended
RED	Reduction
REG	Regulation
REL	Release
REV	Reverse
RH	Right-Hand
RLSK	Right Line Select Key
RMI	Radio Magnetic Indicator
RMP	Radio Management Panel
RNAV	Area Navigation
RNG	Range
RNP	Required Navigation Performance
ROP	Runway Overrun Protection
ROPS	Runway Overrun Prevention System
ROW	Runway Overrun Warning
RPCU	Residual Pressure Control Unit
RPM	Revolution Per Minute
RPTG	Repeating
RQRD	Required
RSV	Reserves
RTE	Route
RTL	Rudder Travel Limit
RTO	Rejected Takeoff
RTOW	Regulatory Takeoff Weight
RUD	Rudder
RVSM	Reduced Vertical Separation Minimum
RWY	Runway

S

Abbreviation	Term
S	South
S/C	Step Climb
S/D	Step Descent
S/D	Shut Down
S/F	Slats/Flaps

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Abbreviation	Term
S/N	Serial Number
SN	Serial Number
SAAAR	Special Aircrew and Aircraft Authorization Required
SAT	Static Air Temperature
SATCOM	Satellite Communication
SC	Single Chime
SCP	Software Control Panel
SD	System Display
SDAC	System Data Acquisition Concentrator
SDCU	Smoke Detection Control Unit
SDF	Simplified Directional Facility
SEC	Spoiler Elevator Computer
SEL	Selector
SFCC	Slat/Flap Control Computer
SFE	Seller-Furnished Equipment
SID	Standard Instrument Departure
SIM	Simulation
SLT	Slat
SPD	Speed
SPD LIM	Speed Limit
SPLR	Spoiler
SRS	Speed Reference System
STAR	Standard Terminal Arrival Route
STAT	Static
STAT INV	Static Inverter
STBY	Standby
STD	Standard
STEER	Steering
STRG	Steering
STS	Status
SWTG	Switching
SYNC	Synchronize
SYS	System

T

Abbreviation	Term
T.O	Takeoff
T/O	Takeoff
TO	Takeoff
T/C	Top of Climb

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Abbreviation	Term
T/D	Top of Descent
TA	Traffic Advisory
TAC	Taxiing Aid Camera
TACAN	Tactical Air Navigation
TACT	Tactical
TAS	True Air Speed
TAT	Total Air Temperature
TAU	Time to intercept
TAWS	Terrain Awareness and Warning System
TBC	To Be Confirmed
TBD	To Be Determined
TCAS	Traffic Alert and Collision Avoidance System
TDU	Temporary Documentary Unit
TEMP	Temperature
TFTS	Terrestrial Flight Telephon System
TGT	Target
THR	Thrust
THS	Trimmable Horizontal Stabilizer
TK	Tank
TK	Track angle
TKE	Track Angle Error
TLA	Throttle Lever Angle
TLU	Travel Limitation Unit
TMR	Timer
TOGA	Takeoff - Go-Around
TOGW	Takeoff Gross Weight
TOW	Takeoff Weight
T-P	Turn Point
TPIS	Tire Pressure Indicating System
TR	Transformer Rectifier
T-R	Transmitter-Receiver
TRANS	Transition
TRK	Track
TROPO	Tropopause
TRU	Transformer Rectifier Unit
TRV	Travel
TSM	Trouble Shooting Manual
TTG	Time to Go
TVMC	Minimum Control Speed Temperature
TWY	Taxiway

U

Abbreviation	Term
UFD	Unit Fault Data
ULB	Underwater Locator Beacon
UNLK	Unlock
UP	Up, Upper
UTC	Universal Coordinated Time

V

Abbreviation	Term
V/S	Vertical Speed
V1	Decision Speed
V2	Takeoff Safety Speed
VAPP	Approach Speed
VBV	Variable Bypass Valve
VC	Calibrated airspeed
VDEV	Vertical Deviation
VEL	Velocity
VERT	Vertical
VERT REV	Vertical Revisor
VFE	Maximum Speed for each Flap configuration
VFEN	VFE Next
VFTO	Final Takeoff Speed
VHF	Very High Frequency
VHV	Very High Voltage
VIB	Vibration
VIP	Vertical Intersection Point
VLE	Maximum Landing Gear Extended Speed
VLS	Lowest Selectable Speed
VLV	Valve
VM	Maneuvering Speed
VMAX	Maximum Allowable Speed
VMC	Visual Meteorological Conditions
VMCA	Minimum Control Speed in the Air
VMCG	Minimum Control Speed on Ground
VMCL	Minimum Control Speed at Landing
VMIN	Minimum Operating Speed
VMO	Maximum Operating Speed
VMU	Minimum Unstick Speed
VOR	VHF Omnidirectional Range
VOR-D	VOR-DME

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Abbreviation	Term
VR	Rotation Speed
VREF	Landing Reference Speed
VSI	Vertical Speed Indicator
VSV	Variable Stator Vane
VU	Visual Unit

W

Abbreviation	Term
WAI	Wing Anti-Ice
WARN	Warning
WBC	Weight and Balance Computer
WBS	Weight and Balance System
WGD	Windshield Guidance Display
WHC	Window Heat Computer
WNDW	Window
WPT	Waypoint
WSHLD	Windshield
WT	Weight
WTB	Wing Tip Brake
WXR	Weather Radar

X

Abbreviation	Term
XBLD	Crossbleed
XCVR	Transceiver
XFR	Transfer
XMTR	Transmitter
XPDR	Transponder
XTK	Crosstrack Error

Y

Abbreviation	Term

Z

Abbreviation	Term
ZFCG	Zero Fuel Center of Gravity
ZFW	Zero Fuel Weight
ZFWCG	Zero Fuel Weight Center of Gravity field

OPERATIONAL PHILOSOPHY

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Localization Title	Toc Index	ID	Reason
OP-030 AP, FD, A/THR Mode Changes and Reversions	C	1	Effectivity update: The information now also applies to MSN 1060.

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INTRODUCTION

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.

GOLDEN RULES FOR PILOTS

INTRODUCTION

The Airbus "Golden Rules for Pilots" are operational guidelines, based on all of the following:
- Basic flying principles
- The adaptation of these basic flying principles to modern-technology aircraft
- The provision of information about required crew coordination for the operation of Airbus aircraft.

The objective of these Golden Rules is to also take into account the principles of flight crew interaction with automated systems, and the principles of Crew Resource Management (CRM), in order to help prevent the causes of many accidents or incidents and to ensure flight efficiency.

GENERAL GOLDEN RULES

The following four Golden Rules for Pilots are applicable to all normal operations, and to all unexpected or abnormal/emergency situations:

1. ***Fly. Navigate. Communicate:*** *In this order and with appropriate tasksharing.*
   Fly! Navigate! Communicate! The flight crew must perform these three actions in sequence and must use appropriate tasksharing in normal and abnormal operations, in manual flight or in flight with the AP engaged.

The following explains each of the three actions, and the steps associated with the performance of these actions:

- ***Fly***

  "**Fly**" indicates that:
  - **The Pilot Flying** (**PF**) must concentrate on "**flying the aircraft**" to monitor and control the pitch attitude, bank angle, airspeed, thrust, sideslip, heading, etc., in order to achieve and maintain the desired targets, vertical flight path, and lateral flight path.
  - **The Pilot Monitoring** (**PM**) must assist the PF and must **actively monitor** flight parameters, and call out any excessive deviation. The PM's role of "actively monitoring" is very important.

  Therefore, both flight crewmembers must:
  - Focus and concentrate on their tasks to ensure appropriate tasksharing
  - Maintain situational awareness and immediately resolve any uncertainty as a crew.

- ***Navigate***

  "**Navigate**" refers to and includes the following four ***"Know where ..."*** statements, in order to ensure situational awareness:
  - Know **where you are…**
  - Know **where you should be…**
  - Know **where you should go…**
  - Know **where the weather, terrain, and obstacles are**.

- ***Communicate***

  "Communicate" involves effective and appropriate crew communication between the:
  - PF and the PM
  - Flight crew and Air Traffic Control (ATC)
  - Flight crew and the cabin crew
  - Flight crew and the ground crew.

  Communication enables the flight crew to safely and appropriately perform the flight, and enhance situational awareness. To ensure good communication, the flight crew should use **standard phraseology** and the **applicable callouts.**

  In abnormal and emergency situations, the PF must recover a steady flight path, and the flight crew must identify the flight situation. The PF must then inform ATC and the cabin crew of:
  - The flight situation
  - The flight crew’s intentions.

The flight crew must therefore always keep in mind the key message:
Fly the Aircraft, Fly the Aircraft, Fly the Aircraft...

To safely and appropriately perform a flight, both flight crewmembers must have basic flying skills, and must be able to fly with appropriate tasksharing in all situations.

2. ***Use the appropriate level of automation at all times.***

   Aircraft are equipped with several levels of automation, used to perform specific tasks. The flight crew must determine the appropriate level of interaction with automated systems, based on the flight situation (e.g. Visibility, incapacitation, system malfunction, etc.), and the task to be performed.

   To use the appropriate level of automation at all times, the flight crew must:
   - **Determine and select** the appropriate level of automation that can include manual flight
   - **Understand** the operational effect of the selected level of automation
   - **Confirm that the aircraft reacts as expected.**

3. ***Understand the FMA at all times.***

   The flight crew must confirm the operational effect of all actions on the FCU , or on the MCDU , via a crosscheck of the corresponding annunciation or data on the PFD and on the ND.

   At all times, the flight crew should be aware of the following:
   - Guidance modes (armed or engaged)
   - Guidance targets
   - Aircraft response in terms of attitude, speed, and trajectory
   - Transition or reversion modes.

   Therefore, to ensure correct situational awareness, at all times, the flight crew must:
   - **Monitor the FMA**
   - **Announce the FMA**
   - **Confirm the FMA**
   - **Understand the FMA**.

4. ***Take action if things do not go as expected***

   If the aircraft does not follow the desired vertical or lateral flight path, or the selected targets , and if the flight crew does not have sufficient time to analyze and solve the situation, the flight **crew must immediately take appropriate or required actions**, as follows:

   The PF should change the level of automation:
   - From managed guidance to selected guidance, or
   - From selected guidance to manual flying.

   The PM should perform the following actions in sequence:
   - Communicate with the PF
   - Challenge the actions of the PF, when necessary
   - Take over, when necessary.


GOLDEN
RULES
FOR PILOTS
AIRBUS


1 Fly, navigate and communicate:
In this order and with appropriate tasksharing
2 Use the appropriate level of automation at all times
3 Understand the FMA at all times
4 Take action if things do not go as expected
AIRBUS

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INTRODUCTION

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

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.

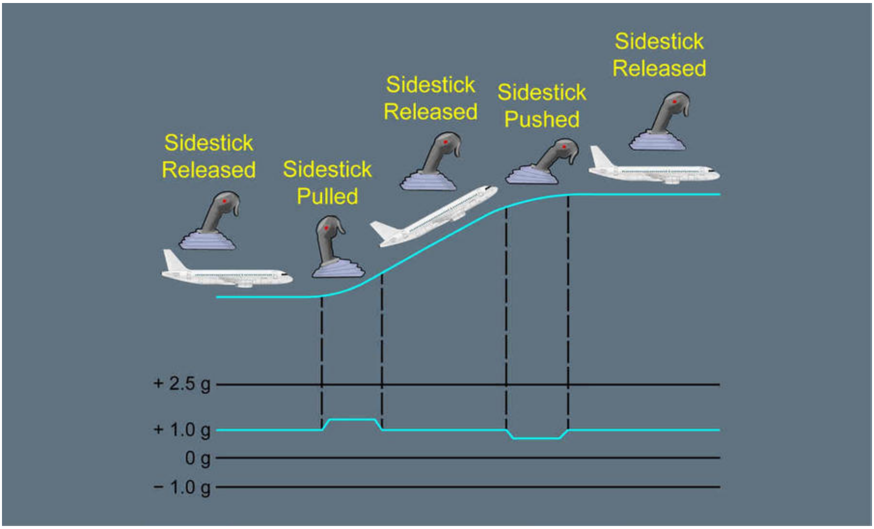
CHARACTERISTICS IN PITCH

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

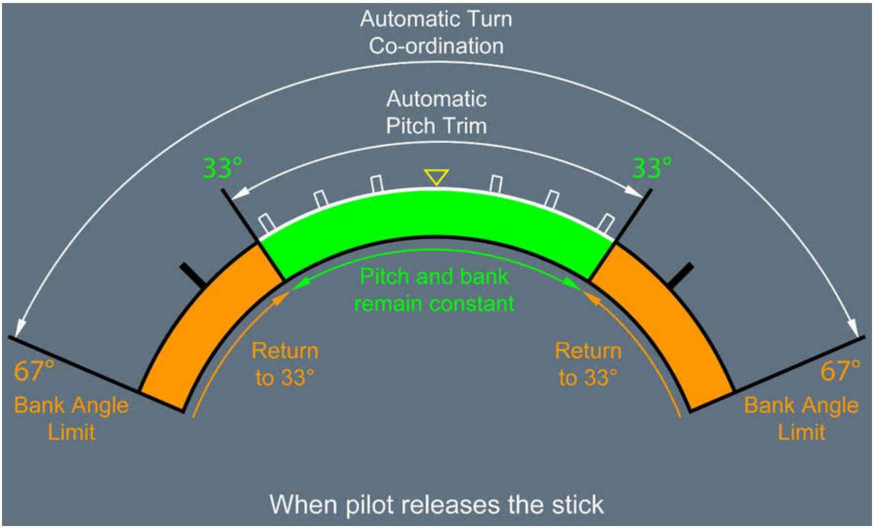
NORMAL CONDITIONS

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:

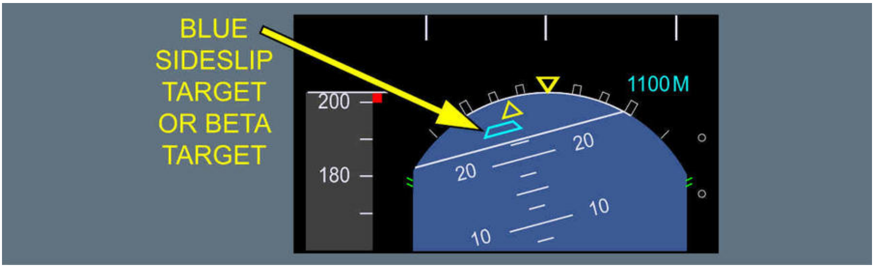
- Lateral pressure on the sidestick to maintain bank
- Aft pressure on the sidestick to maintain level flight.

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

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 ADR s, 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

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

Ident.: OP-020-00005431.0001001 / 22 APR 16
Applicable to: ALL

The ECAM and PFD indicate any control law degradation.

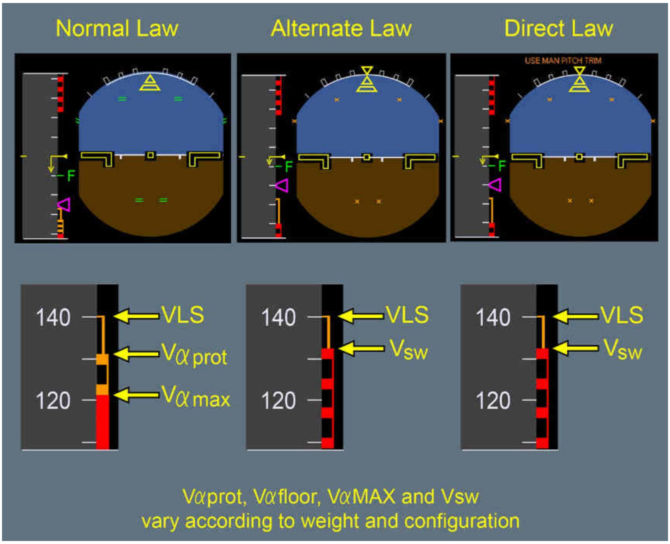
ON THE ECAM

- **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

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

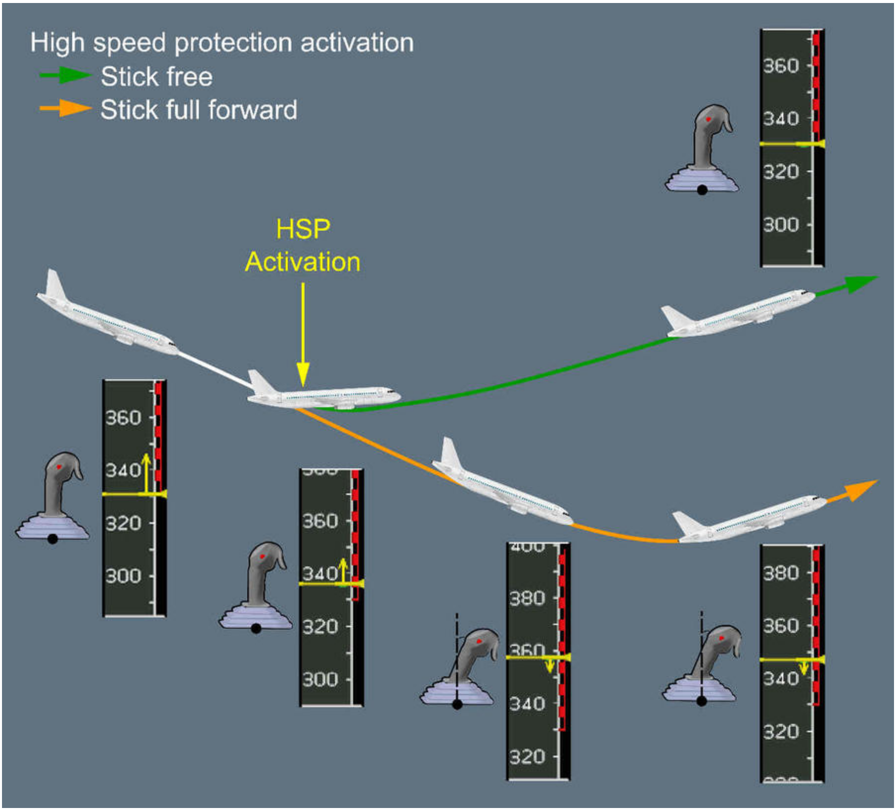
HIGH SPEED PROTECTION

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.

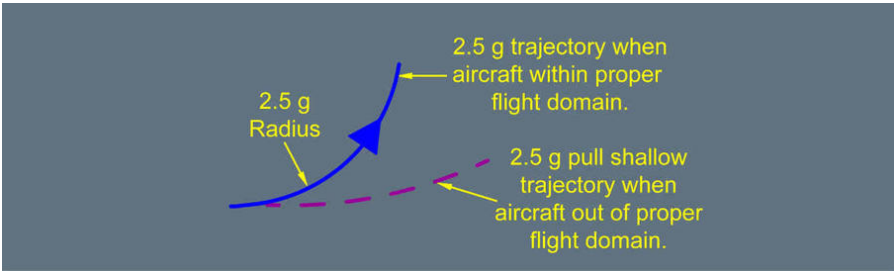
LOAD FACTOR PROTECTION

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.

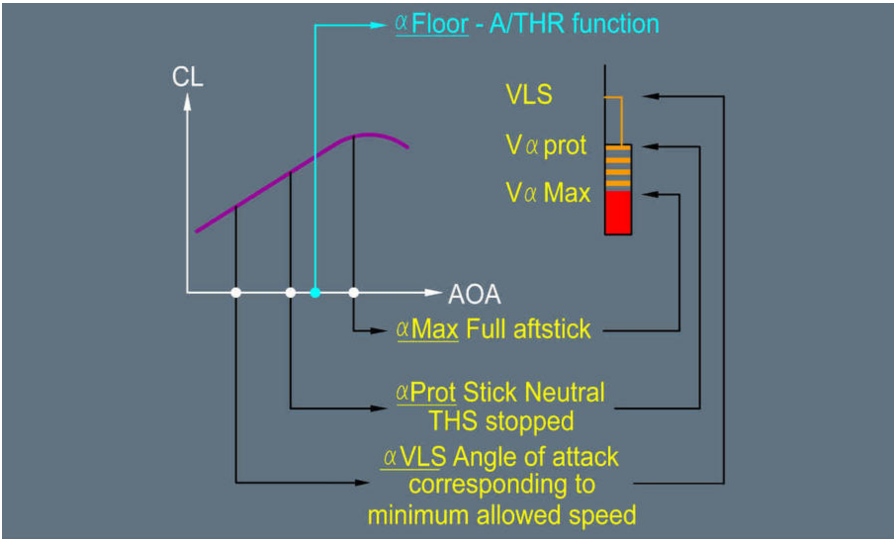
HIGH ANGLE-OF-ATTACK (AOA) PROTECTION

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, warns 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:

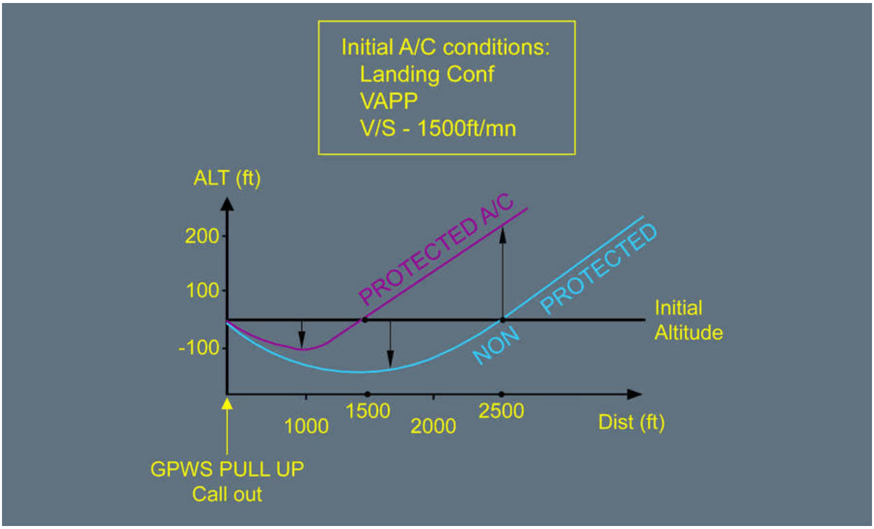
When flying at alpha max, the PF can make gentle turns, if necessary.
The PF must not deliberately fly the aircraft in alpha protection, except for brief periods, when maximum maneuvering speed is required.
If alpha protection is inadvertently entered, the PF must exit it as quickly as possible, by easing 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

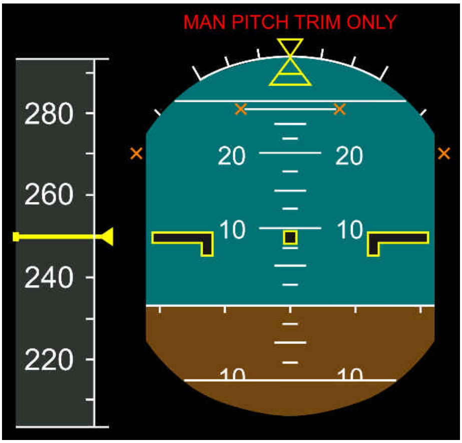


The above-illustrated are typical trajectories flown by all protected or not protected aircraft, when the PF applies the escape procedure after an aural " GPWS PULL UP" alert.
The graph demonstrates the efficiency of the protection, to ensure a duck-under that is 50 % lower, a bucket-distance that is 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 <u>all</u> 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

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



SIDESTICK AND TAKEOVER P/B

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.

USE OF RUDDER

GENERAL

In flight, the rudder controls the yaw, and the vertical stabilizer ensures directional stability. The rudder and the vertical stabilizer are designed to :

- Provide sufficient lateral/directional control of the aircraft during crosswind takeoffs and landings, within the certified crosswind limits
- Provide aircraft control in the case of an engine failure, and maximum asymmetric thrust at any speed above the minimum control speed on ground (VMCG).

Flight crew controls the rudder via a conventional mechanical rudder control. FACs computers provide:

- Yaw damping
- Rudder travel limitation

For more information about yaw control, *Refer to FCOM/DSC-27-10-20 Yaw Control - General*

OPERATIONAL RECOMMENDATIONS

In order to avoid exceeding structural loads on the rudder and vertical stabilizer, the following recommendations must be observed.

THE RUDDER IS DESIGNED TO CONTROL THE AIRCRAFT, IN THE FOLLOWING SITUATIONS

A. In normal Operations, For lateral control

- During takeoff roll, when on ground, particularly in crosswind conditions
- During landing flare with crosswind, for decrab purposes
- During the landing roll, when on the ground.

In the above situations, large and even rapid rudder inputs may be necessary in order to maintain control of the aircraft.
The flight crew should always apply the rudder corrections as necessary, in order to obtain the appropriate aircraft response.
On Airbus aircraft, the rudder control system includes a turn coordination function to achieve acceptable turn coordination,.

B. To counteract thrust asymmetry

Up to full rudder deflection can be used to compensate for the yawing moments that are due to asymmetric thrust.

Note: *At high speed (i.e. slats retracted), thrust asymmetry (eg. due to an engine failure) does not have a significant effect on the yaw control of the aircraft. The rudder deflection required to counter an engine failure and center the sideslip is small.*

C. In some other abnormal situations

The flight crew may also use the rudder pedals in some abnormal situations. For example:

- Loss of both yaw damper systems. The flight crew uses the rudder pedals as deemed necessary, for turn coordination to prevent excessive sideslip.
- Rudder trim runaway. The flight crew uses the rudder pedals in order to return the rudder to neutral
- Landing with an abnormal landing gear position: The flight crew uses the rudder pedals for directional control on the ground.

In all of the normal or abnormal situations that are described above, correct rudder pedals use does not affect the structural integrity of the aircraft.

Note: *In the event of a rudder travel limit system failure, refer to the relevant RUDDER TRAVEL LIMIT FAULT procedure.*

THE RUDDER SHOULD NOT BE USED

- To induce roll
- To counter roll, induced by any type of turbulence.

Regardless of the airborne flight condition, aggressive, full or nearly full, opposite rudder pedal inputs must not be applied. Such inputs can lead to loads higher than the limit, and can result in structural damage or failure. The rudder travel limiter system is not designed to prevent structural damage or failure in the event of such rudder system inputs.

Note: *The Operator policy must never include rudder pedal reversions. This restriction also applies to the so-called "aircraft defensive maneuvers" in order to disable or incapacitate hijackers.*

For dutch roll, the flight control laws combined with the neutral aircraft damping are sufficient to correctly damp the dutch roll oscillations. Therefore, the flight crew should not use the rudder pedals in order to complement the flight control laws.

SPECIFIC CASES: USE OF THE RUDDER DURING UPSET RECOVERY

The Airbus training program emphasizes the correct use of the rudder, particularly during maneuvers that are performed in order to recover upset. The industry-produced "AIRPLANE UPSET RECOVERY TRAINING AID" supports this training program.

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.

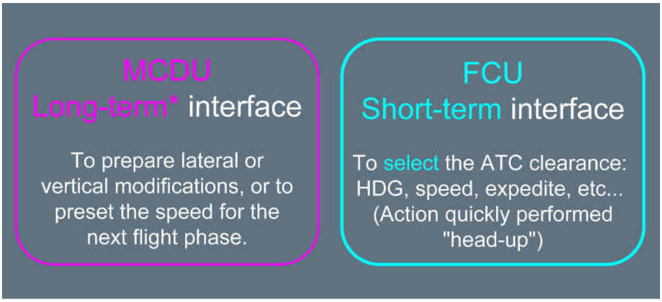
MANAGED AND SELECTED MODES

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

Managed 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).

MAIN INTERFACES WITH THE AP /FD



*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 inputs are performed:
- by the PM, or
- by the PF during a temporary transfer of command.

MCDU inputs must be crosschecked

Below 10 000 ft:

- Time-consuming entries should be avoided
- Entries should be restricted to those that have an operational benefit. (i.e. PERF APPR, DIR TO, INTERCEPT, RAD NAV, Late change of Runway, ACTIVATE SEC F-PLN, ENABLE ALTN)

FCU inputs are performed:
- by the PM (upon PF request) when the AP is OFF, or
- by the PF, when the AP is ON.

FCU inputs must be announced

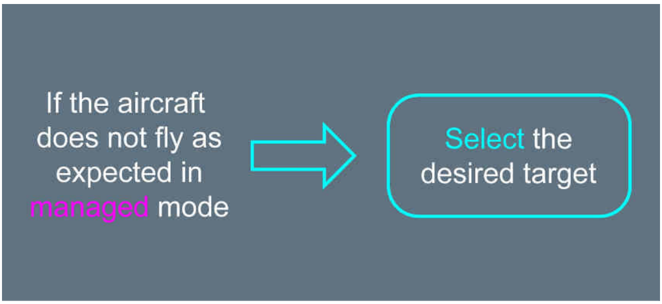
- The PF must check and announce the corresponding PFD/FMA target and mode
- The PM must crosscheck and announce "Checked".

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 ?



- 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 CAT 1 displayed on FMA
  - 500 ft for all others phases (900 ft for A321).

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 (900 ft AGL for A321). 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 AP 1(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.

Note: *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 FD s 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 FD s, to ensure that the A/THR is in SPEED mode, if the A/THR is active.

AUTOTHRUST (A/THR)

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.

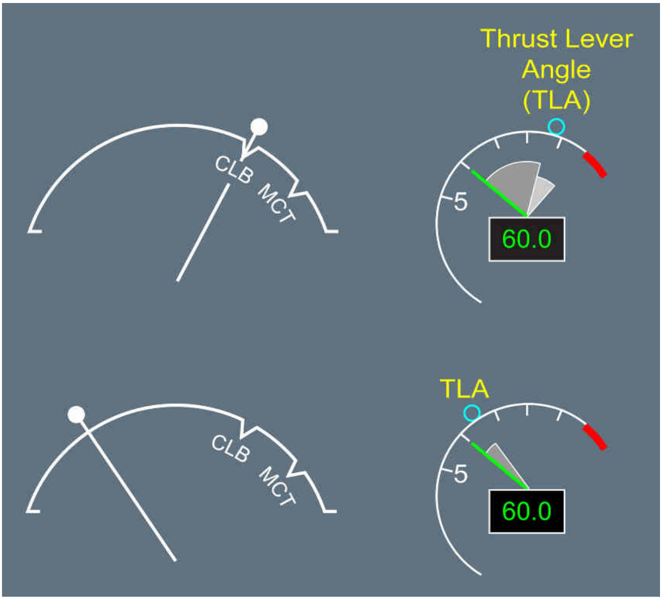
INTERFACE

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).

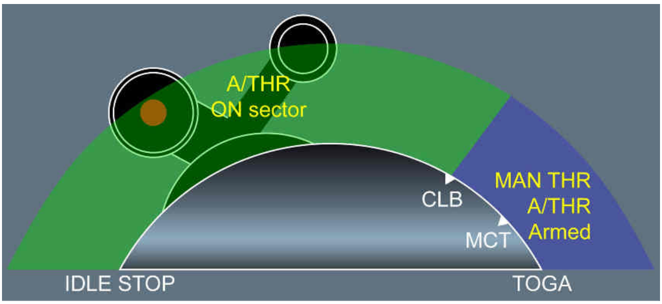
The TLA Determines Max Thrust for the A/THR



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.

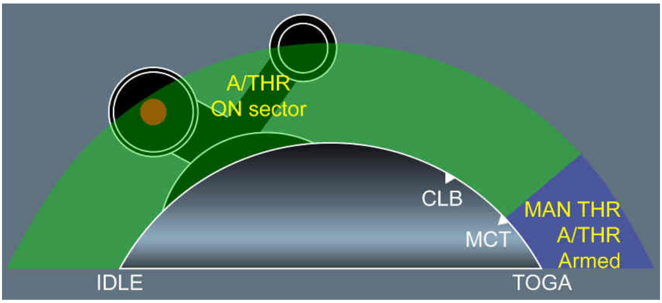
THRUST LEVER(S) BELOW THE CLB DETENT

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

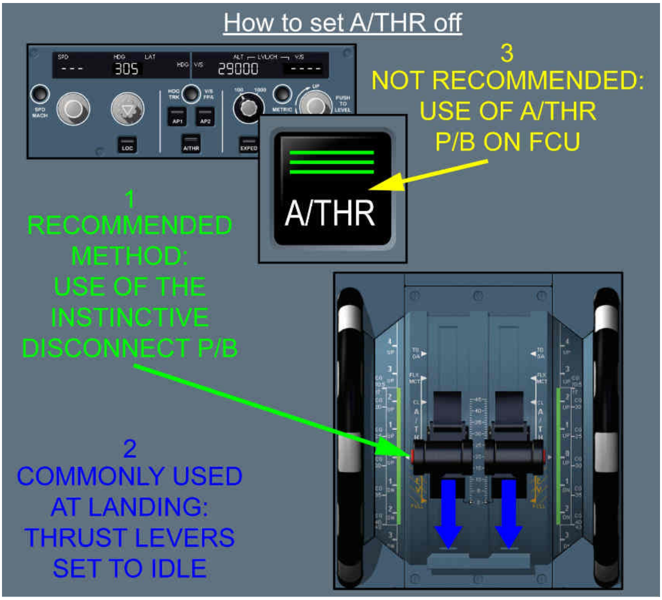
The above-noted principles also apply to an one-engine inoperative situation, except that A/THR can only be active, when thrust levers are set between IDLE and MCT.

A/THR Operating Technique: 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



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

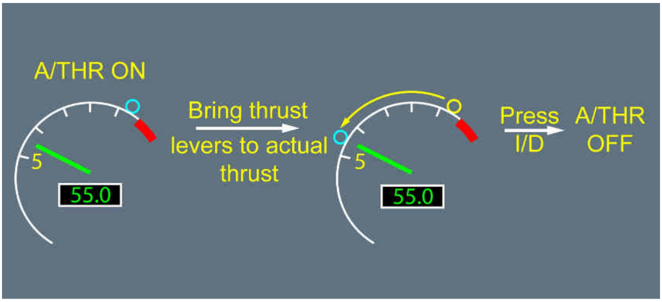
If the I/D pushbutton is pressed when the thrust levers are in CL detent, thrust will increase to MAX CL. This will cause an unwanted thrust increase and may destabilize the approach.

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 to 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.

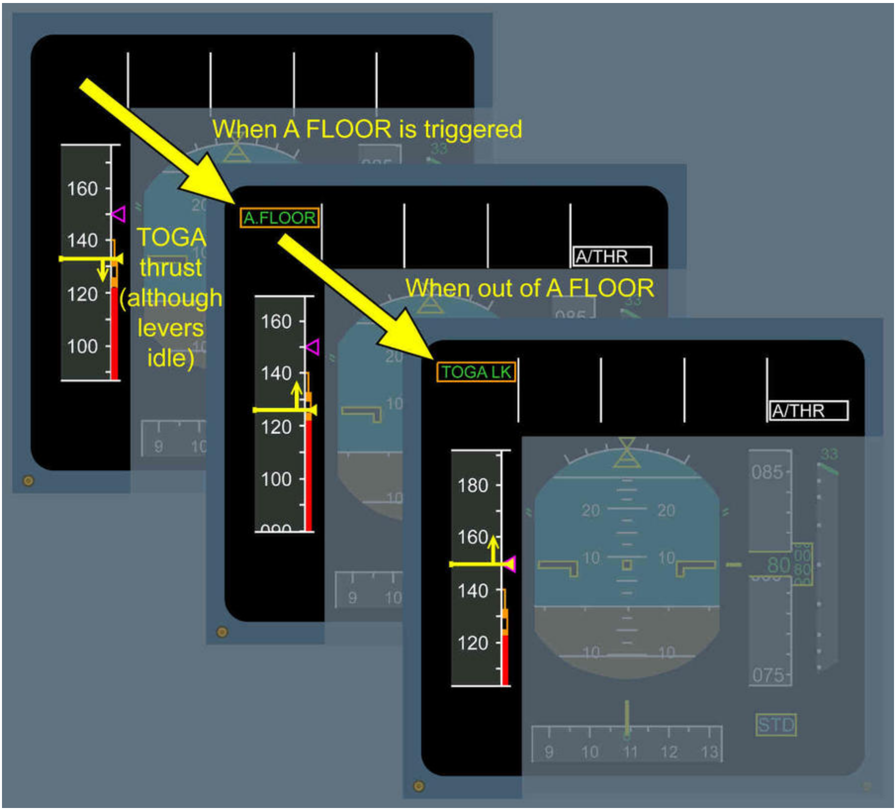
ALPHA FLOOR

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 Indication 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.

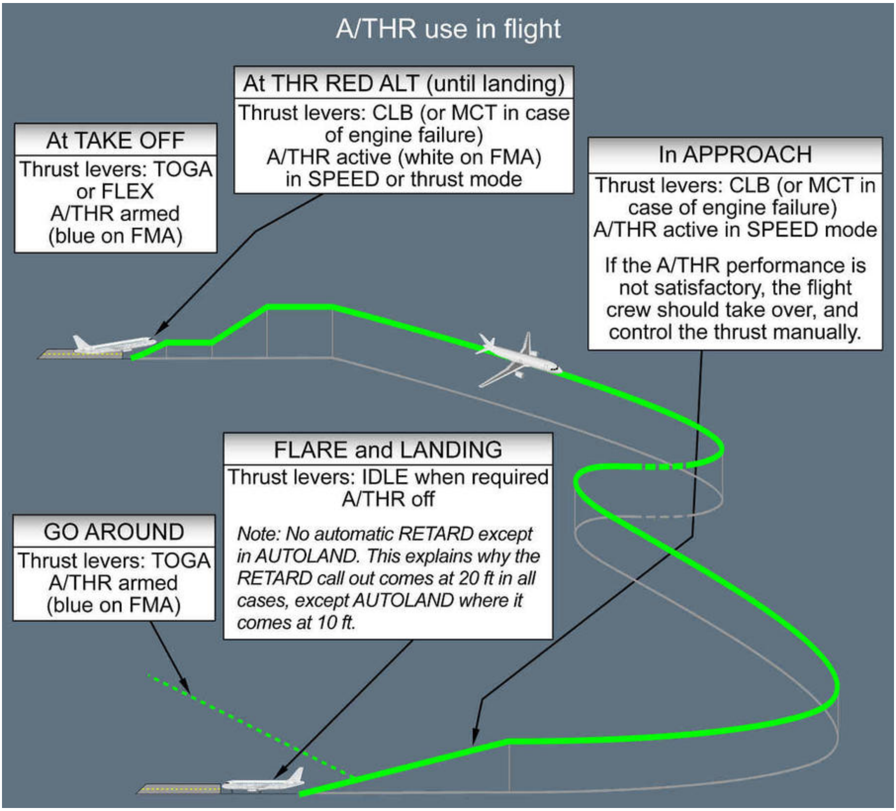
When the aircraft accelerates again, the angle-of-attack drops below the ALPHA FLOOR threshold. TOGA thrust is maintained or locked. This enables the flight crew to reduce thrust, as necessary. TOGA LK appears on the FMA to indicate that TOGA thrust is locked. The desired thrust can only be recovered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

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

AP, FD, A/THR MODE CHANGES AND REVERSIONS

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.*

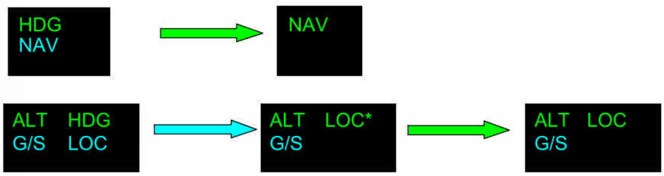
THE LOGICAL SEQUENCE OF MODES

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

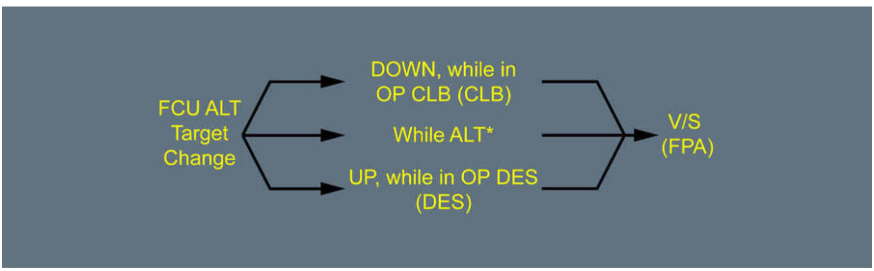
Mode reversions are automatic mode changes that unexpectedly occur, but are designed to ensure coherent AP , FD , and A/THR operations, in conjunction with flight crew input (or when entering a F-PLN discontinuity).

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.

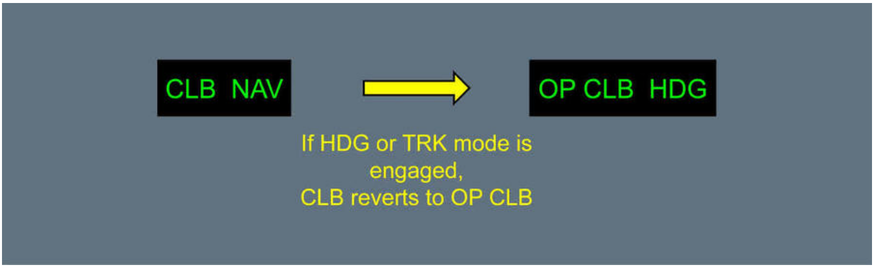
FLIGHT CREW HDG OR TRK MODE ENGAGEMENT ▸ DISENGAGEMENT OF ASSOCIATED MODE ON THE VERTICAL AXIS

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).

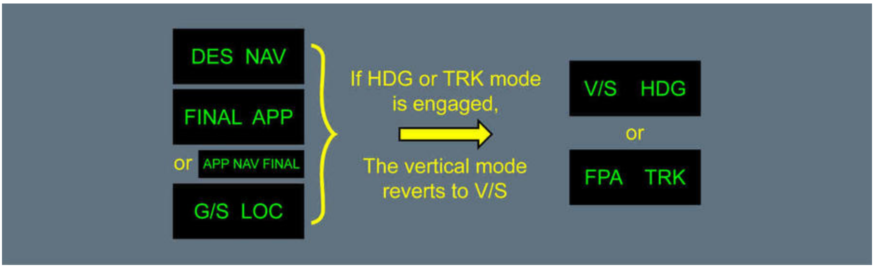
Vertical managed modes can only be used, if the lateral managed NAV mode is used. If the flight crew decides to divert from the lateral F-PLN , the autopilot will no longer guide the aircraft along the vertical F-PLN.
Therefore, in climb:

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.

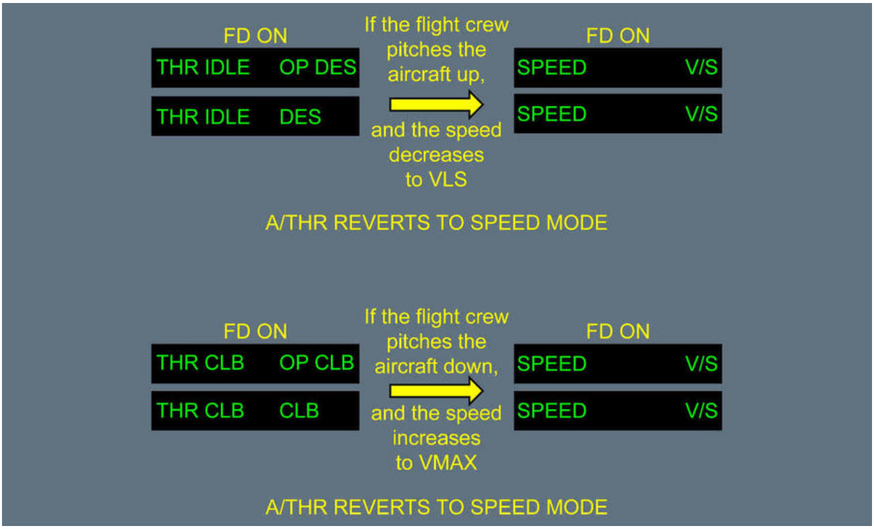
THE AIRCRAFT ENTERS A F-PLN DISCONTINUITY

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

1 **Applicable to: MSN 0517, 1060-2396**

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
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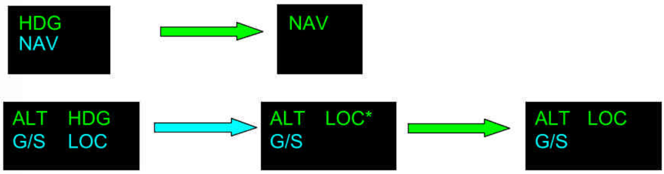

These logical mode changes occur, when the modes are armed. They appear in blue on the FMA.

MODE REVERSIONS

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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).

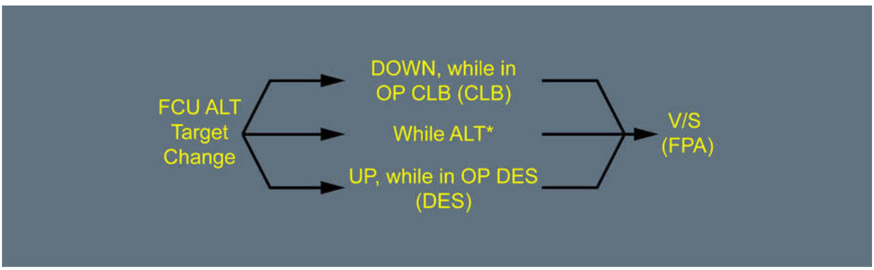
For example, a reversion will occur, when the flight crew:

- 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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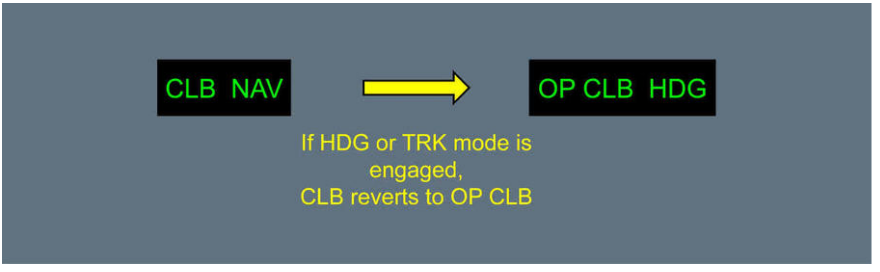
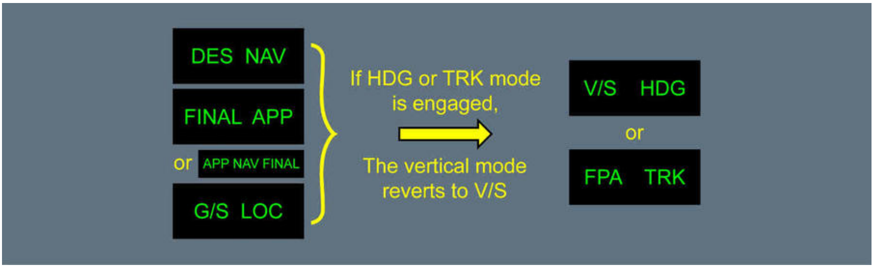
Therefore, in climb:

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.

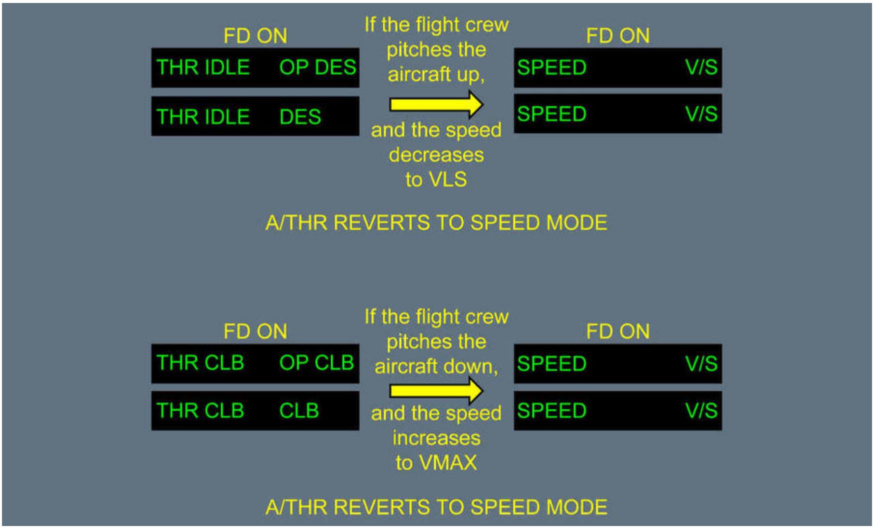
THE AIRCRAFT ENTERS A F-PLN DISCONTINUITY

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



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

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.*

PURPOSE OF THE ECAM

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

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

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

NORMAL OPERATIONS

On ground, the ECAM MEMO is reviewed for feedback on temporarily-selected items (e.g. SEAT BELTS/IGNITION/ENG A/I), and to check whether IRs are aligned. If alignment is not complete, the time remaining will be displayed. It is, therefore, not necessary to refer to the OVHD panel.
In cruise, the main systems should periodically be reviewed during flight (ENG , BLEED, ELEC AC /DC , HYD , FUEL, F/CTL), to ensure that they are operating normally, and to detect any potential problem in advance.
The ECAM MEMO must be included in the instrument review. In cruise, in most of the cases, it should be blank. It helps to make the flight crew aware of any system that a flight crewmember temporarily selected, but forgot to deselect.

A STS label, displayed at the bottom of the E/WD, indicates that there is a STATUS to be reviewed. Therefore, when a C/L calls for STATUS review, press STS, only if the label appears. If there is a STS at engine shutdown, it will pulse at the bottom of the E/WD. If this is the case, the STATUS page should be reviewed for help in completing the technical log.

ECAM ADVISORY

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

ABNORMAL OPERATIONS

TASK SHARING RULES

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

It is important to remember that, after ECAM ACTIONS announcement by the PF:
- The PF's task is to fly the aircraft, navigate, and communicate.
- The PM 's task is to manage the failure, on PF command.

The PF usually remains the PF for the entire flight, unless the Captain decides to take control. The PF will then control the aircraft's flight path, speed, configuration, and engines. The PF will also manage navigation and communication, and initiate the ECAM actions to be performed by the PM, and check that the actions are completed correctly.
The PM has a considerable workload: Managing ECAM actions and assisting the PF on request. The PM reads the ECAM and checklist, performs ECAM actions on PF command, requests PF confirmation to clear actions, and performs actions required by the PF . The PM never touches the thrust levers, even if requested by the ECAM.
Some selectors or pushbuttons (including the ENG MASTER switch, FIRE pushbutton, IR , IDG and, in general, all guarded switches) must be crosschecked by both the PF and PM (except on ground), before they are moved or selected, to prevent the flight crew from inadvertently performing irreversible actions. As a general rule, any computer reset must be also crosschecked by both the PF and PM.
To avoid mistakes in identifying the switches, Airbus' overhead panels are designed to be uncluttered. When the ECAM requires action on overhead panel pushbuttons or switches, the correct system panel can be identified by referring to the white name of the system on the side of each panel. Before performing any action, the PM should keep this sequence in mind: "System, then procedure/selector, then action" (e.g. "air, crossbleed, close"). This approach,

and announcing an intended selection before action, enables the PM to keep the PF aware of the progress of the procedure.

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

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

<u>Crew Coordination</u>

PF	PM
First pilot who notices: MASTER CAUTION/MASTER WARNING.... RESET ANNOUCE .... "TITLE OF FAILURE"	
FLY THE AIRCRAFT ORDER .... ECAM ACTIONS (2)	ECAM .... CONFIRM (1)
(3) ECAM ACTIONS COMPLETE .. CHECK CONFIRM .... CLEAR	ECAM ACTIONS / OEB .. PERFORM REQUEST .. CLEAR "name of SYS"? ECAM .... CLEAR
(4) CONFIRM .... CLEAR	SYSTEM PAGE .... ANALYSE REQUEST .. CLEAR "name of SYS"? SYSTEM DISPLAY .... CLEAR
CONFIRM .... STATUS (5) CONFIRM .... REMOVE STATUS	ANNOUNCE .... STATUS? STATUS .... READ REQUEST .... REMOVE STATUS? STATUS .... REMOVE (6) ANNOUNCE .... ECAM ACTIONS COMPLETED
SITUATON ASSESSEMENT/DECISION	

1. The PM should review the overhead panel and/or associated SD to analyze and confirm the failure, prior to taking any action, and should bear in mind that the sensors used for the SD may be different from the sensors that trigger the failure.

The flight crew must always rely on the CAB PR EXCESS CAB ALT warning, even if not confirmed on the CAB PRESS SD page, as the warning can be triggered by a cabin pressure sensor different from the one used to control the pressure and display the cabin altitude on the SD page.

2. In case of a failure during takeoff or go-around, ECAM actions should be delayed until the aircraft reaches approximately 400 ft, and is stabilized on a safe trajectory. This is an appropriate compromise between stabilizing the aircraft and delaying action.
3. When the ECAM displays several failures, the sequence (action, then request and confirmation, before clearance) should be repeated for each failure. When all necessary actions are completed, amber messages and red titles will no longer appear on the E/WD.
4. When the ECAM displays several system pages, the sequence (request and confirmation before clearance) should be repeated for each system page.
5. The PF may call out "STOP ECAM " at any time, if other specific actions must be performed (normal C/L , or performing a computer reset). When the action is completed, the PF must call out: "CONTINUE ECAM".
6. When slats are extended, the SD automatically displays the STATUS, unless if the page is empty. The STS should be carefully reviewed, and the required procedure applied.
7. When ECAM actions have been completed, and the ECAM status has been reviewed, the PM may refer to the FCOM procedure for supplementary information, if time permits. However, in critical situations the flight should not be prolonged only to consult the FCOM.

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.
- OEB Reminder
  Some Operational Engineering Bulletins (OEB s) contain information that may impact flight crew action, in the event of a system failure. OEBs are filed in the QRH.
  If the OEB reminder function is activated for an ECAM warning/caution, the ECAM will display the : "Refer to QRH Proc" line, when necessary. This line may appear instead of the procedure, or it may be added to the ECAM STATUS.
  In such failure cases, the flight crew should refer to the applicable procedure in the QRH.
- Some procedures require reference to the QRH

IN CASE OF AN ECAM SYSTEM FAULT

DISPLAY UNIT FAILURE

If one ECAM screen fails, the remaining one will display the E/WD. However, in such a case, if a failure or advisory occurs, the system or status page are not displayed automatically. The PM can display a system synoptic on the remaining display unit, by pressing the assigned system pushbutton on the ECP. The synoptic will appear, as long as the pushbutton is pressed.
Therefore, in the case of an advisory and/or failure (indicated by an ADV flag that pulses in white on the bottom of the E/WD), the PM must call up the affected system synoptic, by pressing the related pushbutton.
To review two or three pages of status messages: The PM should release the STS pushbutton for less than two seconds, then press and hold it again.

A double ECAM screen configuration can be recovered using the ECAM /ND switching selector:
- If the Captain is the PM, the switch should be set to "CPT".
- If the First Officer is the PM , the switch should be set to "F/O".

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

DMC FAILURES

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

ECP FAILURE

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

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

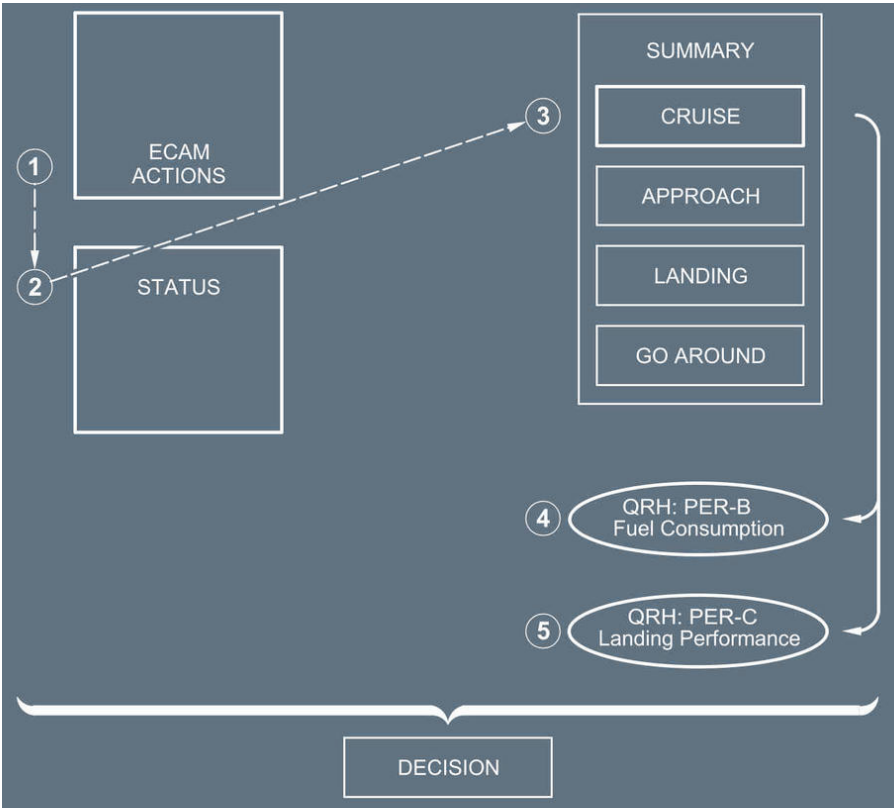
The RCL pushbutton allows to call up all ECAM alerts and the STATUS page that may have been suppressed by the CLR pushbutton or by the flight-phase-related inhibition.
Any alerts that have been inhibited by the EMER CANCEL pushbutton are displayed when the fly crew holds the RCL pusbutton down for more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

GENERAL

The summaries are QRH procedures created to help the flight crew to perform actions in the event of an ELEC EMER CONFIG, or a dual hydraulic failure.
The QRH summaries are divided into four sections: CRUISE, APPROACH, LANDING and GO-AROUND.

SITUATION ASSESSMENT WITH THE CRUISE SECTION OF THE QRH SUMMARY

Situation Assessment with the QRH Summary



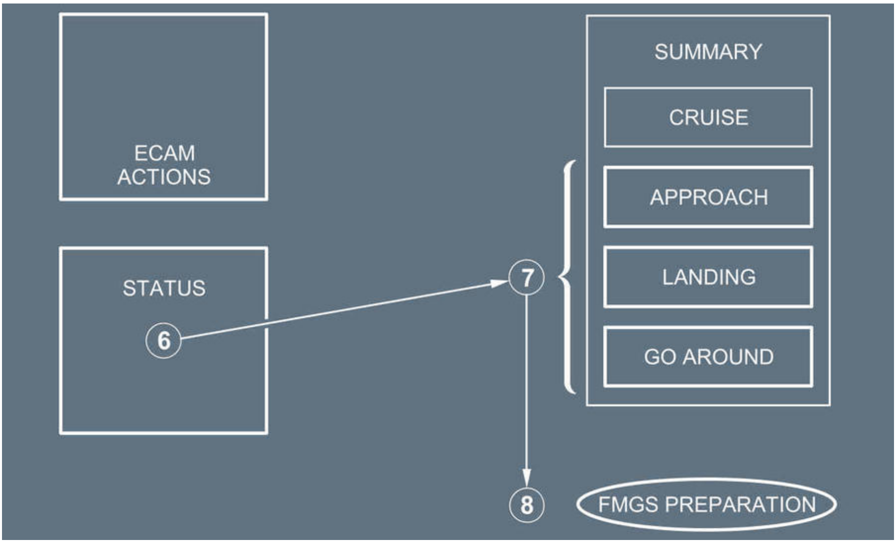
- **Step 1 & 2: The ECAM actions should be applied first.** This includes both the procedure, and the STATUS section. When ECAM actions are completed, the PM announces "ECAM ACTIONS COMPLETED". Then, the PM should refer to the corresponding QRH SUMMARIES.
- **Step 3:** After the review of the ECAM STATUS, the PM should refer to the CRUISE section of the QRH summaries. The CRUISE section highlights the remaining systems (in ELEC EMER configuration only), the main limitations, and the flight capability of the aircraft.

The CRUISE section helps the flight crew to assess the situation, and to select an appropriate runway for landing.

The flight crew should refers, as indicated in the CRUISE section, to the corresponding chapters of the QRH for:
- The evaluation of increased fuel consumption (PER-B) (**step 4**) and,
- The landing performance computation at the selected airport (PER-C) (**step 5**).

APPROACH PREPARATION

Approach Preparation with the QRH Summary

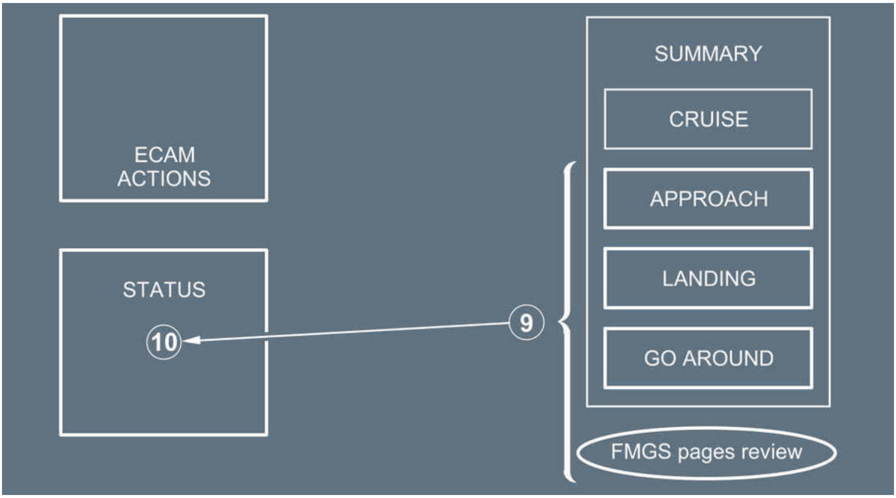


While reviewing the STATUS pages (**step 6**) for approach preparation, the section APPROACH LANDING and GO-AROUND are used to support the preparation (**step 7 & 8**).

When appropriate, these sections include the paper procedure that the flight crew must apply during the APPROACH, LANDING and GO-AROUND phases (LANDING WITH SLATS or FLAPS JAMMED procedure and/or the L/G GRAVITY EXTENSION procedure for example).

APPROACH BRIEFING

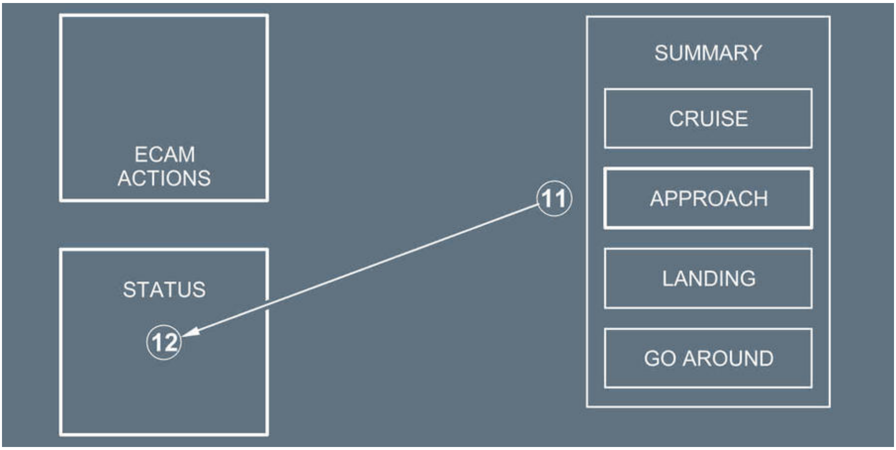
Approach Briefing with the QRH Summary



The section APPROACH, LANDING, and GO-AROUND of the QRH summary should be used to perform the approach briefing, while cross-checking the associated FMGS pages and the STATUS page (**step 9 & 10**).

APPROACH

Approach with the QRH Summary



To perform the approach, the flight crew should refer to the APPROACH section (**step 11**).
Once the aircraft is in final configuration, the LANDING and GO-AROUND sections can be shortly reviewed, as a reminder (braking, NWS , reversers, and L/G retraction in the case of go-around).
Finally, the PM should review the ECAM STATUS (**step 12**), and check that all the APPR PROC actions are completed.

NORMAL OPERATIONS

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NO-010 GENERAL

NO-020 Pre Start

NO-030 START

NO-040 Taxi

Continued on the following page

Continued from the previous page

NO-050 Takeoff

NO-060 CLIMB

NO-070 Cruise

NO-080 DESCENT PREPARATION

Continued on the following page

Continued from the previous page

NO-090 Descent

NO-100 HOLDING

NO-110 Approach General

NO-120 ILS Approach

NO-130 Non Precision Approach

Continued on the following page

Continued from the previous page

NO-140 CIRCLING APPROACH

NO-150 VISUAL APPROACH

NO-160 PRECISION APPROACH

NO-170 Landing

NO-180 Go Around

NO-190 Taxi In

Localization Title	Toc Index	ID	Reason
NO-020 EXTERIOR INSPECTION	E	1	Documentation update: Addition of "EXTERIOR INSPECTION" documentary unit
NO-020 EXTERIOR INSPECTION	E	2	Effectivity update: The information no longer applies to all MSN.
NO-020 COCKPIT PREPARATION	G	3	Effectivity update: The information now also applies to MSN 1060.
NO-030 ENGINE AUTO START	A	1	Effectivity update: The information now also applies to MSN 1060.
NO-030 AVERAGE IDLE ENGINE PARAMETERS	C	2	Effectivity update: The information now also applies to MSN 1060.
NO-050 Thrust Setting	A	1	Effectivity update: The information now also applies to MSN 1060.
NO-060 AP/FD CLIMB MODES	B	1	Effectivity update: The information now also applies to MSN 1060.
NO-070 FMS USE	B	1	Effectivity update: The information now also applies to MSN 1060.
NO-070 FMS USE: MISCELLANEOUS	D	2	Effectivity update: The information now also applies to MSN 1060.
NO-070 SPEED CONSIDERATIONS	F	3	Effectivity update: The information now also applies to MSN 1060.
NO-070 Step Climb	I	4	Effectivity update: The information now also applies to MSN 1060.
NO-090 MODE REVERSION	D	1	Effectivity update: The information now also applies to MSN 1060.
NO-090 DESCENT CONSTRAINTS	E	2	Effectivity update: The information now also applies to MSN 1060.
NO-110 Intermediate Approach	C	1	Effectivity update: The information now also applies to MSN 1060.
NO-110 Ground Speed MINI	E	2	Effectivity update: The information now also applies to MSN 1060.
NO-130 Intermediate Approach	E	1	Effectivity update: The information now also applies to MSN 1060.
NO-150 INITIAL APPROACH	A	1	Effectivity update: The information now also applies to MSN 1060.
NO-180 AP/FD GO-AROUND PHASE ACTIVATION	C	1	Effectivity update: The information now also applies to MSN 1060.
NO-180 GO-AROUND PHASE	D	2	Effectivity update: The information now also applies to MSN 1060.
NO-190 BRAKE TEMPERATURE	B	1	Effectivity update: The information now also applies to MSN 1060.

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INTRODUCTION

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, *Refer to SI-010 GENERAL*.
There are flow patterns at the end of some flight phases to indicate where the actions are to be performed. All flight crewmembers must apply the flow patterns, to ensure that the flight crew performs the actions necessary for a specific flight phase, before completing an applicable checklist.

USE OF NORMAL CHECK LIST

Airbus' NORMAL CHECKLIST takes into account ECAM information, and includes only those items that can directly impact flight safety and efficiency, if actions are not correctly performed. These checklists are of a "non-action" type (i.e. all actions should be completed from memory before the flight crew performs the checklist).
The NORMAL CHECKLIST includes 9 flight phases. The BEFORE START, BEFORE TAKEOFF, and AFTER TAKEOFF checklists are divided in two sections: The "Down to the Line" section, and the "Below the Line" section. This format is designed to help flight crews to manage the workload.
For example, the "BEFORE START - Down to the Line" checklist may be called out, as soon as the Load and Trim Sheet is available and takeoff data is set. On the other hand, the "BEFORE START - Below the Line" checklist may be called out after obtaining start-up clearance.
The Pilot Flying (PF) requests the NORMAL CHECKLIST, and the Pilot Monitoring (PM) reads it.
The checklist actions are referred to as "challenge/response"-type actions. The PF "responds" to the "challenge" only after checking the current status of the aircraft.
If the configuration does not correspond to the checklist response, the PF must take corrective action before "responding" to the "challenge". The PF may request that this action is performed by the PM depending on the situation. If corrective action is not possible, then the PF must modify the response to reflect the real situation (with a specific answer). When necessary, the other flight crewmember must crosscheck the validity of the response. The challenger (PM) waits for a response before proceeding with the checklist. For the checklist items that are identified as "AS RQRD", the response should correspond to the real condition or configuration of the system.
The PM must announce "LANDING CHECKLIST COMPLETE", after reading and completing the checklist.

TASK SHARING FOR SUPPLEMENTARY PROCEDURES

For Supplementary Procedures the tasksharing should be:

- If the procedure is related to engine start, it is recommended to read the entire procedure first and then:
  - The PM reads the actions, and
  - The PF acts on commands.
- Otherwise, the procedure is considered as read and do and is performed by the PM.

COMMUNICATION

EMERGENCY CALL

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

FROM	TO	PHRASEOLOGY	REMARKS
cockpit	cabin	Passenger Address (PA) System: "PURSER TO COCKPIT, PLEASE!"	The Purser, or any other cabin crewmember, must go to the cockpit
Cockpit	Cabin	Passenger Address (PA) System: "ATTENTION CREW! AT STATIONS!"	An emergency evacuation may soon be required.
cockpit	cabin	Passenger Address (PA) System: "CABIN CREW and PASSENGERS REMAIN SEATED!"	The captain decides that an evacuation is not required
cockpit	cabin	Passenger Address (PA) System: "PASSENGERS EVACUATE!"	The captain orders an immediate evacuation
cabin	cockpit	Interphone: "PRIO CAPT"	Any crew member can make such a call. The flight crew must reply.

CROSS-COCKPIT COMMUNICATION

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

Such adjustments and changes include:

- FMGS alterations
- Changes in speed or Mach
- Tuning navigation aids

- Flight path modifications
- System selections (e.g. anti-ice system).

When using cross-cockpit communication, standard phraseology is essential to ensure effective flight crew communication. This phraseology should be concise and exact, and is defined in the FCOM (*Refer to FCOM/PRO-NOR-SOP-90 Communications and Standard Terms*).
In addition to the standard callout, the flight crew should communicate to enhance situation awareness. As per PM role and in accordance with the Airbus golden rules, the PM should monitor and announce any situation that requires PF reaction or should takeover, when necessary.
This is the case for any deviation from the intended flight path, or any case that requires a new assessment of the flight situation and of the flight crew's intention.

STERILE COCKPIT RULE

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

CLEAN COCKPIT

Objects not stored in their dedicated area in the cockpit may fall and cause hazards such as damage the equipment or accidentally operate controls or pushbuttons. Airbus highly recommends that the flight crews put and store all objects in their dedicated area in the cockpit:
- Cups in the cup holders
- Books and paper, if any, in the lateral stowage
- Trash in the waste bin in the lateral console
- Meal trays on the floor behind the flight crew. The flight attendants should collect the meal trays as soon as possible
- Personal equipment properly secured in the various stowage area.

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MMEL/MEL

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.

MMEL ITEM NUMBERING

A code of three or four pairs of digits identifies each MMEL 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 MMEL, *Refer to MMEL/HOW TO USE section*.

MMEL CONTENTS

The MMEL has four sections:
- How to Use (HOW): This section contains general information and describes the organization of the manual.
- MMEL Entries (ME): This section lists all the ECAM alerts and gives a link to the associated MMEL 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.
- MMEL Items (MI):This section is approved by the EASA and lists all the MMEL items with the associated dispatch conditions.
- MMEL Operational Procedures (MO): This section gives the operational procedures that are associated with the MMEL items.

<u>Note:</u> *The MMEL 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 MMEL/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.

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?

SECURED AND TRANSIT STOP

The aircraft is:

- in TRANSIT STOP when the last check list performed by the flight crew is the PARKING C/L
- in SECURED STOP when the last check list performed by the flight crew is the SECURING THE AIRCRAFT C/L

The flight crew performs only the items indicated by an asterisk (*) in the Standard Operating Procedures (SOP's) when there is no flight crew change and after a TRANSIT STOP.
Otherwise, the flight crew performs all the items of the SOP's.

SAFETY EXTERIOR INSPECTION

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

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

PRELIMINARY COCKPIT PREPARATION

OBJECTIVES

The objectives of the preliminary cockpit preparation are:

- To ensure that all safety checks are performed before applying electrical power:
  - The RCL pb is pressed for at least 3 s to display the cautions and warnings from the previous flight.
  - The technical logbook and MEL are checked at this stage.
- To check the liquid levels i.e. oil, hydraulic and oxygen pressure using
  - The HYD pb is pressed to check the hydraulic level
  - The ENG pb is pressed to check engine oil level (*Refer to FCOM/PRO-NOR-SOP-04 ECAM*)
  - The DOOR pb is pressed, to check the oxygen pressure level
- To check the position of surface control levers e.g. slats/flaps, parking brake.

During the Preliminary Cockpit Preparation, the flight crew must also review all OEB s applicable to the aircraft. The flight crew must pay a particular attention to the red OEB s, and more particularly to the red OEB s that must be applied before the ECAM procedure.

OXYGEN

The ECAM S/D DOOR page displays the oxygen pressure. When the oxygen pressure is below a defined threshold, an amber half box highlights the value. This advises the flight crew that the bottle should be refilled. The flight crew should refer to the minimum flight crew oxygen pressure (*Refer to FCOM/LIM-35 Cockpit Fixed Oxygen System*). The prolonged dispatch of the aircraft in such condition is not recommended.

EXTERIOR INSPECTION

1

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
  - Correct closure/latching condition of the fan cowl doors.
  - Safety pins are removed.

EXTERIOR INSPECTION

2 **Applicable to: MSN 0517-0666, 1612-2396**

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
  - Correct closure/latching condition of the fan cowl doors.

ADIRS ALIGNMENT OR REALIGNMENT

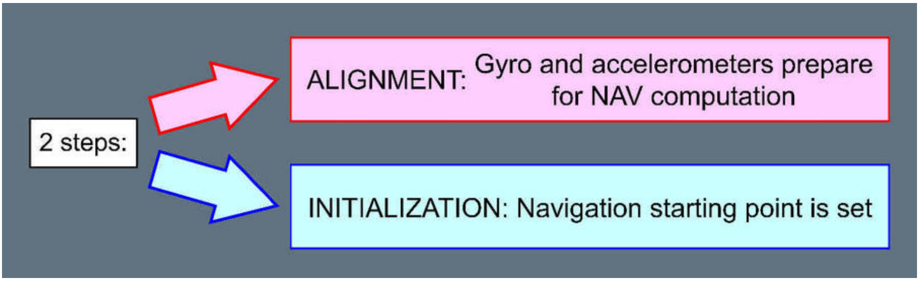
For operational procedures associated to ADIRS, *Refer to FCOM/PRO-SUP-34 IRS Alignment Conditions*.

The flight crew performs the alignment or realignment of IRS during the cockpit preparation. This action enables IRS to operate in NAV mode and to provide continuously the aircraft position.

The flight crew performs:
- The IRS alignment at the aircraft power up, and
- The IRS realignment in transit when the IRS are already in NAV mode and the flight crew wants to reset them for better navigation accuracy.

The flight crew can perform:
- An alignment or a realignment of IRS with a complete IRS alignment procedure, or
- A realignment of IRS with a Fast IRS alignment procedure.

The IRS alignment or realignment includes the following two steps:
- Alignment,
- Position Initialization.



ALIGNMENT STEP

During a complete alignment, IRS use the gravity and earth rotation to determine aircraft attitude and true heading, and IRS estimate the current aircraft latitude.
During a fast alignment, IRS reset the ground speed and some internal filters to 0, but IRS do not estimate the aircraft latitude.

POSITION INITIALIZATION STEP

To finish alignment or realignment, the flight crew initialized IRS to a navigation starting point.

AUTOMATIC POSITION INITIALIZATION (AIRCRAFT WITH MP P8194)

- **When the GPS is available:**
  IRS are automatically initialized with the GPS position.
  However, the flight crew can override the automatic position initialization. Therefore, IRS crosschecks the flight crew's manual entry with the GPS position.

- **When the GPS is not available, the flight crew must performed a manual position initialization.**

MANUAL POSITION INITIALIZATION (AIRCRAFT WITH OR WITHOUT MP P8194)

The coordinates of the departure Airport Reference Point (ARP) are displayed on the MCDU INIT page.
However, the most appropriate coordinates for IRS position initialization are the gate coordinates.
In this case, and in order to avoid entry errors, the flight crew should use the slew keys successively for latitude and longitude, instead of inserting the coordinates on the scratchpad.

CHECK OF ADIRS MODE

During the BEFORE START checklist, the flight crew checks that IRS are in NAV mode on the MCDU.
During taxi, a good way to check the global consistency of FMGC entries (Position and flight plan) is to check the runway and the SID on the ND , in comparison to the aircraft symbol that indicates the current aircraft position. To do so, set the ND in ARC or NAV mode with a range 10 NM.

COCKPIT PREPARATION

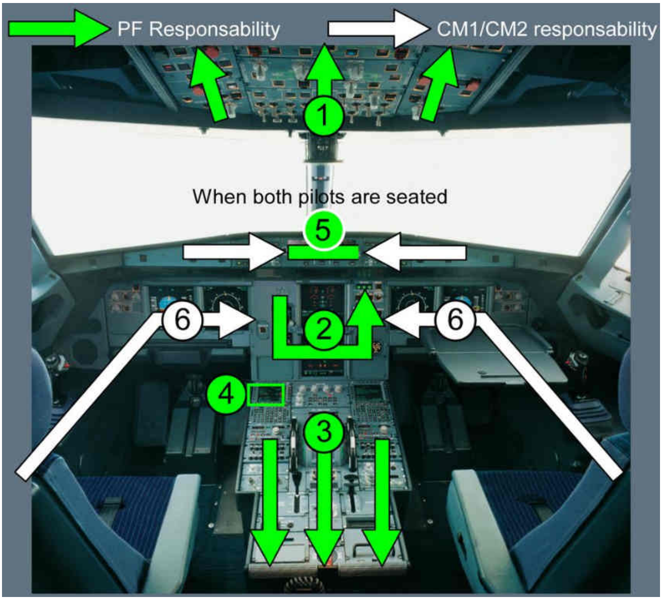
3 **Applicable to: MSN 0517-1060**

FLOW PATTERN

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

1. Overhead panel
2. Center instrument panel
3. pedestal
4. FMGS preparation, and when both pilots are seated:
5. Glareshield
6. Lateral consoles and CM1/CM2 panels

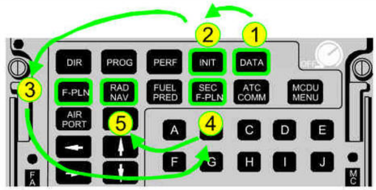
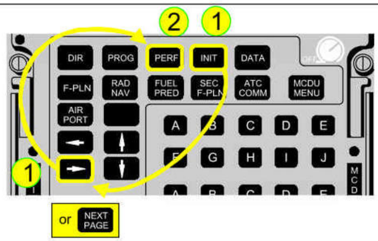
Cockpit preparation flow pattern



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 Init A F-PLN (SEC F-PLN) RAD NAV	
Performance	Init B 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, NAVAID s 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 Alignment or Realignment*). 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, or at a value defined by airline policy. The THR RED/ACC may be changed in the PERF TAKE-OFF page, if required. The flight crew should consider the applicable noise abatement procedure.

  The one-engine-out acceleration altitude must:
  - Be at least 400 ft above airport altitude
  - Ensure that the net flight path is 35 ft above obstacles
  - Ensure that the maximum time for takeoff thrust is not exceeded.

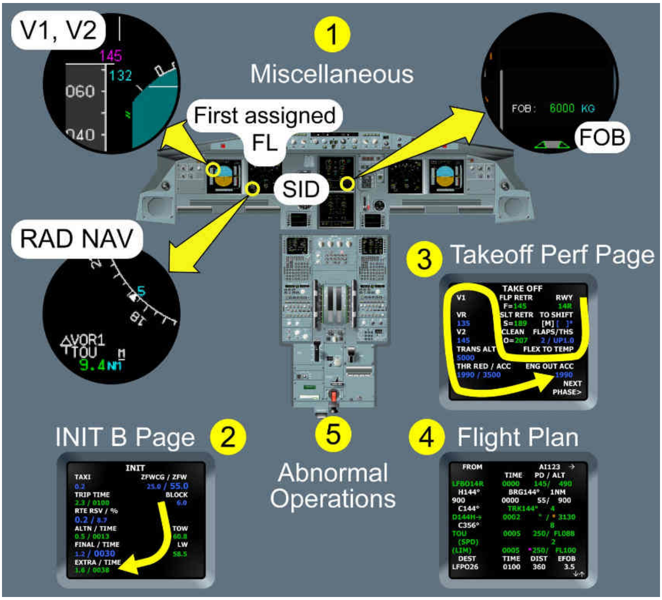
  Therefore, there are generally a minimum and a maximum one engine out acceleration altitude values. The minimum value satisfies the first two criteria. The maximum value satisfies the last one. Any value between those two may be retained.
  The one engine out acceleration altitude is usually defaulted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

The PF should perform the takeoff briefing at the gate , when the flight crew workload permits, Cockpit preparation has been completed and, before engine start.
The takeoff briefing should be relevant, concise and chronological. When a main parameter is referred to by the PF, both flight crewmembers must crosscheck that the parameter has been set or programmed correctly. The takeoff briefing covers the following:

Take off briefing with associated checks



1- Miscellaneous	
Aircraft type and model (Tail strike awareness)	
Aircraft technical status (MEL and CDL considerations, relevant OEB)	
NOTAMS	
Weather	
RWY conditions	
Use of ENG/Wing Anti Ice	
ENG Start Procedure	
Push Back	
Expected Taxi Clearance	
Use of Radar	
Use of Packs for Takeoff	
2- INIT B Page	
Block Fuel (1)	(FOB on EW/D)
Estimated TOW	
Extra time at destination	
3- Takeoff Perf Page	
TO RWY	
TO CONF	
FLEX / TOGA (1)	(FLEX TOGA on MCDU)

Continued on the following page

Continued from the previous page

3- Takeoff Perf Page	
V1 , VR , V2 [(1)]	(V1 , V2 on PFD)
TRANS ALT	
THR RED / ACC Altitude	
4- Flight Plan	
Minimum Safe Altitude	
First assigned FL [(1)]	(altitude target in blue on PFD)
Flight Plan description [(1)]	(SID on MCDU FPLN page)
RAD NAV [(1)]	(RAD NAV on ND)
5- Abnormal Operations	

For any failure before V1:
CAPT will call "STOP" or "GO"

In case of failure after V1:
continue TO , no actions before 400 ft AGL except gear up
reaching 400 ft AGL , ECAM actions
reaching EO ACC altitude

- If the engine is secured, level off, accelerate and clean up
- Otherwise continue climbing until the engine is secured (but not above EO maximum acceleration altitude)

at green dot: OP CLB, MCT , resume ECAM , after TO C/L, status
ENG OUT routing: EOSID , SID, radar vector, immediate return ...

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

COCKPIT PREPARATION

FLOW PATTERN

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

1. Overhead panel
2. Center instrument panel
3. pedestal
4. FMGS preparation, and when both pilots are seated:
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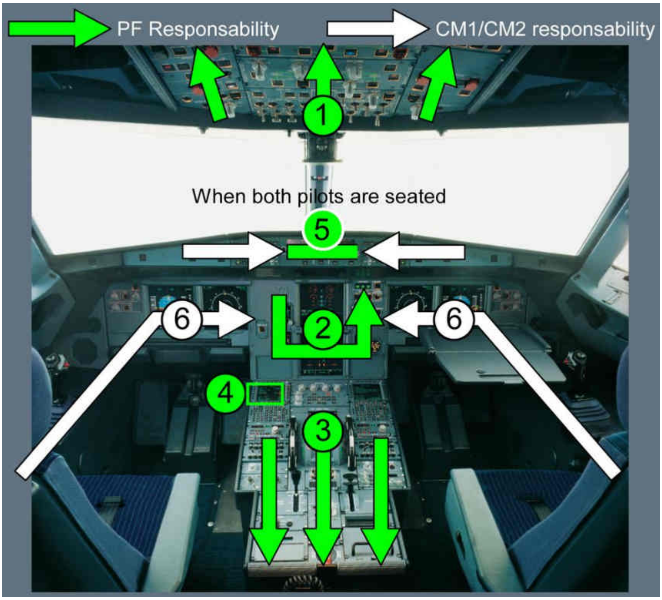
Cockpit preparation flow pattern



FMGS PROGRAMMING

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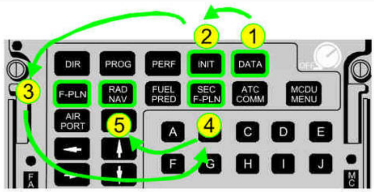
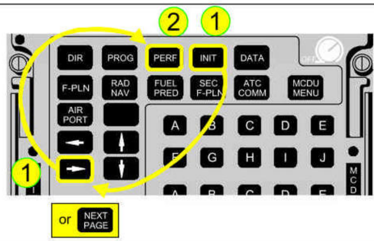
Navigation	Status Init A F-PLN (SEC F-PLN) RAD NAV	
Performance	Init B PERF	

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- DATA
  The database validity, NAVAID s and waypoints (possibly stored in previous flight), and PERF FACTOR must be checked on the STATUS page.
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  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 Alignment or Realignment*).
  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.

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  The F-PLN A page is to be completed thoroughly including:
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- 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, or at a value defined by airline policy. The THR RED/ACC may be changed in the PERF TAKE-OFF page, if required. The flight crew should consider the applicable noise abatement procedure.

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  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.

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Once the FMGS has been programmed, the PM should then cross check the information prior to the take-off briefing.
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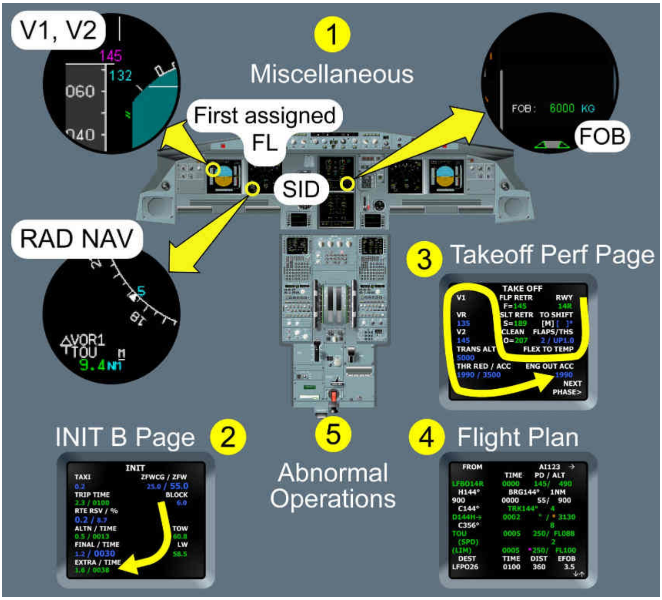
Take off briefing with associated checks



1- Miscellaneous
Aircraft type and model (Tail strike awareness)
Aircraft technical status (MEL and CDL considerations, relevant OEB)
NOTAMS
Weather
RWY conditions
Use of ENG/Wing Anti Ice
ENG Start Procedure
Push Back
Expected Taxi Clearance
Use of Radar
Use of Packs for Takeoff

2- INIT B Page	
Block Fuel [(1)]	(FOB on EW/D)
Estimated TOW	
Extra time at destination	

3- Takeoff Perf Page	
TO RWY	
TO CONF	
FLEX / TOGA (1)	(FLEX TOGA on MCDU)
V1 , VR , V2 (1)	(V1 , V2 on PFD)
TRANS ALT	
THR RED / ACC Altitude	

4- Flight Plan	
Minimum Safe Altitude	
First assigned FL (1)	(altitude target in blue on PFD)
Flight Plan description (1)	(SID on MCDU FPLN page)
RAD NAV (1)	(RAD NAV on ND)

5- Abnormal Operations

For any failure before V1:
CAPT will call "STOP" or "GO"

In case of failure after V1:
continue TO , no actions before 400 ft AGL except gear up
reaching 400 ft AGL , ECAM actions
reaching EO ACC altitude

- If the engine is secured, level off, accelerate and clean up
- Otherwise continue climbing until the engine is secured (but not above EO maximum acceleration altitude)

at green dot: OP CLB, MCT , resume ECAM, after TO C/L, status
ENG OUT routing: EOSID , SID, radar vector, immediate return ...

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

MISCELLANEOUS

SEATING POSITION AND ADJUSTMENT OF RUDDER PEDALS

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 flight crew must have their feet in a position so that full rudder deflection combined with full braking, even differential, can be applied instinctively and without delay.
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.

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ENGINE AUTO START

1 **Applicable to: MSN 1060, 2396**

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 MODE selector is set to "START", the FADEC s 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, or when AVAIL is displayed, the PF can start engine 1.
The flight crew should check the relative engine vibration level.
When the ENG MODE 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).

ENGINE AUTO START

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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 MODE selector is set to "START", the FADEC s are electrically-supplied. When there is sufficient BLEED PRESS, the PF begins the start sequence by setting the ENG MASTER switch to ON. The flight crew should monitor the start sequence:
- Start valve opens
- N2 increases
- IGN A(B)
- Fuel flow
- EGT
- N1
- Oil pressure increases
- Start valve closes
- IGN indication off (*Refer to FCOM/PRO-NOR-SOP-08 Automatic Engine Start*)

When the engine is at idle, or when AVAIL is displayed, the PF can start engine 1.
The flight crew should check the relative engine vibration level.
When the ENG MODE 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

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

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

AVERAGE IDLE ENGINE PARAMETERS

2 **Applicable to: MSN 1060, 2396**

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

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

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

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 MODE selector to CRANK, then set the MAN START switch to ON).

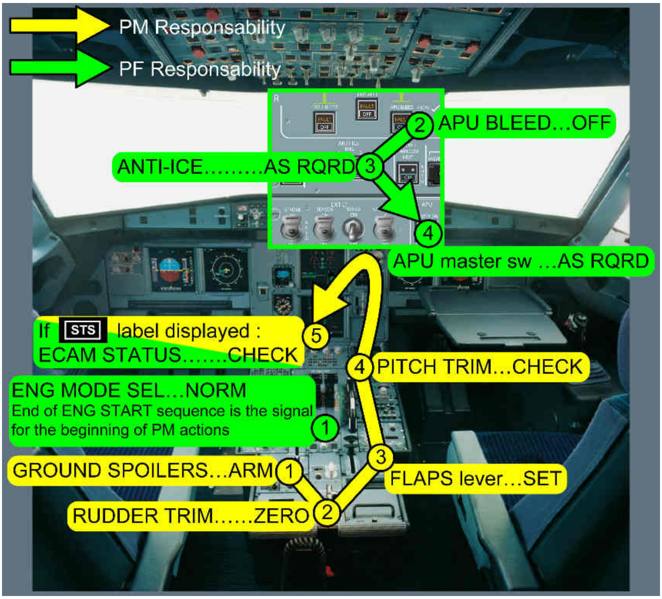
Do NOT use the ENG FIRE pushbutton, this would stop power to the FADECs, and would stop the motoring sequence. The fire extinguisher must not be used, as it will not extinguish an internal engine fire. As a first priority, the engine must be ventilated.
If the ground crew reports a tailpipe fire, and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

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 Mode Selector*) before setting the thrust lever to high power. The warm-up can include any taxi time at idle.

AFTER START FLOW PATTERN

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.



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POWERPUSH

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.

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Nevertheless, cabin evacuation is possible with the PPU in place.

TAXI ROLL AND STEERING

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

THRUST USE

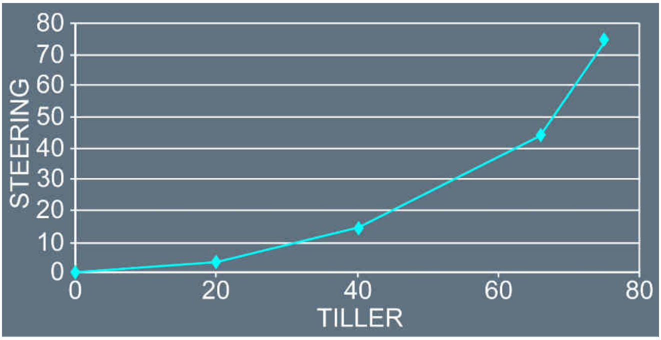
The flight crew will need a little power above idle thrust to move the aircraft (approximately up to 40 % N1).
Excessive thrust application can result in exhaust-blast damage or Foreign Object Damage (FOD).
Thrust should normally be used symmetrically.

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.

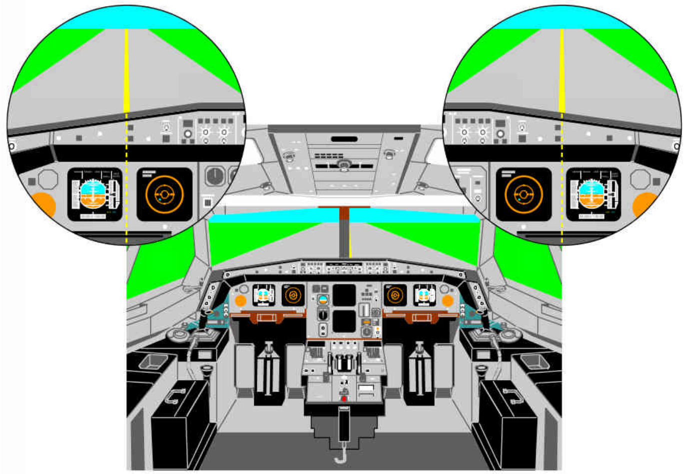
STEERING TECHNIQUE

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.



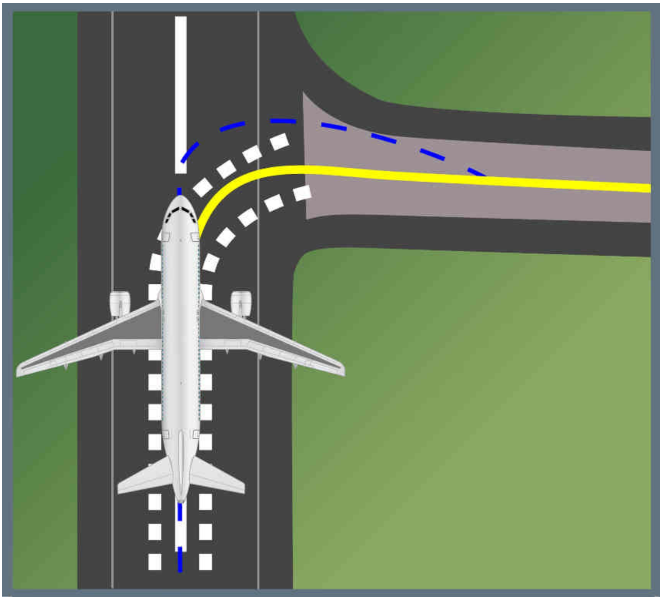
Therefore, the PF should move the tiller smoothly and maintain the tiller's position. Any correction should be small and smooth, and maintained for enough time to enable the pilot to assess the outcome. Being over-active on the tiller will cause uncomfortable oscillations.
On straight taxiways, the aircraft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

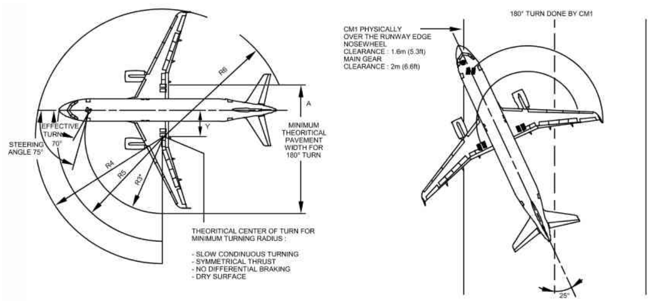
For the CM1

- 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 CM1 assesses to be physically over the runway edge on A320/A321 or to be about 2 m before the runway edge on A318/A319, 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 CM2 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 CM2, the procedure is symmetrical (taxi on the left hand side of the runway).

Aircraft Dimensions



BRAKE CHECK

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 (green pressure has taken over yellow pressure). Although green hydraulic power supplies the braking system, each time pedals are quickly pressed, a brief brake pressure indication may appear on the BRAKE PRESS indicator. No maintenance action is required if the pressure peak is less than 2 000 PSI. If a “spongy” pedal is felt during taxi, this indicates a degraded performance of the alternate braking system. Spongy pedals can change the feeling of braking.

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CARBON BRAKE WEAR

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

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

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

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

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

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

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

- "Full left, full right, neutral"

Full control input must be held for sufficient time for full travel to be reached and indicated on F/CTL page.
The PM then applies full longitudinal and lateral sidestick deflection, and on the F/CTL page, silently checks full travel and correct sense of all elevators and ailerons, and correct deflection and retraction of all spoilers.
If this check is carried out during taxiing, it is essential that the PF remains head-up throughout the procedure.

TAKEOFF BRIEFING CONFIRMATION

The TAKEOFF BRIEFING CONFIRMATION should only review any changes that may have occurred since the full TAKEOFF BRIEFING done at the parking bay (e.g. change of SID, change in runway conditions, etc.).

TAXI WITH ONE ENGINE SHUTDOWN

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

- It is recommended to retain the use of engine 1 during taxi to maintain the green hydraulic system for normal braking and NWS.
- Before releasing the parking brake, the yellow electrical pump will be set ON to pressurize the yellow hydraulic system (ALT/PARK BRK) and avoid PTU operation. The crew will check the hydraulic yellow accumulator pressure.
- Slow or tight turns in the direction of the operating engine may not be possible at high gross weights.
- It is not possible for ground personnel to protect the engine against fire, when the aircraft moves away from the ramp.
- The remaining engines should be started with sufficient time for engine warm-up before takeoff.

- Any faults encountered during or after starting the remaining engine may require a return to the gate for maintenance and thus generate a further departure delay.
- Taxi with one engine shut down may require higher thrust than usual. Caution must, therefore, be exercised to avoid excessive jet-blast and the risk of Foreign Object Damage (FOD).
- The use of APU is recommended but the APU bleed should be switched off to avoid ingestion of exhaust gases by the air conditioning system.
- Before ENG2 start,
  - The yellow electrical pump is set off to check correct operation of the PTU
  - APU BLEED is set back to ON for ENG2 bleed start.

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MISCELLANEOUS

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

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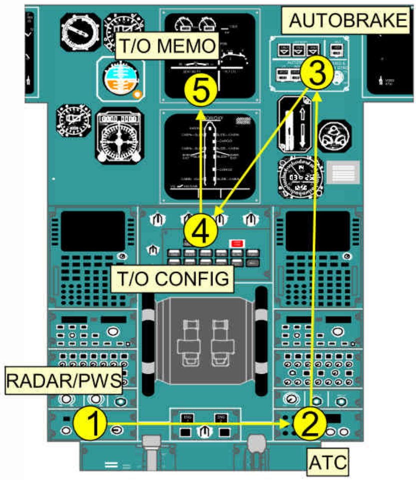

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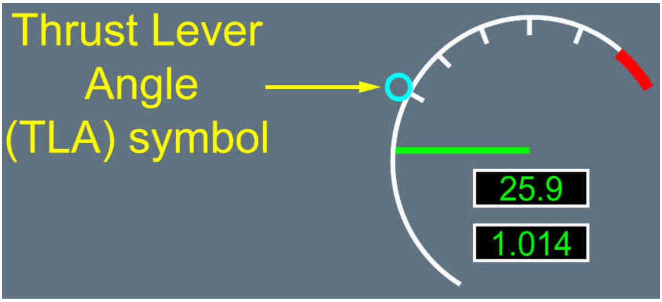
THRUST SETTING

The PF should announce "Take-off". The PF then applies power 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.
- Once stabilized, from 1.05 EPR / 50 % N1 to 1.15 EPR / 70 % N1 by reference to the TLA indicator on the EPR / N1 gauge.
- Then, to FLX / TOGA, as required to reach take-off thrust at 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.
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.

THRUST SETTING

1 **Applicable to: MSN 1060, 2396**

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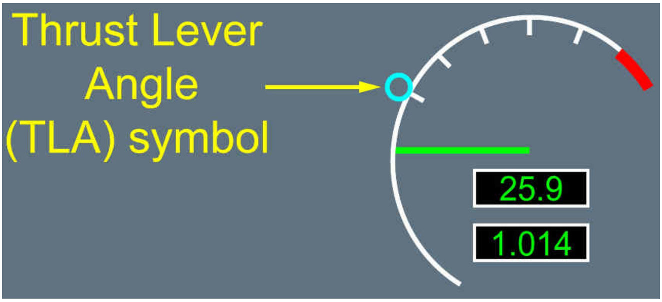

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This procedure ensures that all engines will accelerate similarly. If not properly applied, this may lead to asymmetrical thrust increase, and, consequently, to severe directional control problem.
The Electronic Engine Control (EEC) computer prevents 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

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.

In the event of unexpected lateral disturbance during takeoff roll, the flight crew should use the rudder as for counteracting any lateral disturbance. Indeed, excessive rudder input may increase the magnitude of the lateral disturbance. The flight crew may be surprised during takeoff roll by unexpected lateral disturbance in conditions such as:
- The presence of thermals or thermal vortices that often develop in hot and dry countries. Sometimes, these thermal streams get stronger, and create small whirlwinds referred to as "dust devils", or
- The jet blast of another aircraft close to the active runway, or
- The wind that accelerates between two buildings by "venturi" effect.

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

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

ROTATION

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.

TAIL STRIKE AVOIDANCE

INTRODUCTION

If tailstrike it is not a concern for the A318, the importance of this subject increases as fuselage length increases. Therefore, it is particularly important for A321 operators.
Tail strikes can cause extensive structural damage, which can jeopardize the flight and lead to heavy maintenance action. They most often occur in such adverse conditions as crosswind, turbulence, windshear, etc.

MAIN FACTORS

EARLY ROTATION

Early rotation occurs when rotation is initiated below the scheduled VR. The potential reasons for this are:
- The calculated VR is incorrect for the aircraft weight or flap configuration.
- The PF commands rotation below VR due to gusts, windshear or an obstacle on the runway.

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

ROTATION TECHNIQUE

The recommendation given in the ROTATION TECHNIQUE paragraph should be applied.
A fast rotation rate increases the risk of tailstrike, but a slow rate increases take-off distance. The recommended rate is about 3 °/s, which reflects the average rates achieved during flight test, and is also the reference rate for performance calculations.

CONFIGURATION (NOT APPLICABLE TO A318)

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

When the actual takeoff weight is lower than the permissible one, the flight crew uses FLEX TO thrust. For a given aircraft weight, a variety of flap configurations are possible. Usually, the flight crew selects the configuration that provides the maximum FLEX temperature. This is done to prolong engine life. The first degrees of flexible thrust have an impact on maintenance costs about 5 times higher than the last one.
The configuration that provides the maximum FLEX temperature varies with the runway length.
On short runways, CONF 3 usually provides the highest FLEX temperature, and the tail clearance at lift off does not depends on the configuration.
On medium or long runways, the second segment limitation becomes the limiting factor, and CONF 2 or CONF 1+F becomes the optimum configuration, in term of FLEX temperature.
In these cases, the tail clearance at lift off depends on the configuration. The highest flap configuration gives the highest tailstrike margin.

TAKEOFF TRIM SETTING

The main purpose of the pitch trim setting for take-off is to provide consistent rotation characteristics. Take-off pitch trim is set manually via the pitch trim wheel.
The aircraft performs a safe takeoff, provided the pitch trim setting is within the green band on the pitch trim wheel.

However, the pitch trim setting significantly affects the aircraft behaviour during rotation:
- With a forward CG and the pitch trim set to the nose-down limit the pilots will feel an aircraft "heavy to rotate" and aircraft rotation will be very slow in response to the normal take off stick displacement.
- With an aft CG and the pitch trim set to the nose-up limit the pilots will most probably have to counteract an early autorotation until VR is reached.

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

CROSSWIND TAKEOFF

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

OLEO INFLATION

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

ACTION IN CASE OF TAILSTRIKE

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

THRUST REDUCTION ALTITUDE

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

At the acceleration altitude, the FD pitch mode changes from SRS to CLB or OP CLB mode. The speed target jumps:
- Either to the managed target speed e.g. speed constraint, speed limit or ECON climb speed
- Or to the preselected climb speed (entered by the pilot on the MCDU PERF CLB page before takeoff).

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

During takeoff phase, F and S speeds are the minimum speeds for retracting the surfaces:
- At F speed, the aircraft accelerating (positive speed trend): retract to 1.
- At S speed, the aircraft accelerating (positive speed trend): retract to 0.

If the ENG MODE 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

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 or 225 kt on some A321, *Refer to FCOM/LIM-13 Maximum Flaps/Slats Speeds*), 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.

OVERSPEED WARNING DURING SLATS/FLAPS TRANSITION

During the Slats/Flaps transition, the flight crew must respect the VMAX displayed on the PFD. The VMAX value displayed on the PFD speed scale is based on the Slats/Flaps control lever position. The OVERSPEED WARNING is based on the actual Slats/Flaps surface position. Therefore, during Slats/Flaps transition, the dynamic acceleration of the airplane may lead to a temporary OVERSPEED WARNING even if the current speed is out of the red and black strip displayed on the PFD. In this situation, there are no operational consequences.

IMMEDIATE TURN AFTER TAKE-OFF

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.

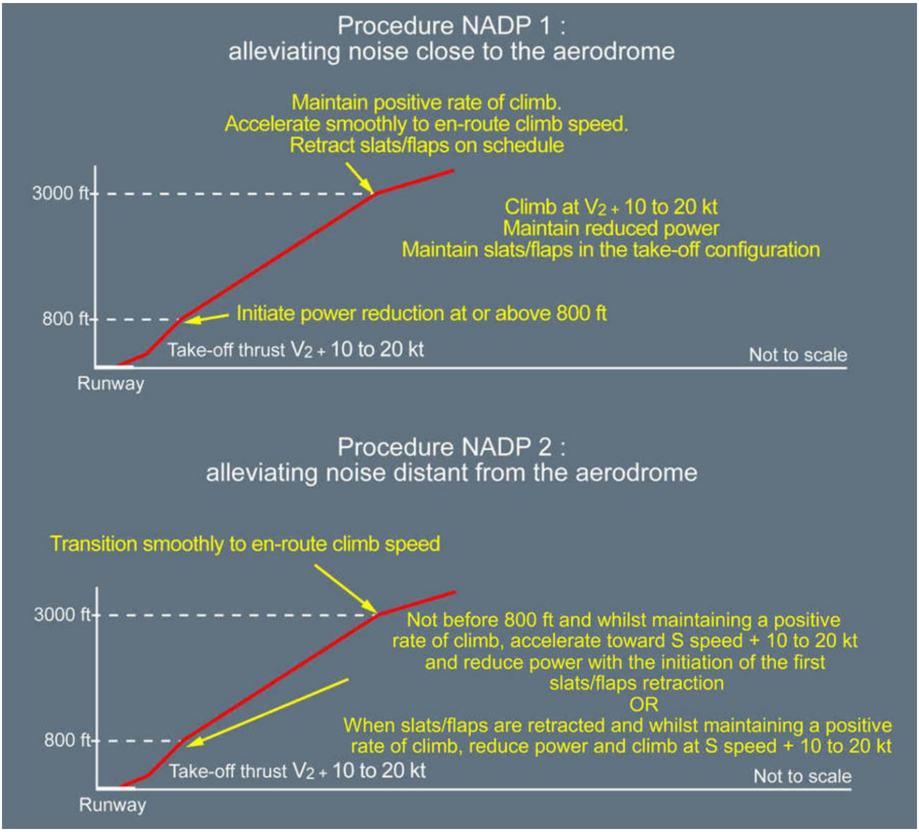
LOW ALTITUDE LEVEL-OFF

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

NOISE ABATEMENT TAKE-OFF

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

NOISE ABATEMENT TAKE-OFF



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GENERAL

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

The AP /FD climb modes may be either
- Managed
- Selected

MANAGED

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

SELECTED

The selected AP /FD modes in climb are OP CLB , V/S and EXPED .
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 EXPED mode is used to climb with maximum vertical gradient i.e. the target speed becomes green dot. Its use should be avoided above FL 250.
The crew should be aware that altitude constraints in the MCDU F-PLN page are observed only when the climb is managed, i.e. when CLB is displayed on the FMA. Any other vertical mode will disregard any altitude constraints.

A likely scenario would be, when the FCU altitude is set above an altitude constraint and the pilot selects V/S when below that constraint to avoid a potential TCAS TA. In this case, the aircraft will disregard the altitude constraint.

AP/FD CLIMB MODES

1 **Applicable to: MSN 0517, 1060-1612**

The AP /FD climb modes may be either

- Managed
- Selected

MANAGED

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

SELECTED

The selected AP /FD modes in climb are OP CLB , V/S and EXPED .
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 EXPED mode is used to climb with maximum vertical gradient i.e. the target speed becomes green dot. Its use should be avoided above FL 250.
The crew should be aware that altitude constraints in the MCDU F-PLN page are observed only when the climb is managed, i.e. when CLB is displayed on the FMA. Any other vertical mode will disregard any altitude constraints.

A likely scenario would be, when the FCU altitude is set above an altitude constraint and the pilot selects V/S when below that constraint to avoid a potential TCAS TA. In this case, the aircraft will disregard the altitude constraint.

AP/FD CLIMB MODES

The AP /FD climb modes may be either

- Managed
- Selected

MANAGED

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

SELECTED

The selected AP /FD modes in climb are OP CLB , V/S and EXPED .
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 EXPED mode is used to climb with maximum vertical gradient i.e. the target speed becomes green dot. Its use should be avoided above FL 250.
The crew should be aware that altitude constraints in the MCDU F-PLN page are observed only when the climb is managed, i.e. when CLB is displayed on the FMA. Any other vertical mode will disregard any altitude constraints.

A likely scenario would be, when the FCU altitude is set above an altitude constraint and the pilot selects V/S when below that constraint to avoid a potential TCAS TA. In this case, the aircraft will disregard the altitude constraint.

SPEED CONSIDERATIONS

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

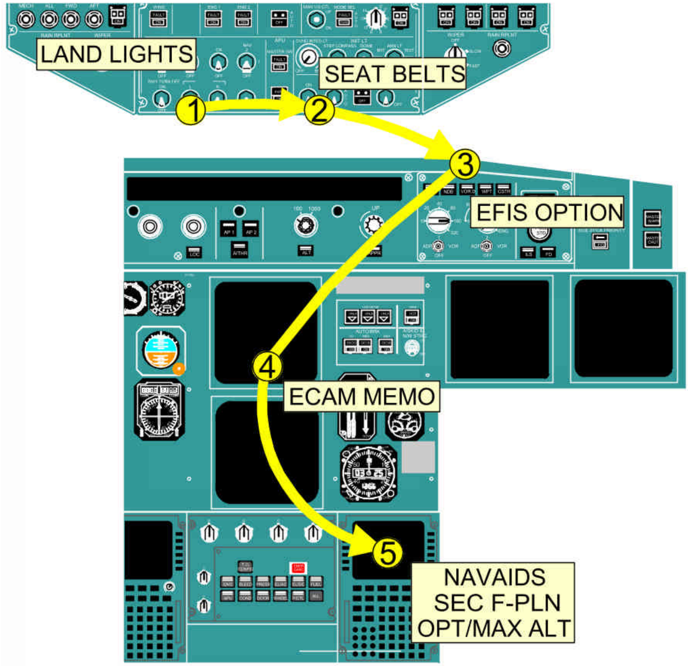
The MCDU PROG page provides the crew with the MAX REC ALT and with the OPT ALT information (See cruise section). This information is to be used to rapidly answer to ATC : "CAN YOU CLIMB TO FL XXX?"
The MCDU PERF CLB page provides predictions to a given FL in terms of time and distance assuming CLB mode. 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

If the aircraft is following the programmed SID , the AP /FD should be in NAV . If ATC vectors the aircraft, HDG will be used until a time when clearance is given to either resume the SID or track direct to a specific waypoint. In either case, the crew must ensure that the waypoints are properly sequenced.
The crew should keep in mind that the use of HDG mode e.g. following ATC radar vectors, will revert CLB to OP CLB and any altitude constraints in the MCDU F-PLN page will not be observed unless they are selected on the FCU.

10 000 FT FLOW PATTERN

10 000 ft FLOW PATTERN



EFIS Option:
The PF will select CSTR for grid MORA
The PM will select ARPT

PREFACE

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

1 Applicable to: MSN 0517-1060

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

CRUISE FL

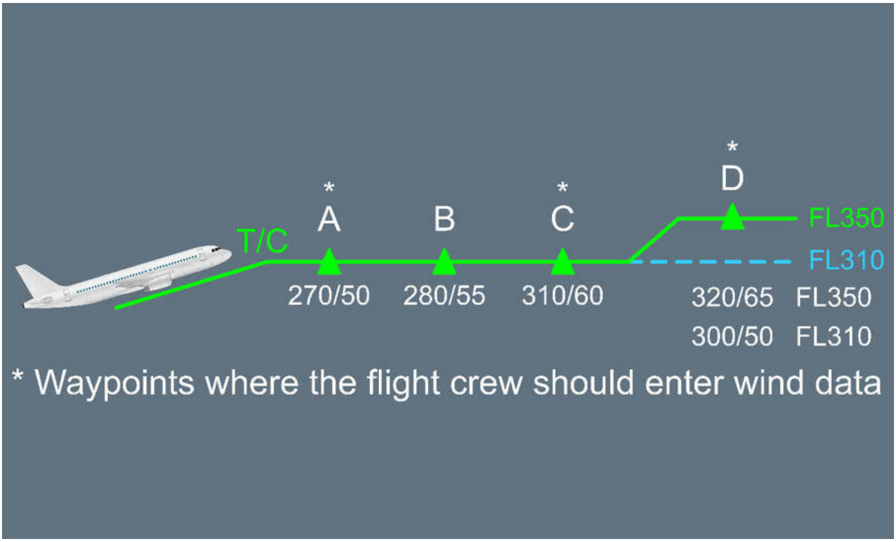
If the aircraft is cleared to a lower cruise flight level than the pre-planned cruise flight level displayed on MCDU PROG page, the cruise Mach number will not be targeted. The crew will update the MCDU PROG page accordingly.
When at cruise FL , the AP altitude control is soft. This means that the AP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



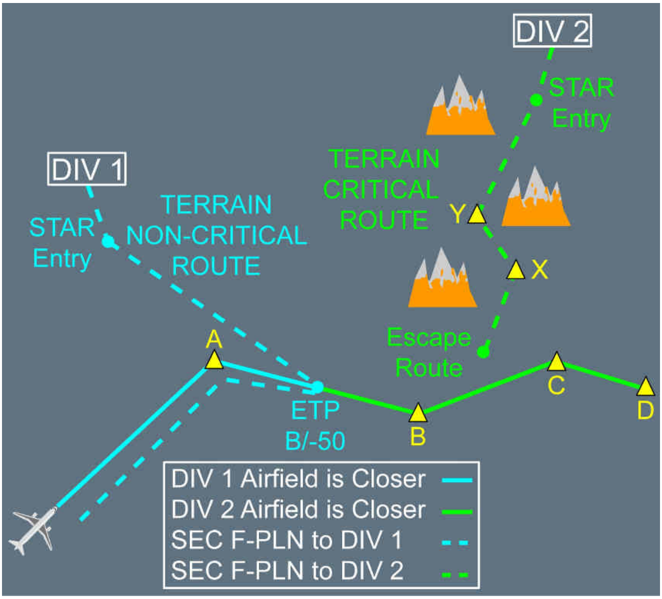
If at D waypoint, the CFP provides the wind at FL 350 but not at FL 310, it is recommended to insert the same wind at FL 310 as the one at FL 350. This is due to wind propagation rules, which might affect the optimum FL computation.

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

2 **Applicable to: MSN 0517-1060**

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

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.

FMS USE: MISCELLANEOUS

If ATC modifies the routing, the crew will revise the F-PLN . Once achieved and if printer is installed, the crew may perform a new F-PLN print.

If there is weather, the crew will use the OFFSET function which can be accessed from a lateral revision at PPOS . The crew will determine how many NM are required to avoid the weather. Once cleared by ATC, the crew will insert the offset.
If ATC gives a DIR TO clearance to a waypoint far from present position, the crew will use the ABEAM facility. This facility allows both a better crew orientation and the previously entered winds to be still considered.

COST INDEX

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 F-PLN . However, the crew should be aware that any modification of the CI would affect trip cost.

SPEED CONSIDERATIONS

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

3 **Applicable to: MSN 1060-2396**

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

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 flight crew should be aware that flying at a FL different from the OPT FL can have an adverse effect on 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.

SPEED DECAY DURING CRUISE

FACTORS THAT CAUSE A SPEED DECAY DURING CRUISE

On aircraft with no failure, and the A/THR engaged or the MAX CLB Thrust applied in manual mode, a continuous speed decay during cruise phase may be due to:

- A large and continuous increase in tailwind or decrease in headwind, in addition to an increase in the Outside Air Temperature (OAT), that results in a decrease of the REC MAX FL (*Refer to NO-070 ALTITUDE CONSIDERATIONS*), or
- A large downdraft, when the flight crew flies (parallel and) downwind in a mountainous area, due to orographic waves. The downdraft may have a negative vertical speed of more than 500 ft/min. Therefore, if the aircraft is in a downdraft, the flight crew must climb in order to maintain altitude, and the pitch angle and the thrust value increase. Without sufficient thrust margin, the flight crew may notice that aircraft speed decays, but the REC MAX FL is not modified.

THRUST MARGIN AND EXTERNAL PARAMETERS

The flight crew must be aware that at high altitude, the thrust margin (difference between the thrust in use and the maximum available thrust) is limited. The maximum available thrust decreases when there is an increase in altitude and/or outside temperature. In some conditions, MCT may be the maximum available thrust. In such a situation, it is useless to put the thrust levers in the TOGA detent to try to increase the thrust.
The REC MAX FL indicated in the PROG page of the MCDU decreases when the OAT increases. The nearer the aircraft is to the REC MAX FL, the smaller the thrust margin.

GREEN DOT (GD) SPEED AS A REFERENCE

The optimum lift/drag speed is the GD speed. The GD speed uses the lowest quantity of thrust necessary to maintain the required/desired altitude. When the aircraft speed is below GD speed, any decrease in speed requires an increase in thrust in order to maintain the required/desired altitude. Therefore, if aircraft speed is below GD speed and continues to decrease, even with the maximum available thrust in use, if the flight crew maintains the current altitude, the angle of attack will further increase.

OPERATIONAL RECOMMENDATION

The nearer the aircraft is to the REC MAX FL, the smaller the thrust margin the flight crew has to manage a speed decay during cruise.
If aircraft speed goes below GD speed, with the maximum available thrust in use, the only way for the flight crew to avoid a dangerous increase in the angle of attack is to descend.

As a result, the flight crew can recover normal aircraft speed and the normal thrust margin.

STEP CLIMB

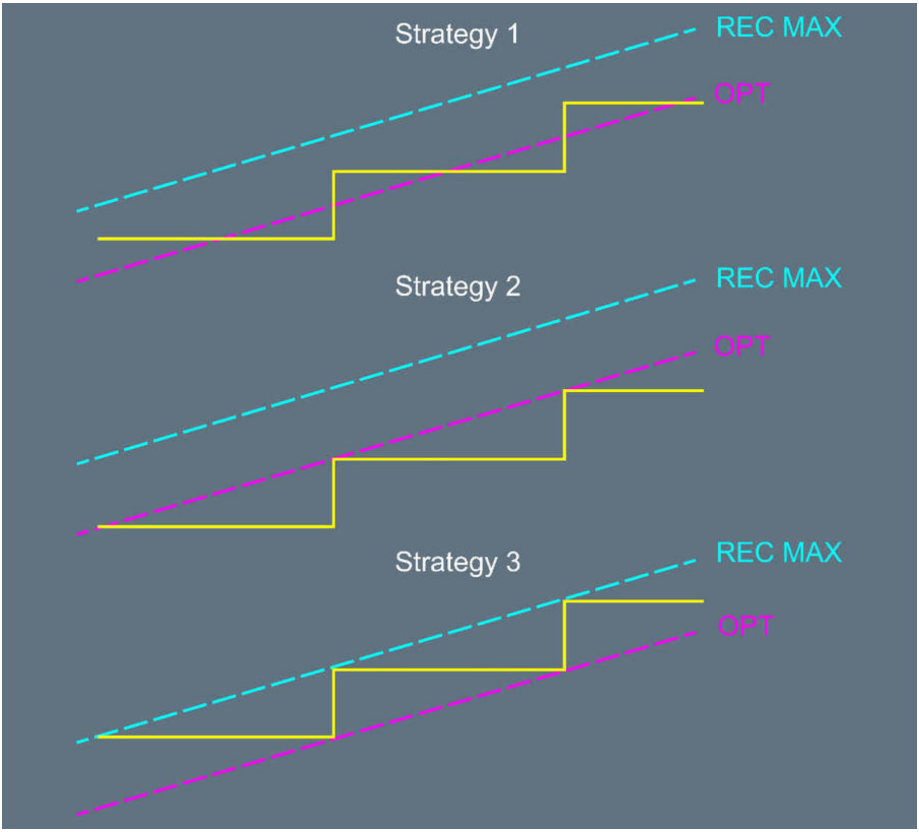
4 **Applicable to: MSN 0517-1060**

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

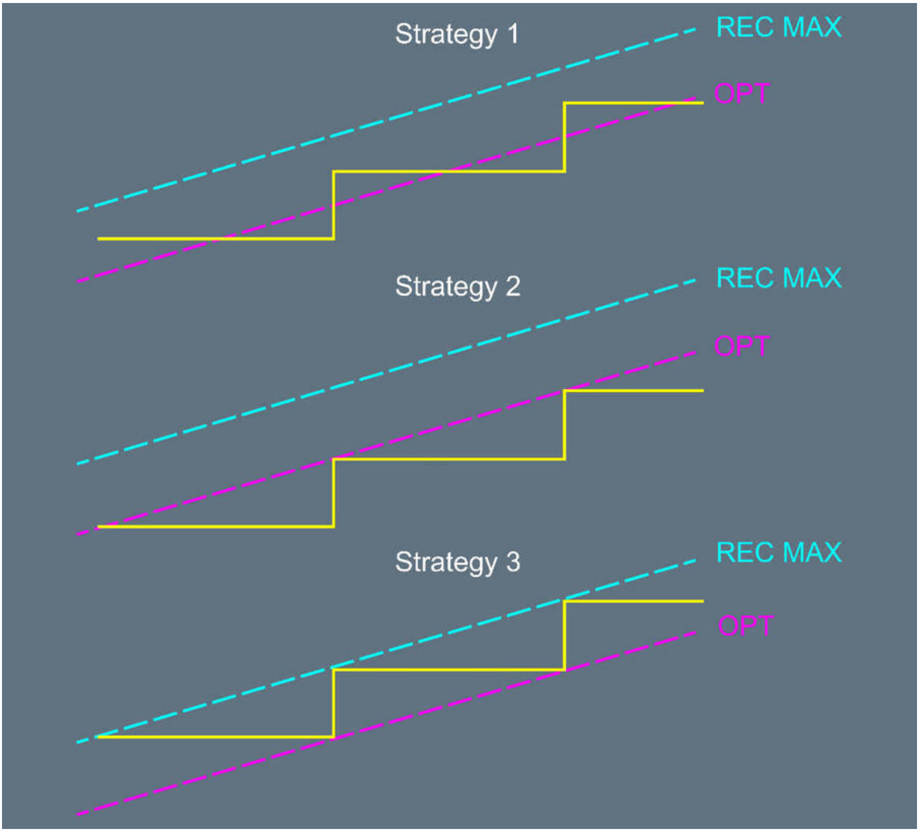
Since the optimum altitude increases as fuel is consumed during the flight, from a cost point of view, it is preferable to climb to a higher cruise altitude when the aircraft weight permits. This technique, referred to as a Step Climb, is typically accomplished by initially climbing approximately 2 000 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

The selected cruise altitude should normally be as close to optimum as possible. As deviation from optimum cruise altitude increases, performance economy decreases.

The flight crew should be aware that flying at a FL different from the OPT FL can have an adverse effect on the trip cost.

FUEL MONITORING

The flight plan fuel burn from departure to destination is based on certain assumed conditions. These include gross weight, cruise altitude, route of flight, temperature, cruise wind and cruise speed.
Actual fuel consumption should be compared with the flight plan fuel consumption at least once every 30 min.
The crew should be aware that many factors influence fuel consumption, such as actual flight level, cruise speed and unexpected meteorological conditions. These parameters should normally be reflected in the FMS.
If the sum of FOB and FU is significantly more than FOB at engine start, an erroneous or over read fuel quantity indication can be suspected.

The crew may suspect a fuel leak in case of :

- A significant deviation between planned and actual fuel figures
- An excessive fuel flow leading to a potential imbalance
- The sum of (FOB +FU) is significantly less than FOB at engine start, or is decreasing.

In this situation the crew must apply the FUEL LEAK paper procedure.

FUEL TEMPERATURE

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.

LANDING PERFORMANCE CONSIDERATIONS

As per EU-OPS 1.400: "Before commencing an approach to land, the commander shall satisfy himself/herself that, according to the information available to him/her, 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, having regard to the performance information contained in the Operations Manual".
The flight crew should always consider a landing performance assessment (*Refer to SI-090 Definitions*) in the reported conditions as part of their approach preparation.
There are some specific triggers for doing in-flight performance assessment:

- **Wet runways**: on smooth runways, in hot and high conditions or for runways with descending slope, the flight crew should check the landing performance.
- **Contaminated runways**:
  - Under FAA regulation, the dispatch assumes wet runway at arrival, therefore the flight crew should systematically re-assess the landing performance in flight,
  - Under EASA regulation, the flight crew should re-assess the landing performance in flight, especially for runways with descending slope.
- **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
- The flight crew decides to land with **autoland** and/or **autobrake**,
- **Runway change** versus assumptions made at dispatch. If it is not known which runway was planned to be used at time of dispatch, assume that it was based on the longest runway and no wind. 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).
- **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

The flight crew should obtain the latest information for landing (weather, runway state, braking action, etc, ...) at the latest 15 min prior to descent. The flight crew should check the landing performance (VAPP , Landing distance) and the PF should program the FMGS for the descent and arrival. The fuel predictions are accurate if the F-PLN is correctly entered in terms of arrival, go-around and alternate routing.
The PF should program the FMGS as follows:

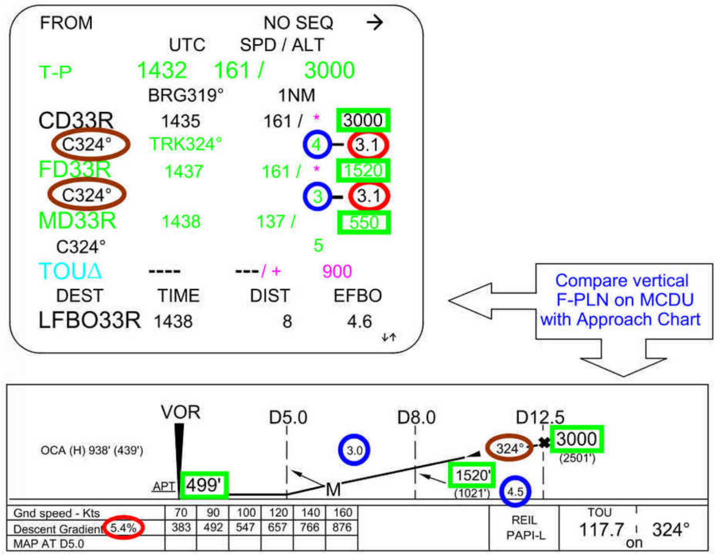
F-PLN

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:
  - Check its position and altitude
  - Check the FPA.
- 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 navaids ident, frequency and associated course of destination airfield as required. It is not recommended manually forcing the navaids identifier as, in case of late runway change, the associated navaids 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:

- 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 °/20 kt (With managed speed mode in approach, ground speed mini-function will cope with the gusts).
- Minima. Check that OAT is within the limit for approach using FINAL APP guidance
- 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.

APPROACH BRIEFING

The main objective of the approach briefing is for the PF to inform the PM of his intended course of action for the approach. The briefing should be practical and relevant to the actual weather conditions expected. It should be concise and conducted in a logical manner. It should be given at a time of low workload if possible, to enable the crew to concentrate on the content. It is very important that any misunderstandings are resolved at this time.
Before starting an approach, the flight crew must brief again any change to the procedure initially planned during descent preparation (in particular changes to lateral, vertical and go around trajectory).

PF briefing	Associated cross check
Aircraft type and technical status	
NOTAM	
Weather	
- Accessibility - Runway in use	
Fuel	
- Extra fuel	FUEL PRED page
Descent	
- TOD (time, position) - MORA , STAR , MSA - Altitude and speed constraints	F-PLN page F-PLN page
Holding (if expected)	
- Entry in holding pattern - MHA and MAX speed	
Approach	

Continued on the following page

Continued from the previous page

PF briefing	Associated cross check
- Approach type - Altitude and final descent point identification - Glide path - Minima - Missed approach procedure - Alternate considerations - Management of degraded navigation	- PERF APPR and ND - F-PLN - PFD /FMA - PERF APPR - F-PLN - F-PLN
Landing	
- Runway data: length, surface (smooth, grooved or porous), runway condition (contaminant type and depth), Braking action if available, expected wind - Landing Performance consideration versus runway data - Tail strike awareness - Use of autobrake (mode, manual take over) - Use of reverses (IDLE, Max) - Expected taxi route	
Radio aids	
	RAD NAV

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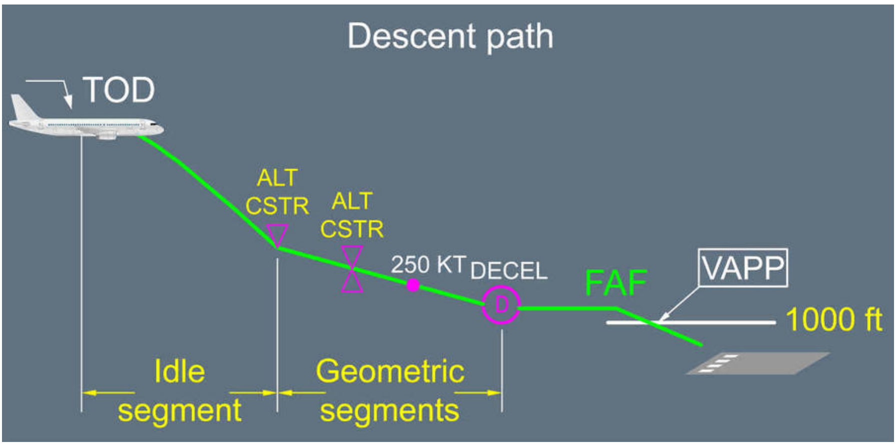
PREFACE

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

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:



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.
With Descent Profile Optimization option (DPO ⧼), the idle segment assumes a given managed speed flown at idle thrust. This gives less flexibility to keep the aircraft on the descent path if engine anti-ice is used or if winds vary. In case of use of engine anti-ice or increased tailwind, the use of speed brakes may be required to go back on the descent path.
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

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.

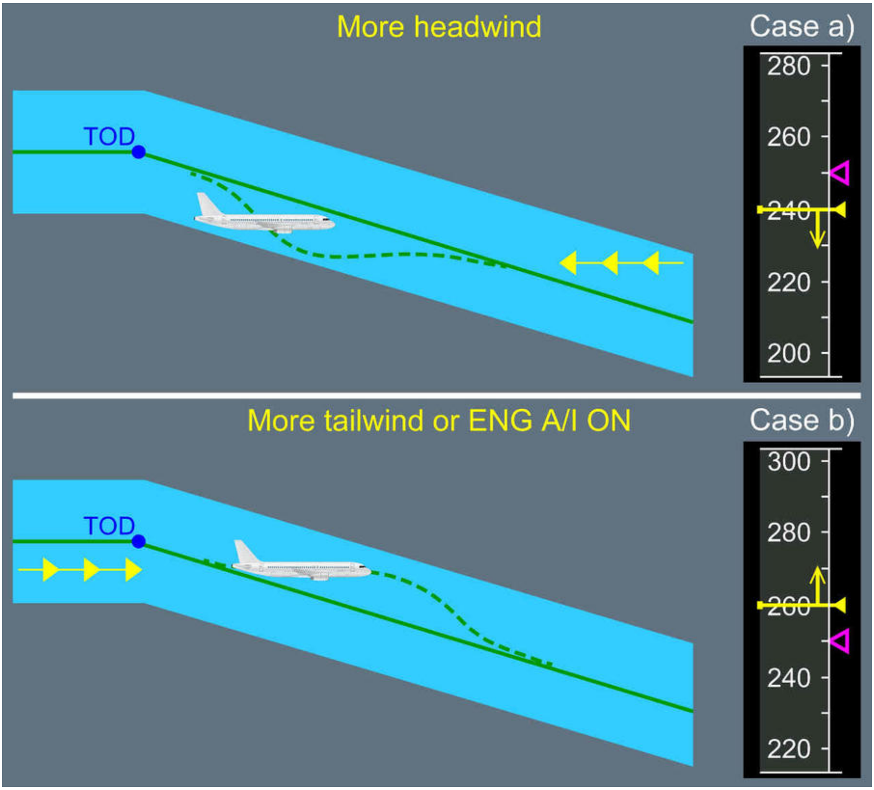
DESCENT INITIATION

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" or "T/D REACHED" 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.

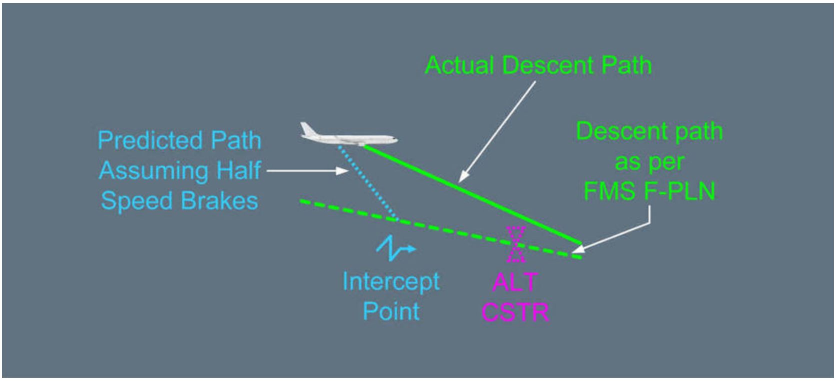
Managed Descent: Speed Target Range Principle



- **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.

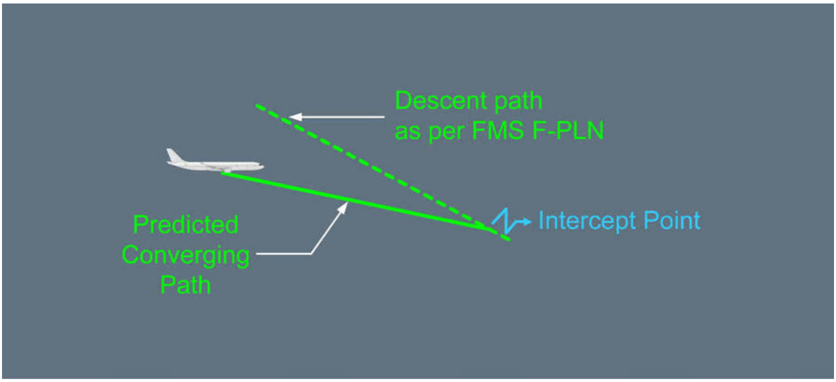
This technique allows an altitude constraint to be matched with minimum use of speedbrakes.
When regaining the descent profile, the speedbrakes should be retracted to prevent the A/THR applying thrust against speedbrakes. If the speedbrakes are not retracted, the "SPD BRK" message on the ECAM memo becomes 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 increase the rate of descent, 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

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

1 Applicable to: MSN 0517, 1060-1612

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

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

2 Applicable to: MSN 0517-1060

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

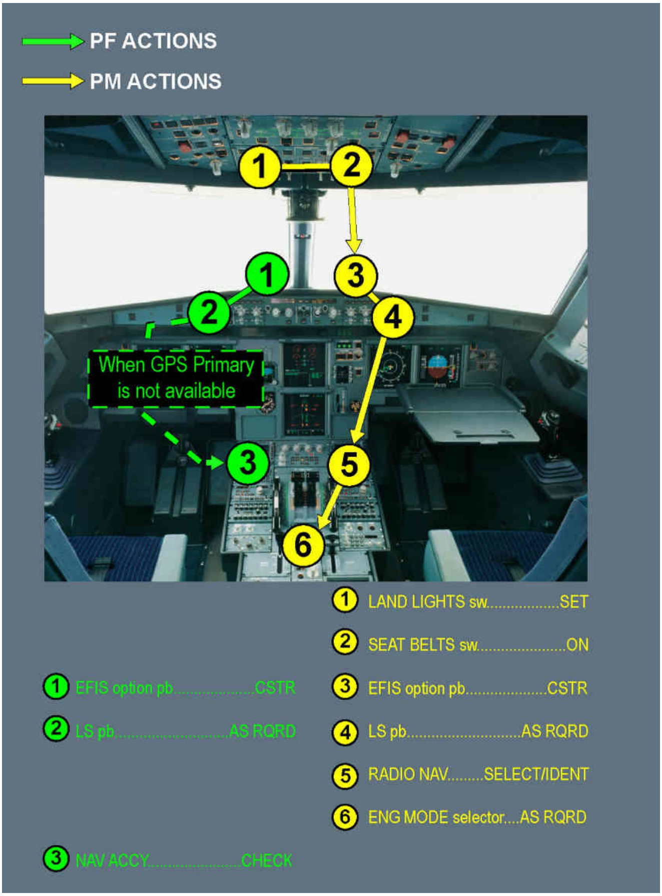
Descent constraints may be automatically included in the route as part of an arrival procedure or they may be manually entered through the MCDU F-PLN page. The aircraft will attempt to meet these as long as DES mode is being used.

The crew should be aware that an ATC "DIR TO " clearance automatically removes the requirement to comply with the speed/altitude constraints assigned to the waypoints deleted from the F-PLN . However, if intermediate waypoints are relevant, e.g. for terrain awareness, then "DIR TO" with ABEAMS may be an appropriate selection as constraints can be re-entered into these waypoints if required.

Following the selection of HDG , DES mode will switch automatically to V/S, and altitude constraints will no longer be taken into account.

10 000 FT FLOW PATTERN

10 000 ft FLOW PATTERN



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PREFACE

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.

HOLDING SPEED AND CONFIGURATION

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 hold speed when entering the holding pattern.

The default hold speed is the lowest of the following:
- Maximum Endurance speed
- ICAO limit holding speed
- Speed constraint (if any).

When no specific speed limit applies, the default hold speed is the Maximum Endurance speed, which 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

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.

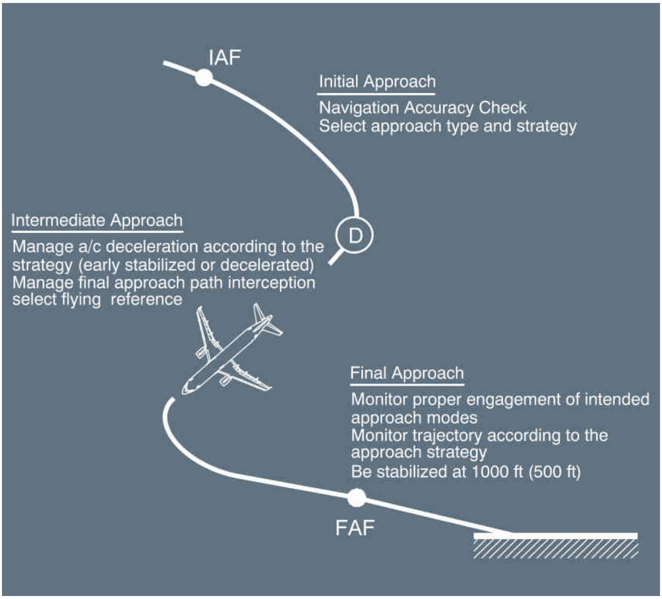
To exit the holding pattern, the crew should select either:

- 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

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.

Approach General



INITIAL APPROACH

NAVIGATION ACCURACY

Prior to any approach, a navigation accuracy check is to be carried out. On aircraft equipped with GPS however, no navigation accuracy check is required as long as GPS PRIMARY is available. Without GPS PRIMARY or if no GPS is installed, navigation accuracy check has to be carried out. The navigation accuracy determines which AP modes the crew should use and the type of display to be shown on the ND.

FLYING REFERENCE

It is recommended to use the FD crossbars for approach using vertical managed guidance (LOC G/S, FINAL APP). The FPV (also called "bird") with FPD is used for approach using FPA guidance (LOC FPA, NAV FPA and TRK FPA).

APPROACH PHASE ACTIVATION

Activation of the approach phase will initiate a deceleration towards VAPP or the speed constraint inserted at the Final Descent Point (FDP).
When in NAV mode with managed speed, the approach phase activates automatically when sequencing the deceleration pseudo-waypoint. If an early deceleration is required, the approach phase can be activated on the MCDU PERF APPR page. When the approach phase is activated, the magenta target speed becomes VAPP.
When in HDG mode, e.g. for radar vectoring, the crew will activate the approach phase manually.

There are two approach techniques:
- The decelerated approach
- The early stabilized approach.

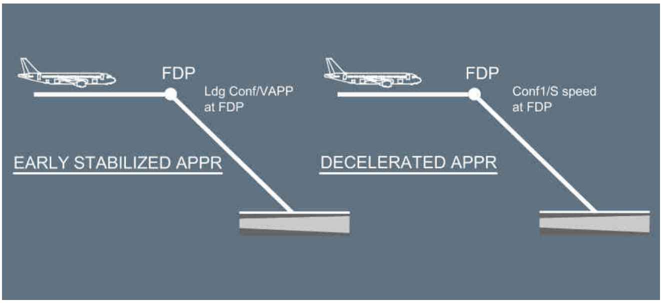
THE DECELERATED APPROACH

This technique refers to an approach where the aircraft reaches 1 000 ft in the landing configuration at VAPP . In most cases, this equates to the aircraft being in CONF 1 and at S speed at the FDP. This is the preferred technique for an approach using vertical managed guidance. The deceleration pseudo waypoint assumes a decelerated approach technique.

THE EARLY STABILIZED APPROACH

This technique refers to an approach where the aircraft reaches the FDP in the landing configuration at VAPP . This technique is recommended for non-precision approaches (LOC FPA, NAV FPA and TRK FPA). To get a valuable deceleration pseudo waypoint and to ensure a timely deceleration, the pilot should enter VAPP as a speed constraint at the FDP.

Early Stabilized versus Decelerated Approach



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 planned route. Correct F-PLN sequencing is important to ensure that the planned 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

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

DECELERATION AND CONFIGURATION CHANGE

Managed speed is recommended for the approach. Once the approach phase has been activated, the A/THR will guide aircraft speed towards the maneuvering speed of the current configuration, whenever higher than VAPP , e.g. green dot for CONFIG 0, S speed for CONFIG 1 etc.
To achieve a constant deceleration and to minimize thrust variation, the crew should extend the next configuration when reaching the current 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 CONFIG 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. (Not applicable for A318)

INTERCEPTION OF FINAL APPROACH COURSE

To ensure a smooth interception of final approach course, the aircraft ground speed should be appropriate, depending upon interception angle and distance to runway threshold. The pilot should refer to applicable raw data (LOC , needles), XTK information on ND and wind component for the selection of an appropriate IAS.

If ATC provides radar vectors, the crew will use the DIR TO RADIAL IN-BND facility. This ensures:

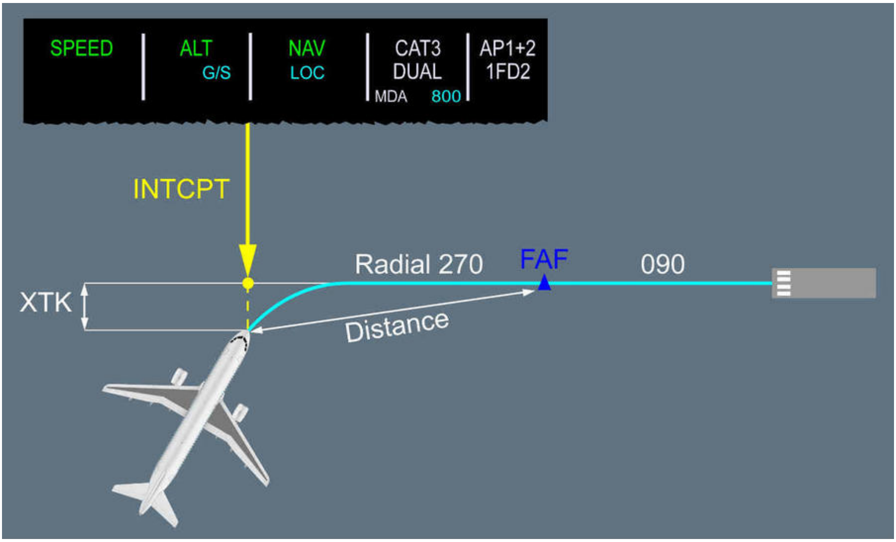
- A proper F-PLN sequencing
- A comprehensive ND display
- An assistance for lateral interception
- The VDEV to be computed on reasonable distance assumptions.

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 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 and on the intercept trajectory for the final approach course, the flight crew will press the APPR pb to arm the approach modes when applicable.

INTERMEDIATE APPROACH

1 **Applicable to: MSN 0517-1060**

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

DECELERATION AND CONFIGURATION CHANGE

Managed speed is recommended for the approach. Once the approach phase has been activated, the A/THR will guide aircraft speed towards the maneuvering speed of the current configuration, whenever higher than VAPP , e.g. green dot for CONFIG 0, S speed for CONFIG 1 etc.
To achieve a constant deceleration and to minimize thrust variation, the crew should extend the next configuration when reaching the current 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 CONFIG 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. (Not applicable for A318)

INTERCEPTION OF FINAL APPROACH COURSE

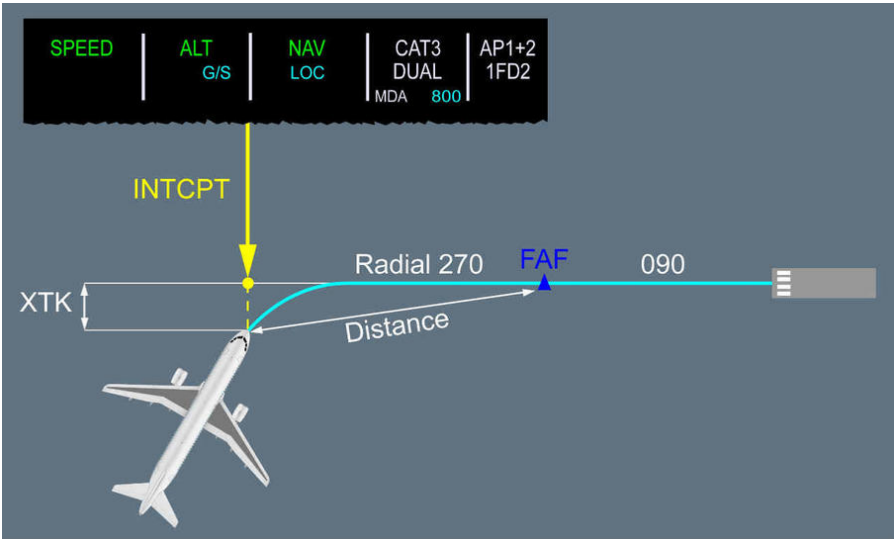
To ensure a smooth interception of final approach course, the aircraft ground speed should be appropriate, depending upon interception angle and distance to runway threshold. The pilot should refer to applicable raw data (LOC , needles), XTK information on ND and wind component for the selection of an appropriate IAS.

If ATC provides radar vectors, the crew will sequence the F-PLN by checking that the TO WPT, on upper right hand corner of ND, is the most probable one and meaningful. This provides:

- A comprehensive ND display
- An assistance for lateral interception (XTK)
- A meaningful vertical deviation
- The go around route to be displayed.

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 and on the intercept trajectory for the final approach course, the flight crew will press the APPR pb to arm the approach modes when applicable.

FINAL APPROACH

FINAL APPROACH MODE ENGAGEMENT MONITORING

The flight crew will monitor the engagement of G/S* for ILS approach, FINAL for vertical managed NPA or will select the Final Path Angle (FPA) reaching final descent for vertical 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.

		Navigation accuracy	
	GPS Primary	High	Low

Continued on the following page

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LOC G/S	LOC , G/S deviations	
FINAL APP	XTK (or L/DEV), VDEV, raw data	-
NAV FPA	XTK, Altitude vs Distance, raw data	-
LOC FPA LOC-B/C FPA	LOC, Altitude vs Distance	
TRK FPA	Raw data, Altitude vs Distance	

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.

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 as per criteria given in the FCOM (*Refer to FCOM/PRO-NOR-SOP-18-A Stabilization Criteria*).
If, for any reason, one flight parameter deviates from stabilized conditions, the PM will make a callout as stated below:

Exceedance and associated PM callout		
Parameter	Exceedance	Callout
IAS	Speed target +10 kt / -5 kt	"SPEED"
V/S	Descent rate exceeds 1 200 ft/min	"SINK RATE"
Pitch attitude	+10 ° / -2.5 °[(1)]	"PITCH"
Bank angle	7 °	"BANK"

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Exceedance and associated PM callout				
ILS only	Localizer	Excess Deviation	1/2 dot PFD	"LOC"
	Glide slope		1/2 dot PFD	"GLIDE"
NPA		XTK greater than 0.1 NM V/DEV greater than 1/2 dot Course greater than 2.5 °(VOR) Course greater than 5 ° (ADF) Altitude Distance check		"CROSS TRACK" "V/DEV" "COURSE" "COURSE" "__FT HIGH (LOW)"

(1) *The pitch attitude upper threshold becomes +7.5 ° or A321.*

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.

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

2 **Applicable to: MSN 0517-1060**

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:

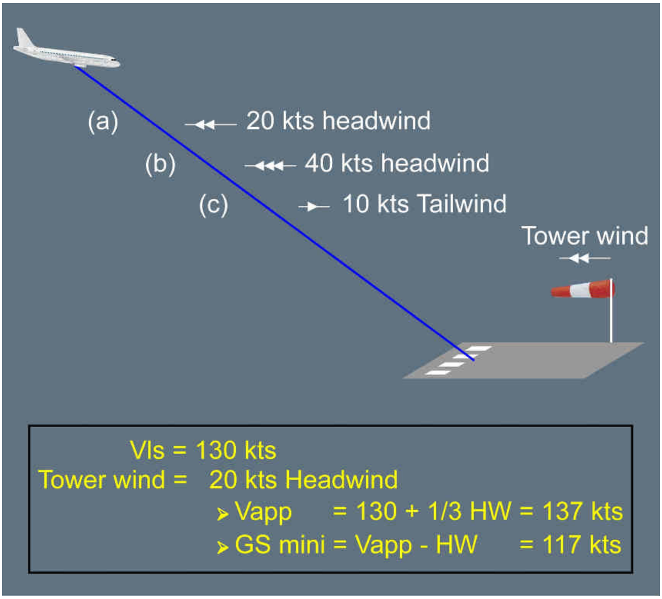
GS mini = VAPP - Tower head wind component

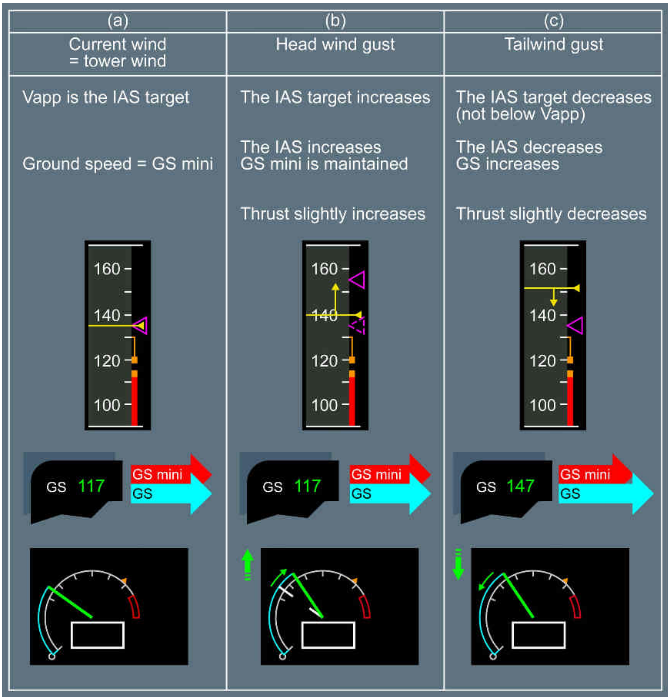
In order to achieve that goal, the aircraft ground speed should never drop below GS mini in the approach, while the winds are changing. Thus the aircraft IAS must vary while flying down, in order to cope with the gusts or wind changes. In order to make this possible for the pilot or for the A/THR , the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





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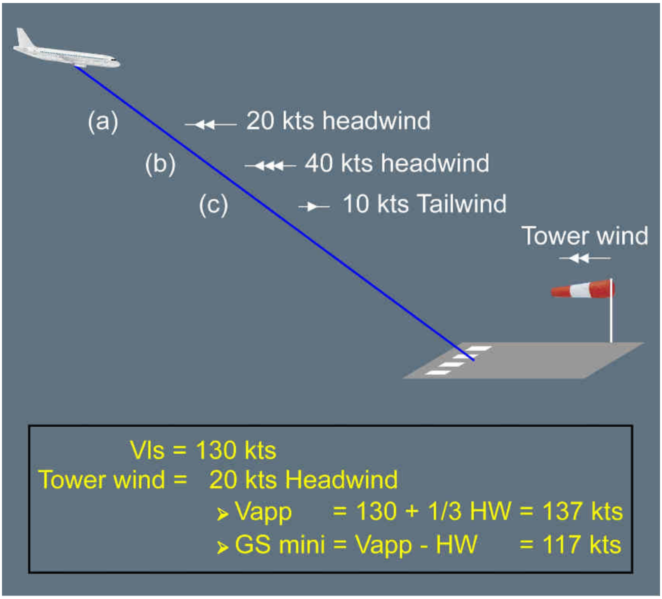
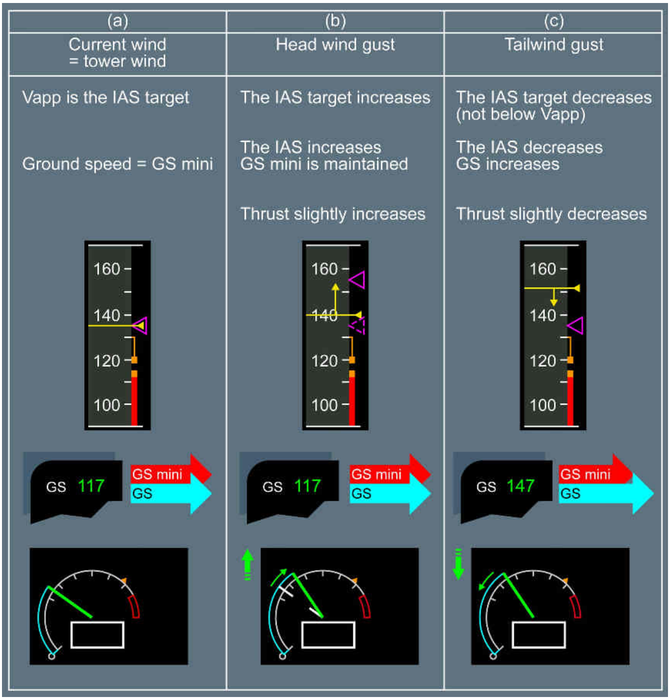
IAS Target Speed = GS mini + Current headwind component

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

Example





DISCONTINUED APPROACH

The discontinued approach is an alternative technique to the GO AROUND procedure to interrupt an approach when the aircraft is at or above the selected FCU altitude.
Contrary to the GO AROUND procedure, the discontinued approach technique does not require the flight crew to set the thrust levers to TOGA detent.
The flight crew should initiate the discontinued approach technique with the callout: “CANCEL APPROACH”.
The first action of the flight crew is to disengage <u>and</u> disarm any AP /FD approach mode, by pressing on the APPR pbor LOC pb.

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PREFACE

This chapter deals with some characteristics of the ILS approach. Recommendations mentioned in APPROACH GENERAL chapter apply.
For CAT 1 ILS , the crew will insert DA /DH values into MDA (or MDH if QFE function is available) field on the MCDU PERF APPR page, since these values are baro referenced.
For CAT II or CAT III ILS , the crew will insert DH into DH field on MCDU PERF APPR page, since this value is a radio altimeter referenced.

INITIAL APPROACH

NAVIGATION ACCURACY

When GPS PRIMARY is available, no NAV ACCURACY monitoring is required. When GPS PRIMARY is lost the crew will check on MCDU PROG page that the required navigation accuracy is appropriate. If NAV ACCURACY DOWNGRAD is displayed, the crew will use raw data for navigation accuracy check. The navigation accuracy determines which AP modes the crew should use and the parameters that must be monitored during the approach (consequently the type of display to be shown on the PFD and ND - *Refer to NO-110 INITIAL APPROACH* and *Refer to NO-110 FINAL APPROACH*).

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), an early 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

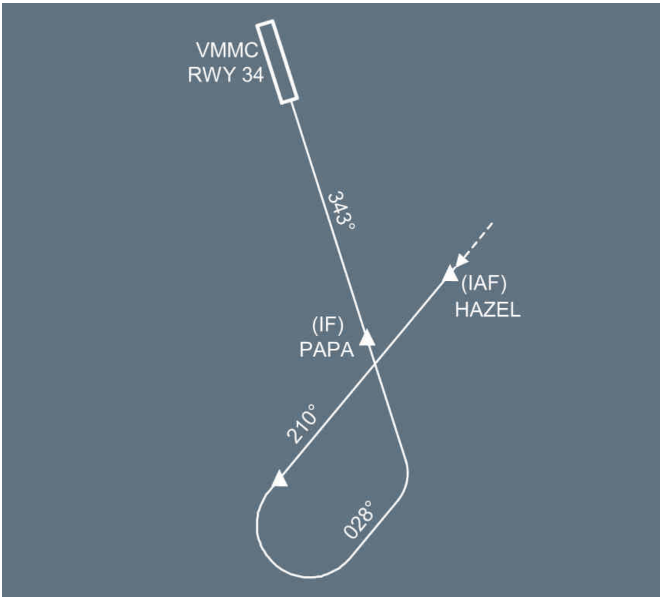
- LOC and GS scales and deviations are displayed on PFD
- IDENT is properly displayed on the PFD. If no or wrong ident displayed, the crew will check the audio ident.

INTERMEDIATE APPROACH

INTERCEPTION OF FINAL APPROACH COURSE

When cleared for the ILS and when on the intercept trajectory for the LOC , the flight crew should press the APPR pb. This arms the approach modes, and LOC and GS are displayed in blue on the FMA . At this stage, the second AP, if available, should be selected.
In the example below, if the ATC clears the aircraft for the procedure at HAZEL, the flight crew must delay the push on the APPR pb, as the aircraft is not on the intercept trajectory for the LOC:

VMMC ILS RWY34 via HAZEL



If the ATC clears for a LOC capture only, the flight crew will press the LOC pb-sw on the FCU.
If the ATC clears for approach at a significant distance, e.g. 30 NM, the flight crew should be aware that the G/S may be perturbed and CAT 1 will be displayed on FMA till a valid Radio Altimeter signal is received.

FINAL APPROACH

GLIDE SLOPE INTERCEPTION FROM ABOVE

The following procedure should only be applied when established on the localizer. There are a number of factors which might lead to a glide slope interception from above. In such a case, the flight crew must react without delay to meet the stabilization criteria.
In order to get the best rate of descent when cleared by ATC and below the limiting speeds, the flight crew should lower the landing gear and select flaps as required (at least CONF 2 should be selected to ensure that the aircraft speed will not increase). Speedbrakes may also be used, noting the considerations detailed in the subsection "Deceleration and configuration change" earlier in this chapter.

When cleared to intercept the glide slope, the flight crew should:

- Press the APPR pb on FCU and confirm G/S is armed,
- Select the FCU altitude above aircraft altitude to avoid unwanted ALT*,
- Select V/S 1 500 ft/min initially. V/S in excess of 2 000 ft/min will result in the speed increasing towards VFE.

Use V/S rather than OP DES to ensure that the A/THR is in SPEED mode rather than IDLE mode. The flight crew should carefully monitor the rate of descent to avoid exceeding VFE . When approaching the G/S path, G/S* will engage. The flight crew should monitor the G/S capture with raw data (pitch and G/S deviation). The go-around altitude should be set on the FCU at G/S*.

ILS RAW DATA

INITIAL APPROACH

FLYING REFERENCE

The "bird" is to be used as the flying reference.

APPROACH PHASE ACTIVATION

The approach technique is the early stabilized approach.

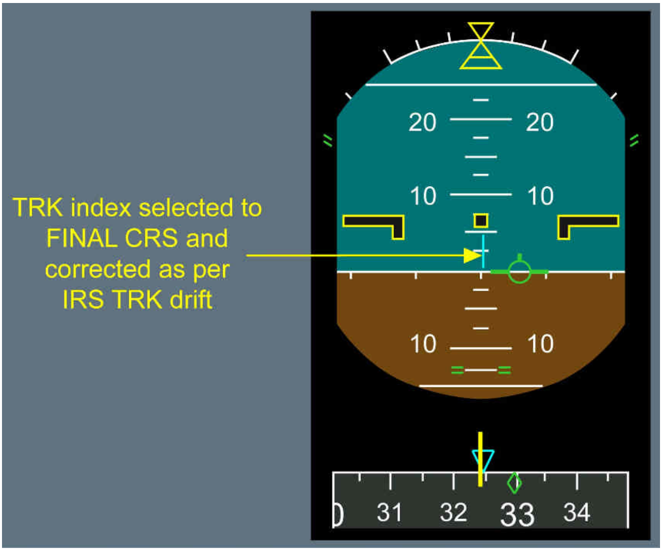
INTERMEDIATE APPROACH

The TRK index will be set to the ILS course and, once established on the LOC , the tail of the bird should be coincident with the TRK index. This method allows accurate LOC tracking taking into account the drift.

Should the LOC deviate, the pilot will fly the bird in the direction of the LOC index, and when re-established on the LOC , set the tail of the bird on the TRK index again. If there is further LOC deviation, check unwanted residual bank angle. Also a slight IRS drift should be suspected as the bird is computed out of IRS data.
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. Should the G/S deviate, the pilot will make small corrections in the direction of the deviation and when re-established on the G/S , reset the bird to the G/S angle.



PREFACE

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

NPA are defined as:
- VOR approach
- NDB approach
- LOC, LOC-BC approach
- R-NAV approach.

APPROACH STRATEGY

The overall strategy of NPA completion is to fly it "ILS alike" with the same mental image or representation and similar procedure. Instead of being referred to an ILS beam, the AP /FD guidance modes and associated monitoring data are referred to the FMS F-PLN consolidated by raw data. LOC only approach is the exception where LOC mode and localizer scale are to be used. This explains why the crew must ensure that the FMS data is correct, e.g. FMS accuracy, F-PLN (lateral and vertical) and proper leg sequencing.
The use of AP is recommended for all non-precision approaches as it reduces crew workload and facilitates monitoring the procedure and flight path.

LIMITATIONS

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.

The use of FINAL APP , NAV V/S , NAV /FPA modes is not permitted with the autopilot on to perform NPA approaches if one engine is inoperative (for more information, *Refer to FCOM/LIM-22-10 Non-Precision Approaches with Engine-Out*). Only FD use is permitted.
In others words, if the use of the autopilot is preferred, its use will be limited to TRK /FPA or HDG V/S modes.

INITIAL APPROACH

NAVIGATION ACCURACY

The navigation accuracy determines which AP /FD modes the flight crew should use and the parameters that must be monitored during the approach (consequently the type of display to be shown on the PFD and ND - *Refer to NO-110 INITIAL APPROACH* and *Refer to NO-110 FINAL APPROACH*)
Should a NAV ACCY DNGRADED or a GPS PRIMARY LOST message is displayed while flying a managed non-precision approach, the flight crew should proceed as follow:

Message	VOR , ADF , VOR /DME approach	GPS approach
GPS PRIMARY LOST	Cross-check the navigation accuracy: If positive, continue managed approach (1) If negative, revert to selected approach with raw data.	Interrupt the approach if external visual reference are not sufficient
NAV ACCY DNGRADED		-

(1) *If HIGH accuracy is lost on one FMGC, the approach can be continued with the AP /FD associated to the other FMGC.*

FLYING REFERENCE

It is recommended to use the FD crossbars for approach using vertical managed guidance (FINAL APP). The FPV (also called "bird") with FPD is used for approach using FPA guidance (LOC FPA, NAV FPA and TRK FPA).

APPROACH PHASE ACTIVATION

Decelerated approach may be flown for approach using FINAL APP.
The early stabilized approach technique is recommended for LOC FPA, NAV FPA and TRK FPA approaches flown with the bird.

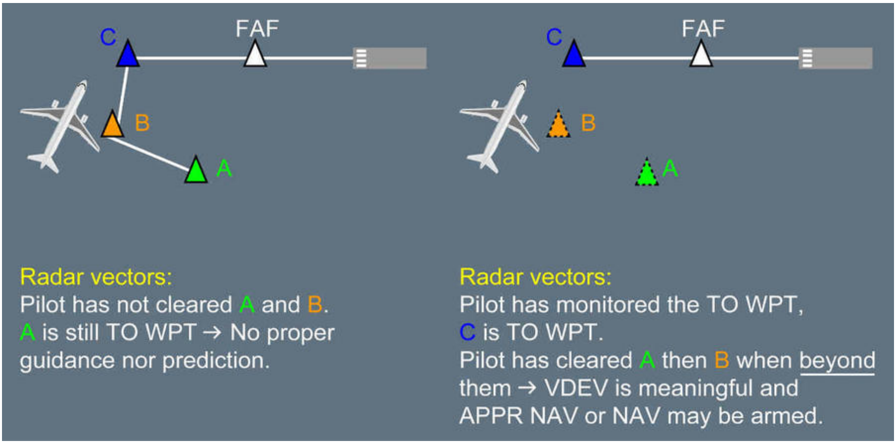
INTERMEDIATE APPROACH

1 **Applicable to: MSN 0517-1060**

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.

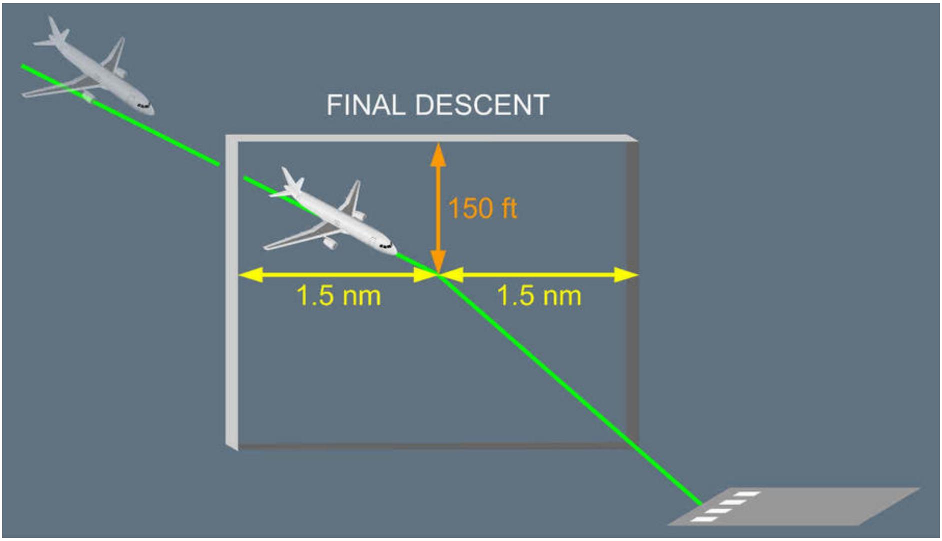
F-PLN Sequence in Approach



When ATC gives radar vector and clears for final approach course interception, the flight 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 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.

  <u>Note:</u> *A white arrow indicates that at least one of the engagement conditions is not met.*



If the green solid line intercepts the F-PLN active leg (1), this creates an INTERCPT point with final approach axis. APP NAV will engage when intercepting the final approach course.

If the green solid line intercepts the PRE NAV engagement path (2), APP NAV engages when intercepting the final approach course. The PRE NAV engagement path is at least 1 NM and may be longer depending on aircraft speed.

HDG or TRK may be used to smooth the final approach course interception. When close to the final approach course, DIR TO function may be used.

If the green solid line does not intercept the PRE NAV engagement path (3), APP NAV will not engage.

XTK is related to the beam and the ND gives a comprehensive display.

Additionally, the VDEV becomes active and represents the vertical deviation, which may include a level segment. The VDEV /brick scale will only be displayed if ILS or LS pb is not pressed. If the ILS or LS pb is pressed by mistake, the V/DEV will flash in amber on the PFD.

- 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.

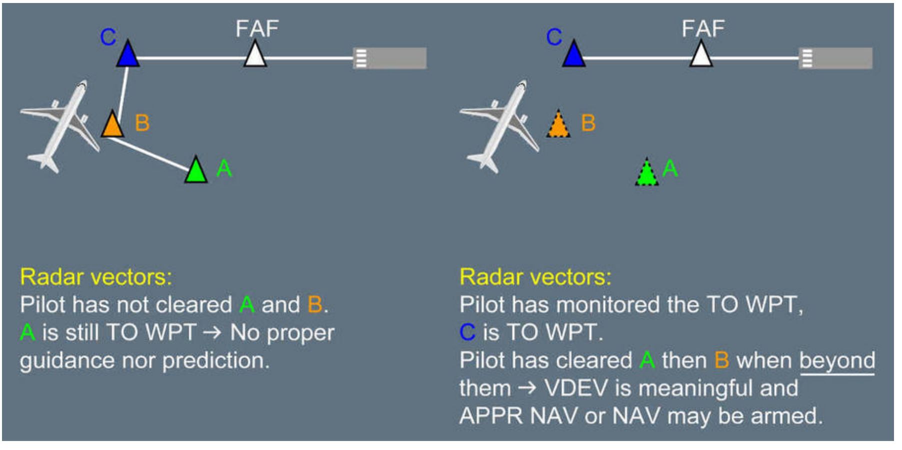
The final approach course interception will be monitored through applicable raw data.

INTERMEDIATE APPROACH

INTERCEPTION OF FINAL APPROACH COURSE

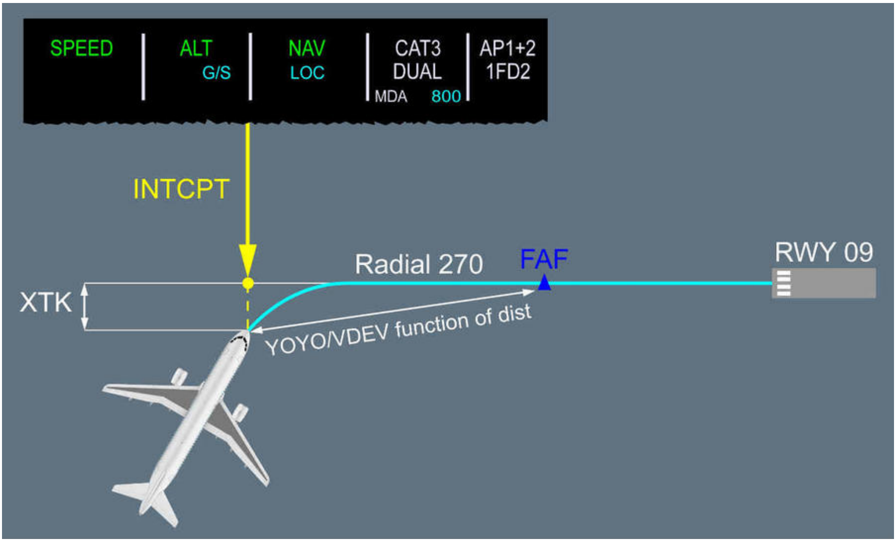
It is essential to have a correct F-PLN in order to ensure proper final approach guidance. Indeed the NAV and APP NAV modes are always guiding the aircraft along the F-PLN active leg and the managed vertical mode ensures VDEV =0, VDEV , being computed along the remaining F-PLN to destination. Hence, 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 flight crew will use DIR TO FAF with RADIAL INBND facility. This creates an ILS alike beam which will be intercepted by NAV and APP NAV modes. Additionally, the VDEV is realistic, XTK is related to the beam and the ND gives a comprehensive display.

F-PLN in Approach

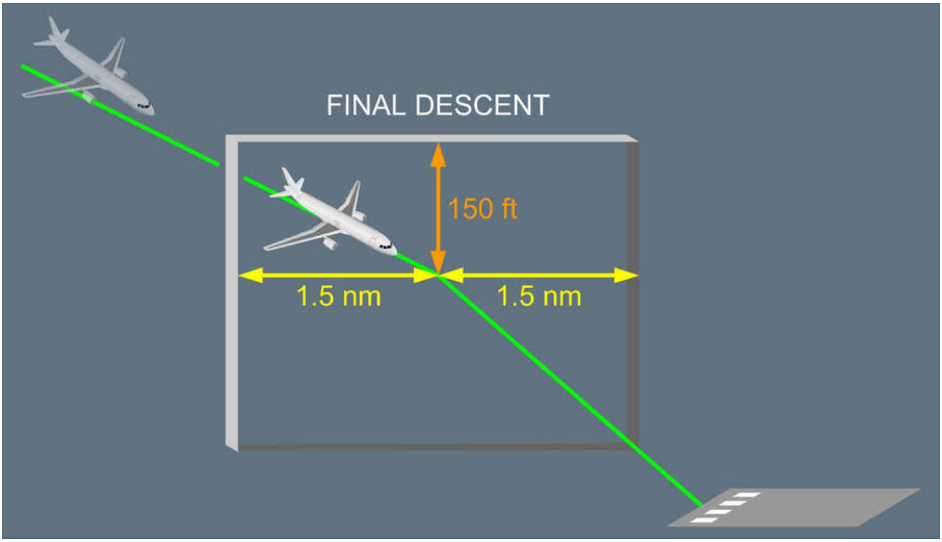


When cleared for final approach course interception, the pilot will either

- 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 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.

  <u>Note:</u> *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

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

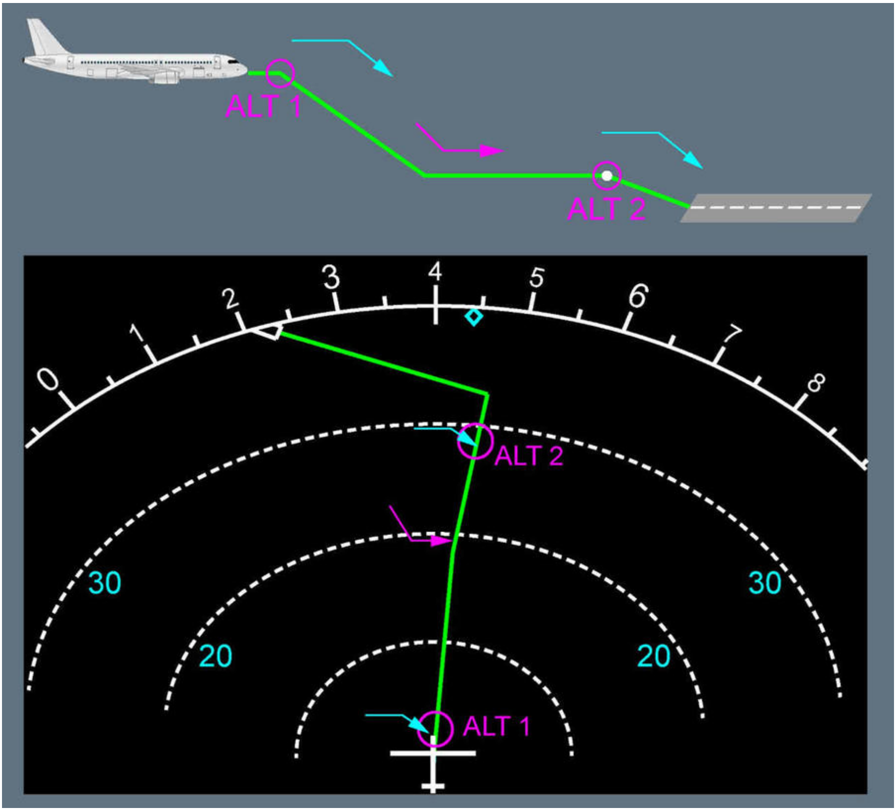
The final approach will be flown either
- Managed or
- Selected

MANAGED

For a managed approach, FINAL APP becomes active and the 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 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 NPA s, 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 the point where the final descent starts at the latest. A smooth interception of the final approach path can be achieved by pulling the FPA selector 0.3 NM prior to the point where the final descent starts.

REACHING THE MINIMA

When approaching MDA, the pilot flying should expand the instrument scan to include outside visual cues.
Reaching MDA, "MINIMUM" is either monitored or called by the crew. The current altitude value becomes amber.
If the required visual conditions are not met by MDA, a missed approach must be initiated.
When the required visual conditions are met to continue the approach, the AP must be disconnected, the FDs selected off Bird on, Runway track and continue for visual approach.

LOC ONLY APPROACH

LOC ONLY approaches may be flown using the LOC signal for lateral navigation and FPA for vertical guidance. General recommendations mentioned above still apply i.e. early stabilized approach technique, use of the bird. Some additional recommendations need to be highlighted.

INITIAL APPROACH

The flight crew will select LS p/b on the EIS control panel.

INTERMEDIATE APPROACH

The flight crew will press LOC pb-sw on the FCU when cleared for approach and on the intercept trajectory for the final approach course. The flight crew will monitor the LOC armed mode and then LOC capture.

FINAL APPROACH

Approaching the point where the final descent starts, the flight crew will initiate the descent as for approach using vertical selected guidance.

LOC BACK COURSE APPROACH

LOC -BC approaches may be flown using the Bird with reference to the LOC -BC signal for lateral guidance and FPA for vertical guidance. General recommendations mentioned above still apply i.e. stabilized approach technique and use of the bird. Some additional recommendations need to be highlighted.

GENERAL

The LOC BC approach consists in using the LOC signal of the opposite runway for lateral approach management.

The ILS will be manually entered in the MCDU RAD NAV page using:
- Either the ident (ILS stored in the FMS database). RWY /ILS MISMATCH message may be triggered and will be disregarded.
- Or the frequency (ILS not stored in the FMS database).

In both cases, the front course will be entered in the CRS field.

INITIAL APPROACH

The crew will select ROSE ILS and TRK /FPA . The crew will not select ILS or L/S p/b on the EIS control panel and ISIS , as it would provide reverse deviation.

INTERMEDIATE APPROACH

When clear for approach, the crew will intercept manually LOC /BC using the blue TRK index with reference with LOC /BC lateral deviation on ND . The crew will not arm LOC or APPR modes.

FINAL APPROACH

Approaching the FAF , the crew will select the FPA corresponding to the final approach path, LOC deviation (proper directional guidance), DME /ALT, time, yoyo.

COLD WEATHER OPERATIONS

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 APPROACH

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. The flight crew can perform the LANDING C/L except the FLAPS for landing. They will check the configuration for landing during the final turn.

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 mode with a low range 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 180 kt for Category C aircraft (ICAO PANS-OPS and JAR OPS). Maintaining F speed during the circling procedure ensures that the aircraft remains within the safe circling area. In regions where FAA TERPS criteria apply, the circling areas and limit speeds are more restrictive. Therefore, in these regions, refer to the Company SOPs.*

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

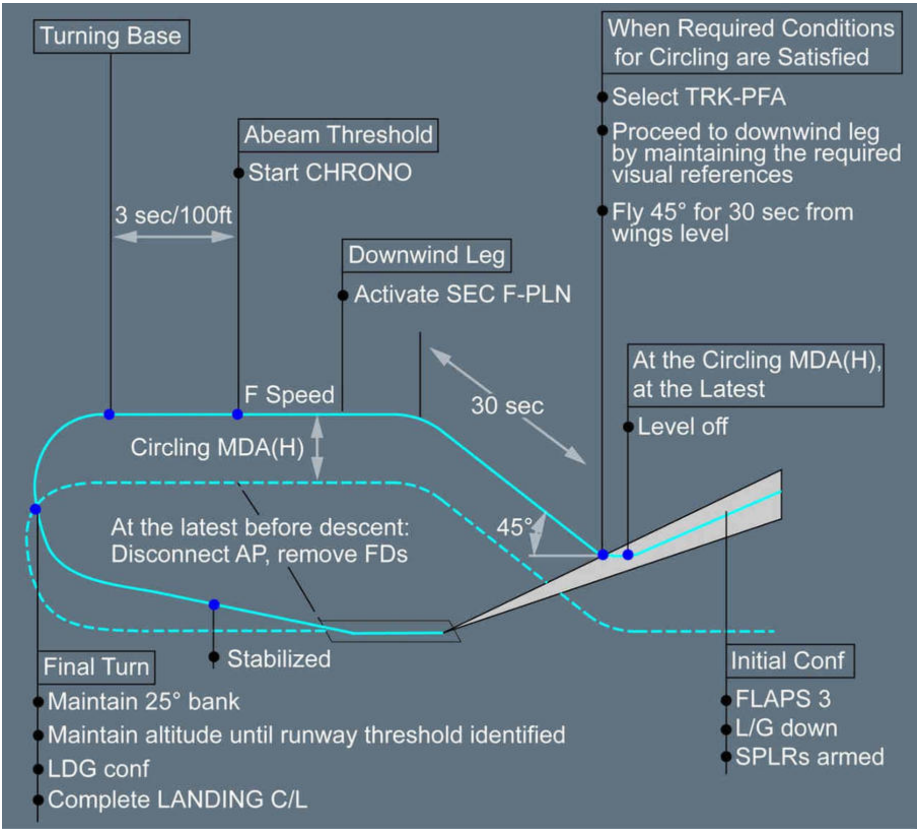
At MAP, if the flight crew finds no visual reference:
- Initiate a go-around

When required conditions for circling are satisfied:
- Select TRK -FPA
- Preselect 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.
- Disconnect the AP and remove the FD s at the latest before starting the descent toward the runway. 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

- Set the landing configuration when appropriate, but ensure early stabilization in final
- 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.
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 FCTM AO-020 Circling One Engine Inoperative.

CIRCLING APPROACH PATTERN



INITIAL APPROACH

1 Applicable to: MSN 0517-1060

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
- BIRD ON
- A/THR confirmed active in speed mode, i.e. SPEED on the FMA.
- Managed speed will be used to enable the "GS mini” function
- The downwind track will be selected on the FCU to assist in downwind tracking.
- The downwind track altitude will be set on FCU

INITIAL APPROACH

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
- BIRD ON
- A/THR confirmed active in speed mode, i.e. SPEED on the FMA.
- Managed speed will be used to enable the "GS mini" function
- The downwind track will be selected on the FCU to assist in downwind tracking.
- The downwind track altitude will be set on FCU

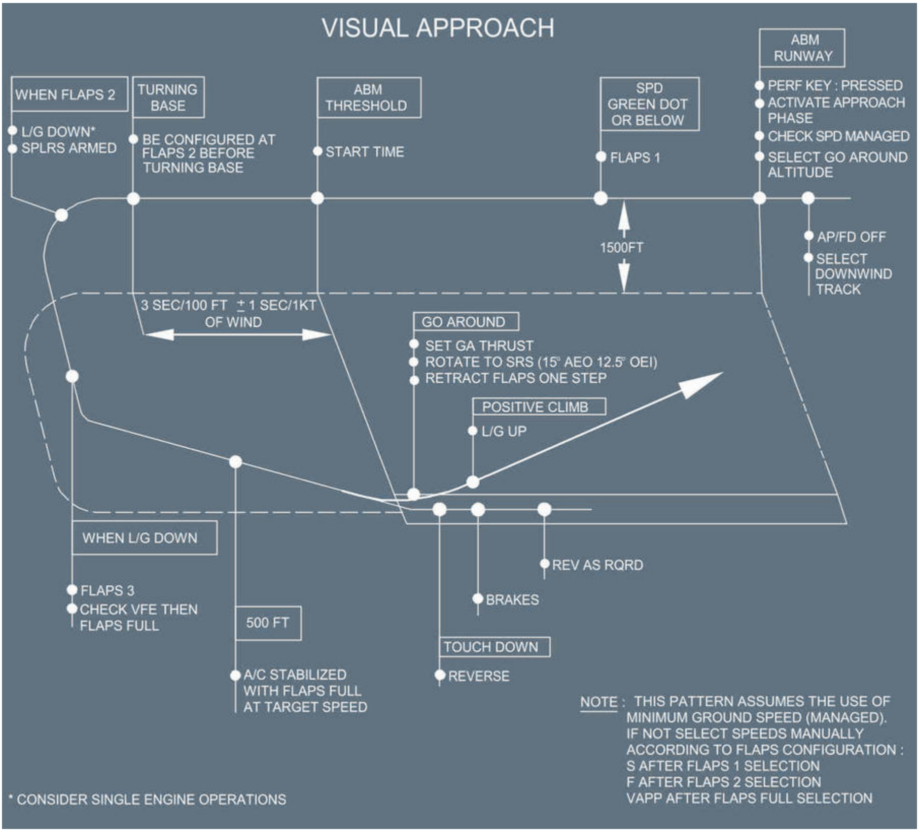
INTERMEDIATE/FINAL APPROACH

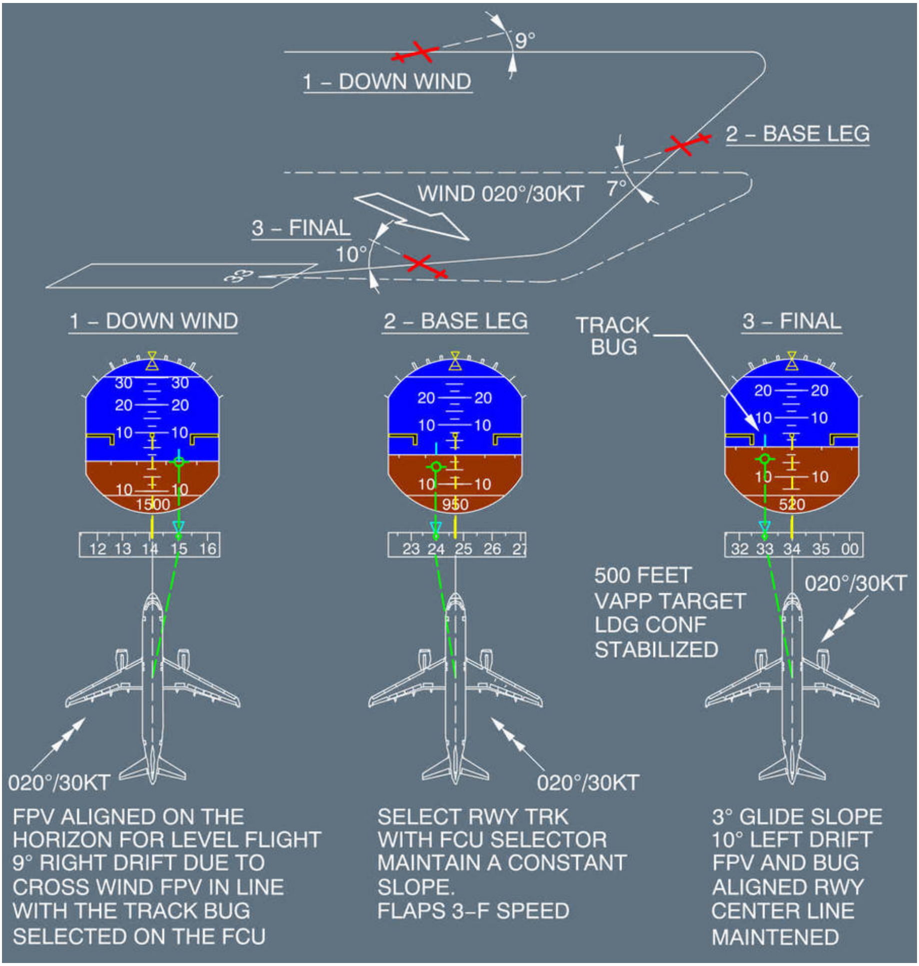
Assuming a 1 500 ft AAL circuit, the base turn should be commenced 45 s after passing abeam the downwind threshold (3 s/100 ft +/- 1 s/1 kt of head/downwind).

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 at VAPP by 500 ft AAL, at the latest. If not stabilised, a go-around must be carried out.

visual approach




9°
1 – DOWN WIND
2 – BASE LEG
WIND 020°/30KT
7°
3 – FINAL
10°
33
1 – DOWN WIND
2 – BASE LEG
TRACK BUG
3 – FINAL
1500
950
520
12 13 14 15 16
23 24 25 26 27
32 33 34 35 00
500 FEET
VAPP TARGET
LDG CONF
STABILIZED
020°/30KT
020°/30KT
020°/30KT
FPV ALIGNED ON THE HORIZON FOR LEVEL FLIGHT 9° RIGHT DRIFT DUE TO CROSS WIND FPV IN LINE WITH THE TRACK BUG SELECTED ON THE FCU
SELECT RWY TRK WITH FCU SELECTOR MAINTAIN A CONSTANT SLOPE. FLAPS 3–F SPEED
3° GLIDE SLOPE 10° LEFT DRIFT FPV AND BUG ALIGNED RWY CENTER LINE MAINTENED


ARPT
NDB
VOR.D
WPT
CSTR
ROSE
NAV
VOR
ARC
ILS
PLAN
ENG
in.Hg
hPa
PULL
STD
10
20
40
80
160
320
FD
ILS
ADF
VOR
OFF
GS 211 TAS 211
ILS APP
CI15R 310°
118 / 15
11.1 NM
9.52
LFBO
1SR
FBO
IN-GND
2.9L
2.5
D145E
1rn.

GENERAL

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

DEFINITION

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 RVR ≥ 1 200 ft	350 m ≤ RVR < 800 m 1 200 ft ≤ RVR < 2 400 ft	RVR ≥ 300 m 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 RVR ≥ 700 ft	RVR ≥ 200 m RVR ≥ 700 ft	RVR ≥ 200 m 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 150 ft ≤ RVR < 700 ft	50 m ≤ RVR < 200 m 150 ft ≤ RVR < 700 ft	75 m ≤ RVR < 200 m 250 ft ≤ RVR < 700 ft

(1) *DH ≥ 50 ft if fail passive*

FLIGHT PREPARATION

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

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 Failures and Associated Actions* for failures and associated actions below 1 000 ft RA that should lead to a go-around.

APPROACH BRIEFING

Before commencing a CAT II/III approach a number of factors must be considered by the crew. In addition to the standard approach briefing, the following points should be emphasised during an approach briefing for a low visibility approach:

- Aircraft capability
- Airport facilities
- Crew qualification
- Weather minima
- Task sharing
- Call-outs
- Go-around strategy

APPROACH PROCEDURE

Ident.: NO-160-00005568.0001001 / 28 AUG 15
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 ", 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")
- 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.

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.
Pull to REV MAX (or REV IDLE if conditions permits) at main landing gear touchdown (not before).
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.

FAILURE AND ASSOCIATED ACTIONS

As a general rule, if a failure occurs above 1 000 ft AGL , the approach may be continued, ECAM actions completed, approach briefing update performed and a higher DH set if required.
Below 1 000 ft (and down to AH in CAT3 DUAL), the occurrence of any failure implies a go-around and a reassessment of the system capability. Another approach may be under taken according to the new system capability. It has been considered that below 1 000 ft, not enough time is available for the crew to perform the necessary switching, to check system configuration and limitation and brief for minima.
In CAT3 DUAL and below AH, as a general rule, a single failure does not necessitate a go-around. A go-around is required if the AUTOLAND warning is triggered.

AUTOLAND IN CAT 1 OR BETTER WEATHER CONDITIONS

The crew may wish to practice automatic landings in CAT I or better weather conditions for training purposes. This type of approach should be carried out only with the airline authorization. The crew should be aware that fluctuations of the LOC and/or GS might occur due to the fact that protection of ILS sensitive areas, which applies during LVP, will not necessarily be in force. It is essential, therefore, that the PF is prepared to take over manually at any time during a practice approach and rollout, should the performance of the AP become unsatisfactory.

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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.

TRANSITION TO VISUAL REFERENCES

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

FLARE AND TOUCHDOWN

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 to -2 °nose down over a period of 8 s. Consequently, the pilot will have to move the stick rearwards, so as to reproduce conventional aircraft aerodynamic characteristics. 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 height 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.
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.
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.

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/sharklet (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).

ROLLOUT

NORMAL CONDITIONS

During the roll out, the rudder pedals will be used to steer the aircraft on the runway centreline.
At high speed, directional control is achieved with rudder. As the speed reduces, the Nose Wheel Steering (NWS) becomes active. However, the NWS tiller will not be used until taxi speed is reached.

CROSSWIND CONDITIONS

The above-mentioned technique applies. Additionally, the pilot will avoid setting stick into the wind as it increases the weathercock effect. Indeed, it creates a differential down force on the wheels into the wind side.
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.
For more information about rudder pedals recommendations, *Refer to NO-020 MISCELLANEOUS*

DECELERATION

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.

REVERSE THRUST EFFICIENCY

Thrust reversers are more efficient at high speeds: The flight crew must select reverse thrust immediately after main landing gear touchdown.
Below 70 kt, thrust reversers efficiency rapidly decreases. Below 60 kt with REV MAX selected, engine stall may occur. Therefore, it is recommended to reduce the reverse thrust to REV IDLE at 70 kt, and keep REV IDLE until taxi speed. However in an emergency case, the flight crew must keep REV MAX until full-stop of the aircraft.
At taxi speed, and not above, stow the thrust reversers before leaving the runway, in order to avoid foreign object ingestion.

REVERSE THRUST SELECTION

The selection of REV MAX is the standard practice for landing.

LANDING ON DRY RUNWAYS

On DRY runways, the flight crew may select REV IDLE.

LANDING ON WET RUNWAYS

On WET runways, the flight crew may select REV IDLE, if all the conditions described in the SOP DESCENT PREPARATION (*Refer to FCOM/SOP DESCENT PREPARATION*) are satisfied.

LANDING ON CONTAMINATED RUNWAYS

On contaminated runways, the flight crew must select REV MAX.

REMINDER ON LANDING DISTANCE COMPUTATION AT DISPATCH FOR DRY AND WET RUNWAYS

DEFINITIONS

ALD	:	The Actual Landing Distance is the distance used on a dry runway from the crossing of the runway threshold at 50 ft until full-stop of the aircraft, using maximum manual braking. No reverse thrust is considered for the calculation of the ALD. The ALD is demonstrated during flight test campaign for certification purpose.
RLD dry	:	The Required Landing Distance on a dry runway is a factored ALD. The factor is 1.67. (RLD dry = ALD x 1.67)

RLD wet : The Required Landing Distance on a wet runway is a factored ALD. The factor is 1.92 (RLD wet = RLD dry x 1.15)

DISPATCH CONDITIONS

For landing distance computation at dispatch, the airline uses the RLD.
Landing distances computed at dispatch for wet runways provide only reduced margins in comparison with landing distances achievable in operations with the use of REV IDLE. Sufficient margins are restored when the flight crew uses REV MAX.
The runway slope is not considered for the landing distance computation at dispatch.
On a destination airport with multiple runways, the landing distance computation at dispatch may be performed on the longest landing runway with no wind.
The expected landing runway may be used for the landing distance computation at dispatch with forecast wind at landing. If the wind condition changes at landing, the flight crew must perform a new landing distance computation.

LANDING WITH REV IDLE ON WET RUNWAYS

The landing distance computation at dispatch (RLD) does not consider REV IDLE operation. Therefore, it is necessary to perform a computation to consider REV IDLE operation, as described in the SOP DESCENT PREPARATION (*Refer to FCOM/SOP DESCENT PREPARATION*). This may be done before the flight.
At descent preparation, if the flight crew considers the use of REV IDLE on a wet runway, they should be able to confirm a MEDIUM TO POOR landing distance computation with no reverse credit on the predicted landing runway.
A MEDIUM TO POOR computation enables the flight crew to consider extreme situations where a runway reported wet is worse than wet. If a runway reported wet is water contaminated, the braking action is a function of the water depth. During active precipitation or shortly afterwards, the water depth is variable, and therefore difficult to evaluate and to report accurately.
Therefore on runways reported wet, the real friction coefficient may be significantly less than expected and/or aquaplaning may occur. When REV IDLE is used, the maximum possible deceleration of the aircraft mainly depends on the runway friction coefficient.

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:

- The use of A/BRAKE is usually preferable because it minimizes the number of brake applications and thus reduces brake wear. Additionally, the A/BRAKE provides a symmetrical brake pressure application which ensures an equal braking effect on both main landing gear wheels on wet or evenly contaminated runway. More particularly, the A/BRAKE is recommended on short, wet, contaminated runway, in poor visibility conditions and in Auto land.
- The use of LO auto brake should be preferred on long and dry runways whereas the use of MED auto brake should be preferred for short or contaminated runways.
- On very short runways, the use of pedal braking is to be envisaged since the pilot may apply full pedal braking with no delay after touch down.
- On very long runways, the use of pedal braking may be envisaged if the pilot anticipates that braking will not be needed. To reduce brake wear, the number of brake application should be limited.
- In case of pedal braking, do not ride the brakes but apply pedal braking when required and modulate the pressure without releasing. This minimizes brake wear.

The 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.

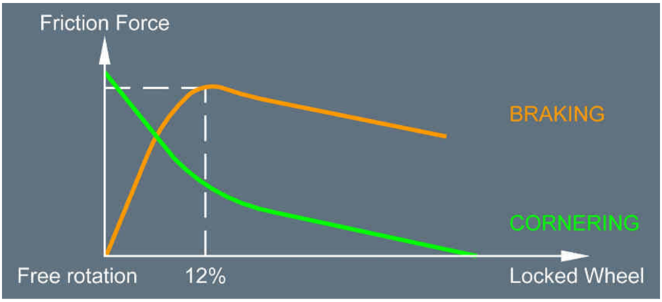
Since the auto brake system senses deceleration and modulates brake pressure accordingly, the timely application of MAX reverse thrust will reduce the actual operation of the brakes themselves, thus the brake wear and temperature.

Auto-brake does not relieve the pilot of the responsibility of achieving a safe stop within the available runway length.

CROSS WIND CONDITIONS

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

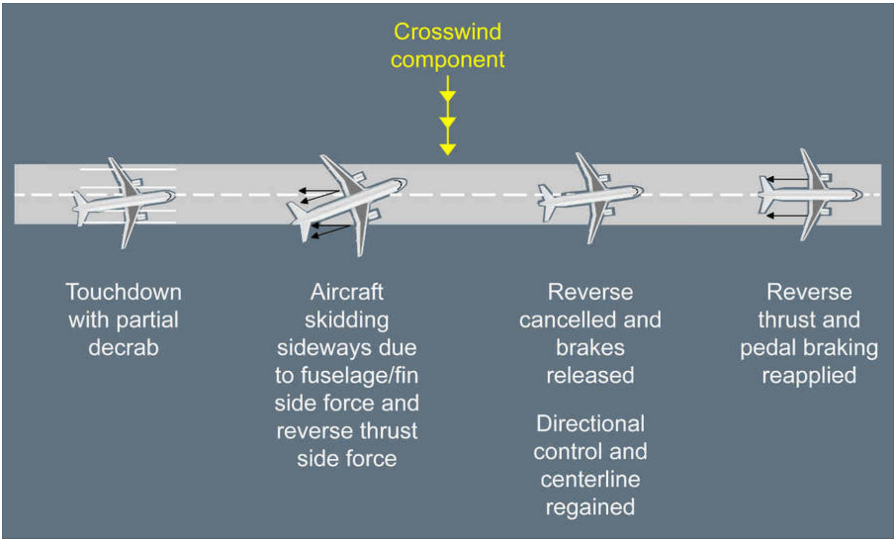
Braking Force and Cornering Force vs Antiskid



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.

For more information about rudder pedals recommendations, *Refer to NO-020 MISCELLANEOUS*

Directional Control During Crosswind Landing



TAIL STRIKE AVOIDANCE

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.

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 as an option on A320 and A321.

BOUNCING AT TOUCH DOWN

In case of light bounce, maintain the pitch attitude and complete the landing, while keeping the thrust at idle. Do not allow the pitch attitude to increase, particularly following a firm touch down with a high pitch rate.
In case of high bounce, maintain the pitch attitude and initiate a go-around. Do not try to avoid a second touch down during the go-around. Should it happen, it would be soft enough to prevent damage to the aircraft, if pitch attitude is maintained.
Only when safely established in the go-around, retract flaps one step and the landing gear. A landing should not be attempted immediately after high bounce, as thrust may be required to soften the second touch down and the remaining runway length may be insufficient to stop the aircraft.

CUMULATIVE EFFECTS

No single factor should result in a tail strike, but accumulation of several can significantly reduce the margin.

PREFACE

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.

CONSIDERATION ABOUT GO-AROUND

DECISION MAKING

A go-around must be considered if:

- There is a loss or a doubt about situation awareness
- If there is a malfunction which jeopardizes the safe completion of the approach e.g. major navigation problem
- ATC changes the final approach clearance resulting in rushed action from the crew or potentially unstable approach
- The approach is unstable in speed, altitude, and flight path in such a way that stability will not be obtained by 1 000 ft IMC or 500 ft VMC.
- Any GPWS , TCAS or windshears alert occur
- Adequate visual references are not obtained at minima or lost below minima.

GO-AROUND NEAR THE GROUND

If the PF initiates a go-around, the flight crew must complete the go-around maneuver. The PF must not initiate a go-around after the selection of the thrust reversers.

If the flight crew performs a go-around near the ground, they should take into account the following:

- The PF should avoid excessive rotation rate, in order to prevent a tailstrike
- A temporary landing gear contact with the runway is acceptable. For more information *Refer to NO-170 Tail Strike Avoidance*
- In the case of bounce, the flight crew must consider delaying flap retraction
- The PF should order landing gear retraction when the aircraft reaches and maintains positive climb with no possibility of subsequent touchdown.

Note: *If the aircraft is on the runway and in FULL configuration when the PF applies TOGA thrust, a CONFIG FLAPS NOT IN T.O CONFIG ECAM alert is triggered. The flight crew should disregard this alert.*

AP/FD GO-AROUND PHASE ACTIVATION

When the thrust levers are set to the TOGA detent, and provided the real slats/flaps configuration is different from clean configuration, all of the following occur:
- The SRS GA and the GA TRK modes engage
- The GA phase activates on the FMS:
  - The missed approach becomes the active F-PLN
  - At the end of the missed approach procedure, the FMS strings the previous flown approach in the active F-PLN.
- For the go-around, the appropriate flight reference is the attitude, because go-around is a dynamic maneuver
- If extended, the speed brakes automatically retract.

If TOGA thrust is not desired during go-around for any reason, e.g. an early go-around ordered by ATC, it is essential that the thrust levers are set momentarily but without delay, to the TOGA detent (i.e. the full forward thrust levers position), in order to ensure proper activation of the SRS GA and the Go-Around phase (i.e. guidance modes and FMS flight phase). Then, the flight crew should set the thrust lever to CL detent to take advantage of the A/THR (the A/THR follows a speed target).

If the thrust levers are not correctly set to the TOGA detent, the following occur:
- The AP/FD remain engaged in approach or landing mode (e.g. G/S, LOC, LAND, FLARE on FMA)
- The FMS does not engage the GA phase, and remains in APPR phase.

AP/FD GO-AROUND PHASE ACTIVATION

1 **Applicable to: MSN 0517, 1060-2396**

When the thrust levers are set to the TOGA detent, and provided the real slats/flaps configuration is different from clean configuration, all of the following occur:
- If the autopilot or the flight director is in use, SRS and GA TRK modes engage.
- If the autopilot and both flight directors are off, the PF will maintain 15 ° of pitch.

- The GA phase activates on the FMS:
  - The missed approach becomes the active F-PLN
  - At the end of the missed approach procedure, the FMS strings the previous flown approach in the active F-PLN.
- If not previously engaged, the FD automatically engages with the HDG /VS reference on the FCU. For the go-around, the appropriate flight reference is the attitude, because go-around is a dynamic maneuver
- If extended, the speed brakes automatically retract.

If TOGA thrust is not desired during go-around for any reason, e.g. an early go-around ordered by ATC , it is essential that the thrust levers are set momentarily but without delay, to the TOGA detent (i.e. the full forward thrust levers position), in order to ensure proper activation of the SRS GA and the Go-Around phase (i.e. guidance modes and FMS flight phase). Then, the flight crew should set the thrust lever to CL detent to take advantage of the A/THR (the A/THR follows a speed target).

If the thrust levers are not correctly set to the TOGA detent, the following occur:
- The AP /FD remain engaged in approach or landing mode (e.g. G/S , LOC , LAND , FLARE on FMA)
- The FMS does not engage the GA phase, and remains in APPR phase.

GO-AROUND PHASE

GO AROUND WITH FD ON

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.

GO AROUND WITH FD OFF

The PF maintains 15 ° of pitch.
The crew will not select the FD ON before the acceleration altitude, since this would not activate the SRS mode. (V/S mode would be activated, maintaining the V/S at mode engagement).
At the thrust reduction/acceleration altitude, the crew will set the selected speed to green dot before setting CLB thrust, since the autothrust will activate in selected speed mode.
The crew will then set the FD ON , and select the appropriate modes.

GO-AROUND PHASE

2 **Applicable to: MSN 0517, 1060-2396**

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.
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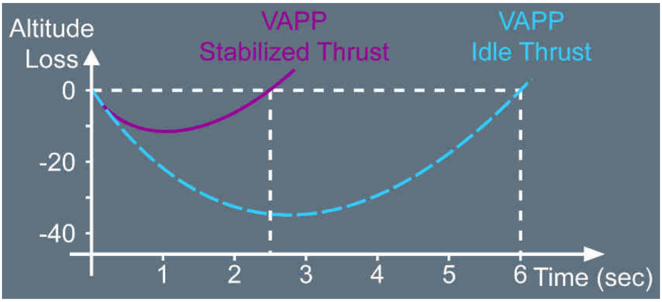
Above the go-around acceleration altitude, or when the flight crew engages another vertical mode (CLB , OP CLB), the target speed is green dot.

ENGINES ACCELERATION

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 lose 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

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.

BRAKE FANS

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

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

1

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

Operate the engines at or near idle thrust for a cooling period (*Refer to FCOM/PRO-NOR-SOP-22 Parking - ENG Master Switches*) before shutdown to thermally stabilize the engines. Idle reverse thrust and normal taxi maneuvering thrust are not considered as high thrust operations.
However, if operationally necessary, all engines may be shut down upon arrival at the gate, regardless of the time since landing.

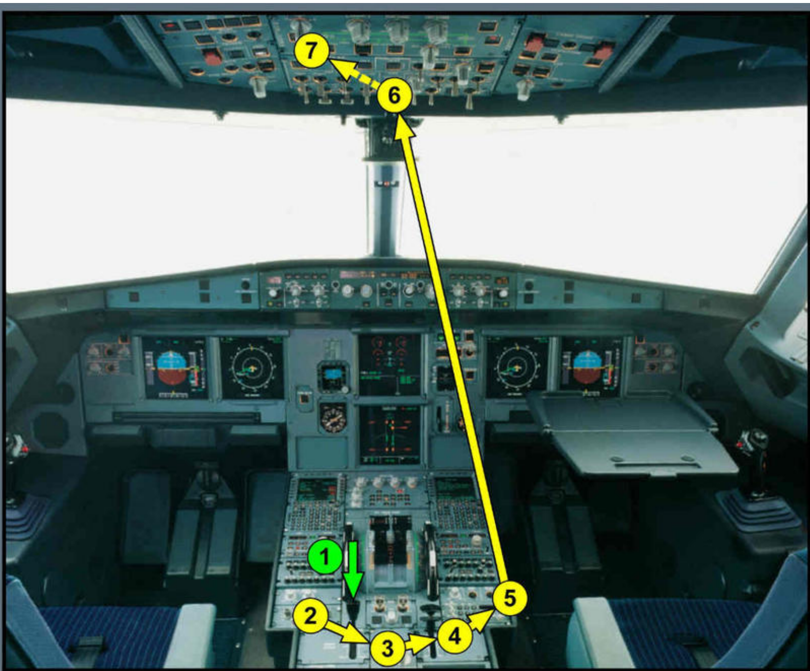
Note: *Routine cooldown times shorter than the recommended period before engine shutdown can cause engine degradation such as blade damage or oil coking.*

TAXI WITH ONE ENGINE SHUTDOWN

Refer to NO-040 TAXI WITH ONE ENGINE SHUTDOWN

AFTER LANDING FLOW PATTERN

After Landing Flow Pattern



PF ACTIONS

1 GRND SPLRS.......DISARM

PM ACTIONS

2 RADAR/PREDICTIVE WINDSHEAR....OFF
3 ENG MODE SEL..............................NORM
4 FLAPS.......................................RETRACT
5 ATC.......................................AS RQRD
TCAS...........................SET on standby
6 APU...START
7 ANTI ICE...................................AS RQRD

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ABNORMAL OPERATIONS

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AO-010 GENERAL

AO-020 OPERATING TECHNIQUES

AO-022 AUTOFLIGHT

AO-024 ELECTRICAL

AO-026 Fire Protection

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Localization Title	Toc Index	ID	Reason
AO-020 Thrust Levers Management in case of Inoperative Reverser(s)	M	1	Effectivity update: The information now also applies to MSN 1060.
AO-090 OVERWEIGHT LANDING	D	1	Effectivity update: The information now also applies to MSN 1060.

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PREFACE

The ABNORMAL OPERATIONS chapter highlights techniques that will be used in some abnormal and emergency operations. Some of the procedures discussed in this chapter are the result of double or triple failures. Whilst it is very unlikely that any of these failures will be encountered, it is useful to have a background understanding of the effect that they have on the handling and management of the aircraft. In all cases, the ECAM should be handled as described in FCTM (*Refer to OP-040 PURPOSE OF THE ECAM*).

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LOW SPEED ENGINE FAILURE

If an engine failure occurs at low speed, the resultant yaw may be significant, leading to rapid displacement from the runway centreline.

To regain or maintain directional control on the runway, it is necessary:
- To immediately reduce both thrust levers to IDLE, which will reduce the thrust asymmetry caused by the failed engine
- To select both reversers irrespective of which engine has failed
- To use rudder pedal for directional control, supplemented by symmetrical or differential braking if needed.

The steering hand-wheels may be used when taxi is reached.

<u>Note:</u> *1. If rudder pedal input and differential braking are needed, apply both on the same side*
2. Below 72 kts, the ground spoilers will not deploy and the auto brake will not activate.

REJECTED TAKE-OFF

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.

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 making process, 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 UNLOCKED
  - 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.

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

Should a RTO procedure is initiated, the following task sharing will be applied.

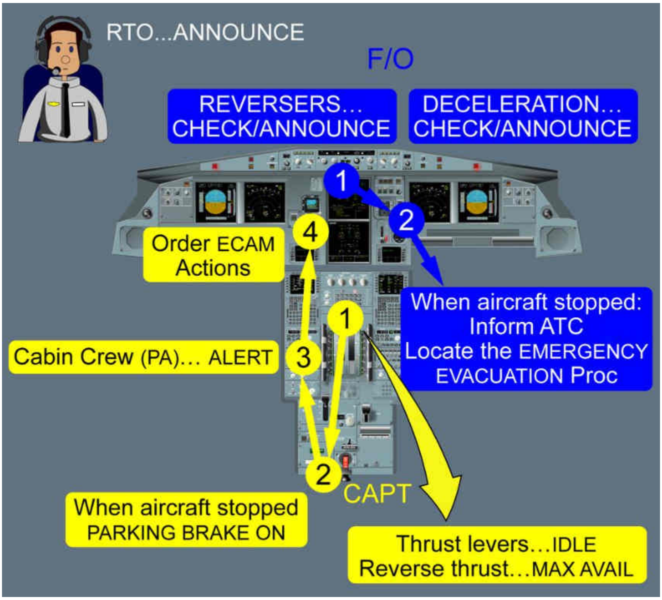
CAPT	F/O
"STOP"........................Announce	
Thrust levers.....................IDLE	
Reverse thrust..........MAX AVAIL	Reversers..........Check/Announce
	Deceleration...Check/Announce (1)
	Cancel any audio warning
<u>Aircraft stopped</u>	
Reverse.........................Stowed	Advise ATC
Parking brake.....................Apply	Locate EMER EVAC Procedure
Cabin Crew (PA)...................Alert	
Order ECAM Actions	Achieve ECAM Actions

(1): Announcing the deceleration means that the deceleration is felt by the crew, and confirmed by the Vc trend on the PFD. The deceleration may also be confirmed by the DECEL light (if the autobrake is on). However, this light only comes on when the actual deceleration is 80 % of the selected rate, it is not an indicator of the proper autobrake operation. For instance, the DECEL light might not appear on a contaminated runway, with the autobrake working properly, due to the effect of the antiskid.

If the takeoff is rejected prior to 72 kt, the spoilers will not deploy and the auto-brake will not function.

If a rejected takeoff is initiated and MAX auto brake decelerates the aircraft, the captain will avoid pressing the pedals (which might be a reflex action). Conversely, if deceleration is not felt, the captain will press the brake pedals fully down.

Rejected takeoff flow pattern



TAKEOFF FOLLOWING RTO

Depending on the technical condition of the aircraft and the reason for the RTO (e.g. ATC instruction), the flight crew may consider a new takeoff attempt subsequent to the RTO.

In this case, the flight crew should:
- Reset both FDs and set FCU
- Restart Standard Operating Procedures from the AFTER START checklist.

INTRODUCTION TO EMERGENCY EVACUATION

GENERAL

The typical case, which may require an emergency evacuation, is an uncontrollable on ground engine fire. This situation, which may occur following a rejected takeoff or after landing, requires good crew coordination to cope with a high workload situation:

- In the rejected takeoff case, the Captain calls "STOP". This confirms that the Captain has controls
- In all other cases, the Captain calls "I HAVE CONTROL" if required, to state the control hand over.

Note: If possible, position the aircraft to keep the fire away from the fuselage, taking into account the wind direction.

DECISION MAKING

As soon as aircraft is stopped, and the parking brake is set, the captain notifies the cabin crew and calls for ECAM ACTIONS. At this stage, the task sharing is defined as follow:

- The first officer carries out the ECAM actions
- The captain builds up his decision to evacuate depending on the circumstances. Considerations should be given to:
  - Fire remaining out of control after having discharged the agents
  - Possible passenger evacuation of the aircraft on the runway
  - Communicating intentions or requests to ATC.

If fire remains out of control after having discharged the fire agents, the captain calls for the **EMER** GENCY **EVAC** UATION procedure located in the inside back cover of the QRH.

THE EMERGENCY EVACUATION PROCEDURE

Some items need to be highlighted:

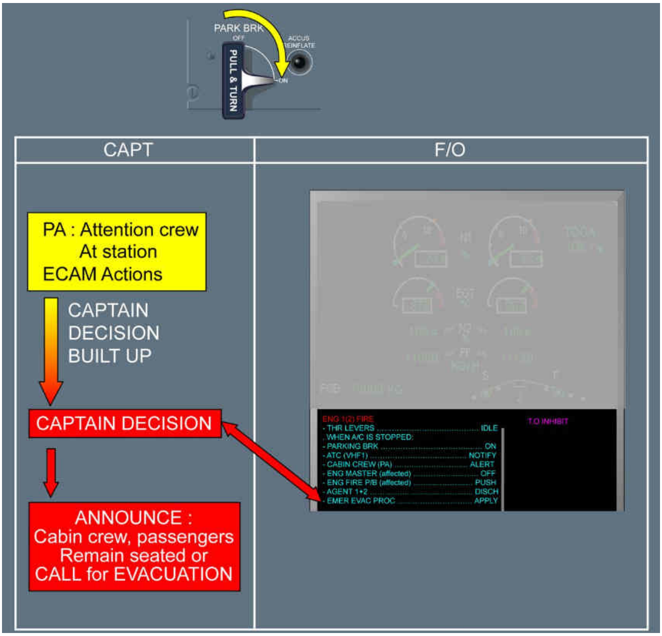
- It is essential that the differential pressure be zeroed.
  In automatic pressurization mode, the crew can rely on the CPC, and the Delta P check is therefore not applicable.
  If MAN CAB PRESS is used in flight, the CAB PR SYS (1+2) FAULT procedure requires selecting MAN V/S CTL to FULL UP position 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)…ALERT reminds the captain for the "CABIN CREW AT STATION" call out. (In case of RTO , this is done during the RTO flow pattern). Cabin crew must be aware that the flight crew is still in control of the situation. In certain circumstances, this will avoid any unwanted or unnecessary evacuation initiated by the cabin crew
- 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,
  - Advises ATC,

  This will be done preferably in this order for a clear understanding by cabin crew.

  Note: *In the case of an emergency evacuation subsequent to a rejected takeoff, the F/O (instead of the captain) advises the ATC.*

On ground with engines stopped, only the right dome light is operational and the three positions (BRT , DIM , OFF) of the DOME light sw remain available, allowing the **EMER** GENCY **EVAC**UATION procedure completion.
The crew will keep in mind that as long as the evacuation order is not triggered, the crew may differ or cancel the passengers' evacuation. As soon as the evacuation order is triggered, this decision is irreversible.
When aircraft is on batteries power, the crew seats can only be operated mechanically.

TASKSHARING IN CASE OF EMERGENCY EVACUATION



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

ENGINE FAILURE - GENERAL

An engine flameout can be due to many reasons, for example:

- Fuel starvation
- Encounter with volcanic ash, sand or dust clouds
- Heavy rain, hail, or icing
- Bird strike
- Engine stall
- Engine control system malfunction.

An engine flameout may trigger an ECAM alert.

The flight crew can detect an engine flameout without damage by a rapid decrease of EPR /N1 , N2 , N3 , EGT and FF.

The flight crew can suspect engine damage, if the flight crew observes two or more of the following symptoms:
- Rapid increase of the EGT above the red line
- Important mismatch of the rotor speeds, or absence of rotation
- Significant increase of aircraft vibrations, or buffeting, or both vibrations and buffeting
- Hydraulic system loss
- Repeated, or not controllable engine stalls.

ENGINE FAILURE AFTER V1

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:

The SRS orders should then be followed which may demand a lower pitch attitude to acquire or maintain V2.
With a positive rate of climb and when the radio height has increased, the PM will call "positive climb". This will suggest to the PF for landing gear retraction.
Shortly after lift off, the lateral normal law commands some rudder surface deflection to minimize the sideslip (there is no feedback of this command to the pedals). Thus, the lateral behavior of the aircraft is safe and the pilot should not be in a hurry to react on the rudder pedals and to chase the beta target.
The blue beta target will replace the normal sideslip indication on the PFD. Since the lateral normal law does not command the full needed rudder surface deflection, the pilot will have to adjust conventionally the rudder pedals to center the beta target.
When the beta target is centred, total drag is 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. Thus, laterally, the aircraft is a stable platform and no rush is required to laterally trim the aircraft. Control heading conventionally with bank, keeping the beta target at zero with rudder. Accelerate if the beta target cannot be zeroed with full rudder. Trim the rudder conventionally.
The use of the autopilot is STRONGLY recommended. Following an engine failure, the rudder should be trimmed out prior to autopilot engagement.
Once AP is engaged, the rudder trim is managed through the AP and, hence, manual rudder trim command, including reset, is inhibited.

THRUST CONSIDERATIONS

Consider the use of TOGA thrust, keeping in mind the following:
- For a FLEX 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.
- For a derated takeoff , the flight crew cannot apply asymmetric TOGA thrust if the speed is below F, due to VMCA considerations.
- Takeoff thrust is limited to 10 minutes.

PROCEDURE

INITIATION OF THE PROCEDURE

The PM will closely monitor the aircraft's flight path. He will cancel any Master Warning/Caution and read the ECAM title displayed on the top line of the E/WD.

Procedures are initiated on PF command. No action is taken (apart from cancelling audio warnings through the MASTER WARNING light) until:
- The appropriate flight path is established and,
- The aircraft is at least 400 ft above the runway.
  A height of 400 ft is recommended because it is a good compromise between the necessary time for stabilization and the excessive delay in procedure initiation.

Priority must be given to the control of aircraft trajectory. Once the PF has stabilized the flight path, the PM confirms the failure and the PF orders ECAM actions.
The flight crew should delay the acceleration for securing the engine. An engine is considered as secured when the ECAM actions of the procedures are performed until:

- "ENG MASTER OFF" for an engine failure without damage
- "AGENT 1 DISH" for an engine failure with damage
- Fire extinguished or "AGENT 2 DISH" for an engine fire.

Note: *If the decision has been taken to delay the acceleration, the flight crew must not exceed the engine out maximum acceleration altitude. (The engine out maximum acceleration altitude corresponds to the maximum altitude that can be achieved with one engine out and the other engine(s) operating at takeoff thrust for a maximum of 10 min.)*

ACCELERATION SEGMENT

At the engine-out acceleration altitude, push ALT pb or push the V/S knob to level off the aircraft and to 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.

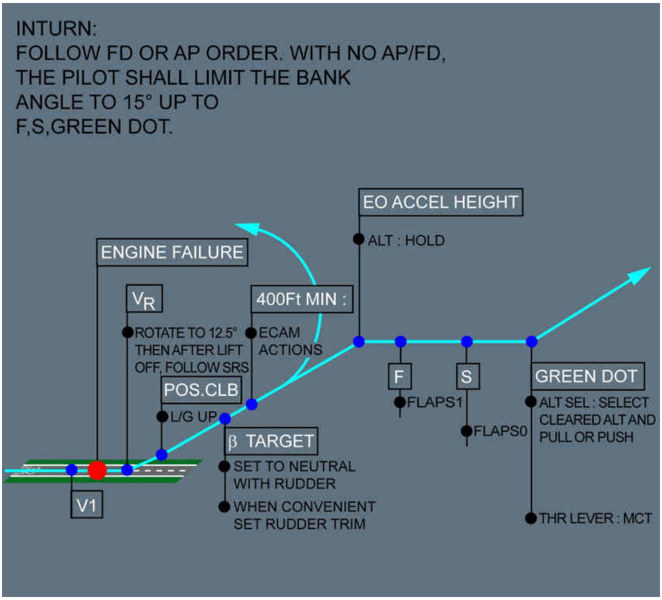
FINAL TAKEOFF SEGMENT

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 lever are already in the FLX /MCT detent, move lever to CL and then back to MCT.
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 (consider OEB, if applicable). When the STATUS is displayed, the AFTER TAKEOFF/CLIMB checklist should be completed and both the computer reset and engine relight (if no damage) considered. STATUS should then be reviewed.

ONE ENGINE OUT FLIGHT PATH

The one engine out flight path will be flown according to the takeoff briefing made at the gate:
- The EOSID (with attention to the decision point location)
- The SID
- Radar vectors...

Engine failure after V1



ENGINE FAILURE DURING INITIAL CLIMB-OUT

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

ENGINE FAILURE DURING CRUISE

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 mentioned in a separate course and also in the FCOM PRO-SPO-40-40 DIVERSION PERFORMANCE DATA.
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.*

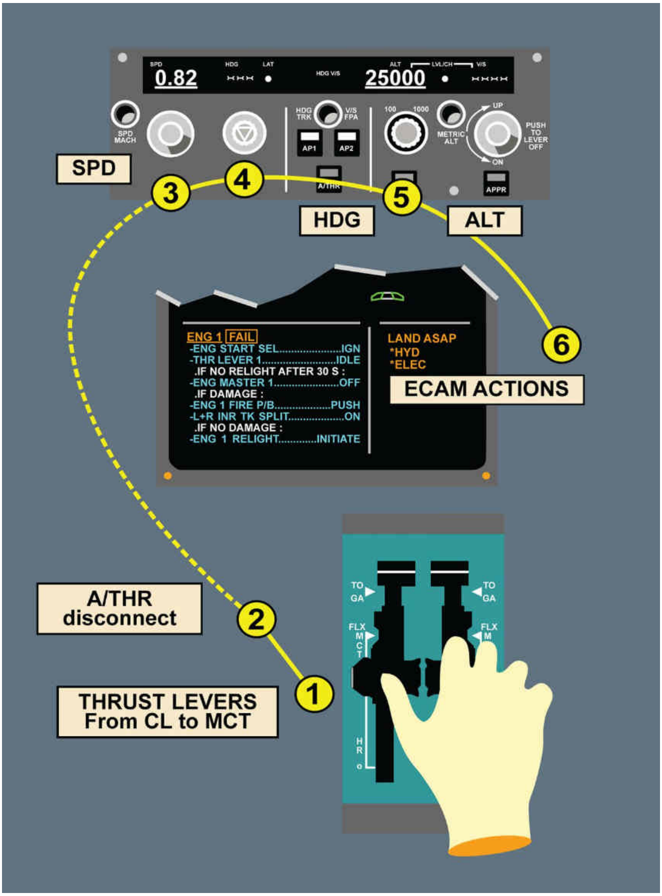
PROCEDURE

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

Then, PF will
- Select the SPEED according to the strategy
- If appropriate, select a HDG to keep clear of the airway, preferably heading towards an alternate. Consideration should be given to aircraft position relative to any relevant critical point
- Select the appropriate engine inoperative altitude in the FCU ALT window and pull for OPEN DES

Then, PF will
- Require the ECAM actions

At high flight levels close to limiting weights, crew actions should not be delayed, as speed will decay quickly requiring prompt crew response. The crew will avoid decelerating below green dot.



The A/THR is disconnected to avoid any engine thrust reduction when selecting speed according to strategy or when pulling for OPEN DES to initiate the descent. With the A/THR disconnected, the target speed is controlled by the elevator when in OPEN DES.
Carrying out the ECAM actions should not be hurried, as it is important to complete the drill correctly. Generally, there will be sufficient time to cross check all actions.

STANDARD STRATEGY

Set speed target M 0.78/300 kt. The speed of 0.78/300 kt is chosen to ensure the aircraft is within the stabilised windmill engine relight in-flight envelope.

The REC MAX EO Cruise altitude, which equates to LRC with anti-icing off, is displayed on the MCDU PROG page and should be set on the FCU . (One engine out gross ceiling at long-range speed is also available in the QRH in case of double FM failure).
If V/S becomes less than 500 ft/min, select V/S -500 ft/min and A/THR on. This is likely to occur as level off altitude is approached.
Once established at level off altitude, long-range cruise performance with one engine out may be extracted from QRH or *Refer to FCOM/PER-OEI-GEN-10 PROCEDURE*.

OBSTACLE STRATEGY

To maintain the highest possible level due to terrain, the drift down procedure must be adopted. The speed target in this case is green dot. The procedure is similar to the standard strategy, but as the speed target is now green dot, the rate and angle of descent will be lower.
The MCDU PERF CRZ page in EO condition will display the drift down ceiling, assuming green dot speed and should be set on FCU . (One engine out gross ceiling at green dot speed is also available in the QRH and FCOM).
If, having reached the drift down ceiling altitude, obstacle problems remain, the drift down procedure must be maintained so as to fly an ascending cruise profile.
When clear of obstacles, set LRC ceiling on FCU , return to LRC speed and engage A/THR.

ENGINE-OUT LANDING

Autoland is available with one engine inoperative, and maximum use of the AP should be made to minimise crew workload. If required, a manual approach and landing with one engine inoperative is conventional. The pilot should trim to keep the slip indication centred. It remains yellow as long as the thrust on the remaining engine(s) is below a certain value.
With flap selected and above this threshold value, the indicator becomes the blue beta target. This is a visual cue that the aircraft is approaching its maximum thrust capability.
Do not select the gear down too early, as large amounts of power will be required to maintain level flight at high weights and/or high altitude airports.
To make the landing run easier, the rudder trim 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

In normal conditions, circling with one engine inoperative requires the down wind leg to be flown in CONF 3, with landing gear extended.
In hot and high conditions and at high landing weight, the aircraft may not be able to maintain level flight in CONF 3 with landing gear down. The flight crew should check the maximum weight showed in the QRH CIRCLING APPROACH WITH ONE ENGINE INOPERATIVE procedure table. If the landing weight is above this maximum value, the landing gear extension should be delayed until established on final approach.
If the approach is flown at less than 750 ft RA , the warning "L/G NOT DOWN" will be triggered. "TOO LOW GEAR" warning is to be expected, if the landing gear is not downlocked at 500 ft RA. Therefore, if weather conditions permit, it is recommended to fly a higher circling pattern.

ONE ENGINE INOPERATIVE GO-AROUND

A one engine inoperative go-around is similar to a go-around flown with all engines.
On the application of TOGA, the flight crew must apply rudder 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 will be 12.5 °.
The lateral FD mode will be GA TRK (or NAV if option installed) and this must be considered with respect to terrain clearance.
At the engine-out acceleration altitude, apply the same technique as described earlier. *Refer to AO-020 ENGINE FAILURE AFTER V1*.

THRUST LEVERS MANAGEMENT IN CASE OF INOPERATIVE REVERSER(S)

1 **Applicable to: MSN 1060, 2396**

PREFACE

This section provides recommendations on thrust levers management in case of inoperative reverser(s). These recommendations are applicable in case of in-flight failure (including engine failure) and/or in case of MEL dispatch with reverser(s) deactivated.

AT LEAST ONE REVERSER OPERATIVE

If at least one reverser is operative, the general recommendation is to select the reverser thrust on both engines during rejected takeoff (RTO) and at landing, as per normal procedures.

Note: *The ENG 1(2) REVERSER FAULT ECAM caution may be triggered after the reverser thrust is selected. This is to remind the flight crew that one reverser is inoperative.*

NO REVERSERS OPERATIVE

If no reversers are operative, the general recommendation is to not select the reverser thrust during RTO and at landing.
However, the PF still sets both thrust levers to the IDLE detent, as per normal procedures.

BRIEFING

IMPORTANCE OF THE FLIGHT CREW BRIEFING

Among others, the aircraft status must be reviewed during the flight crew briefing. Any particularities (operational consequences, procedures, associated task sharing and callout) must be reviewed at that time. The flight crew must notably review:

- The status of the thrust reversers and if reverser thrust can be used
- Operational effect (aircraft handling during roll-out).

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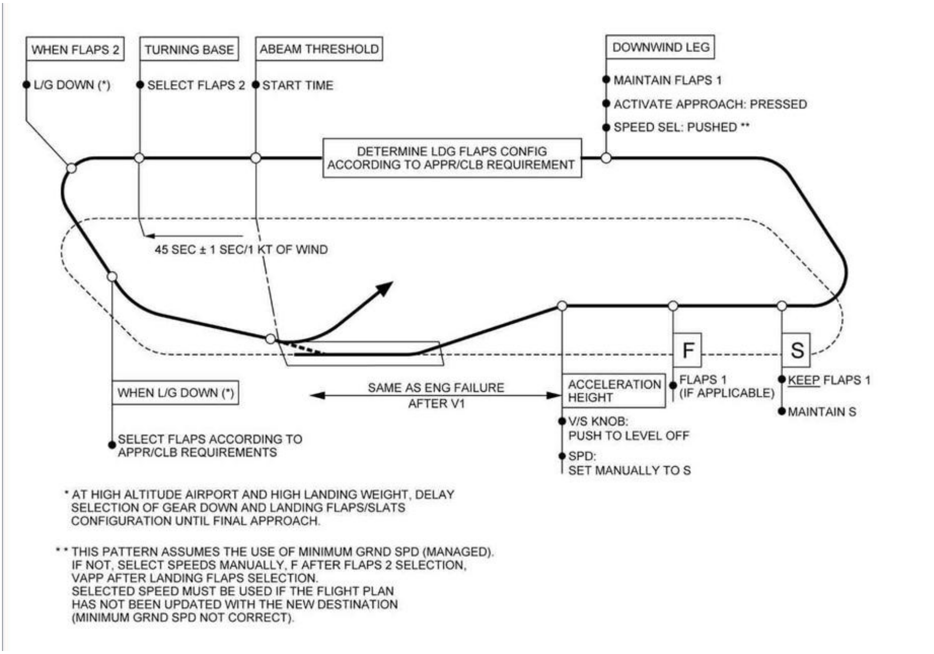
IMMEDIATE VMC LDG FOLLOWING ENG FAILURE ON TO



STALL RECOVERY

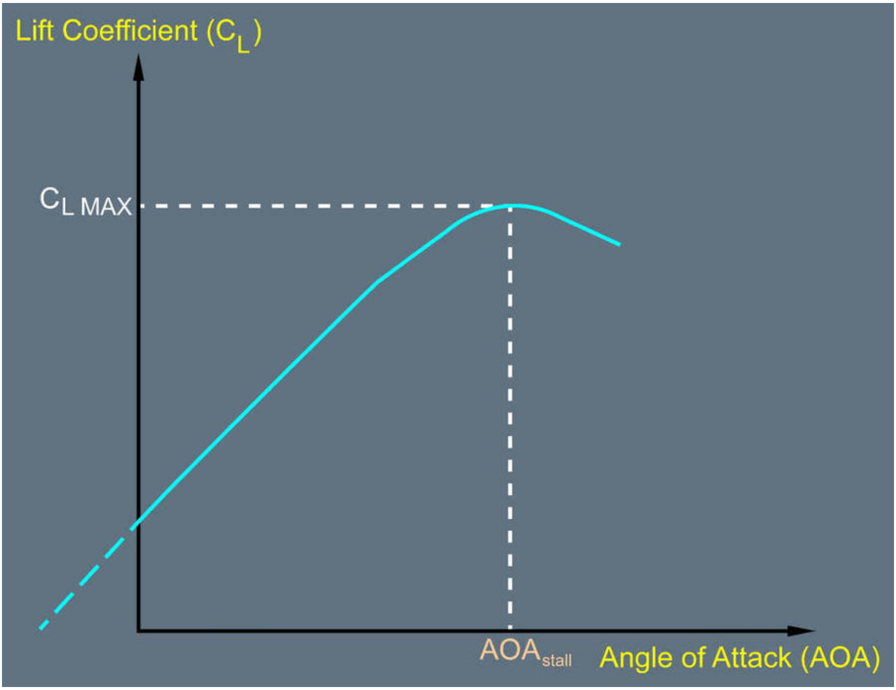
DEFINITION OF THE STALL

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

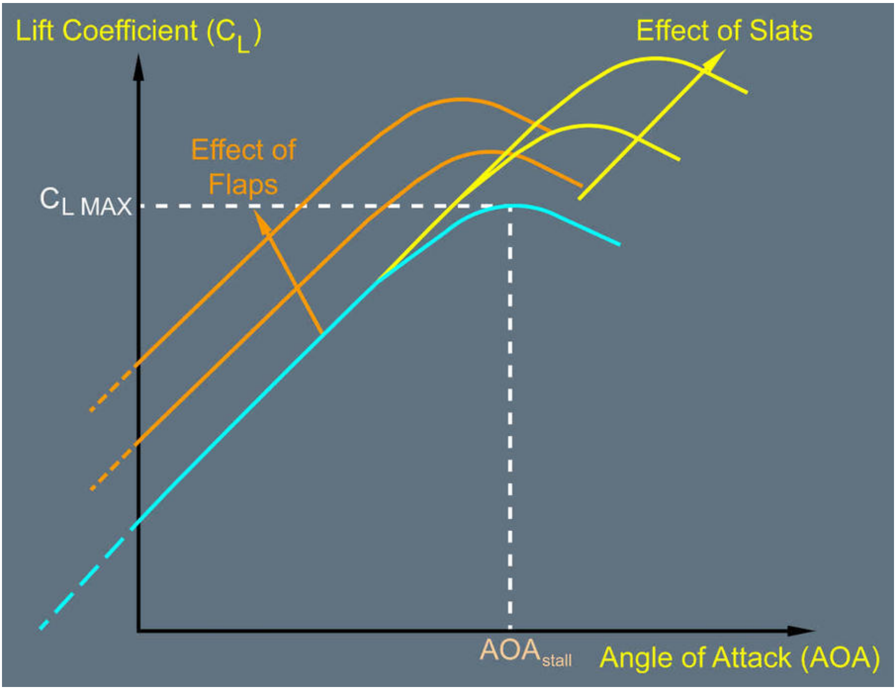


If the AOA further increases up to a value called AOA $_{stall}$, the lift coefficient will reach a maximum value called $C_{L\ MAX}$.

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

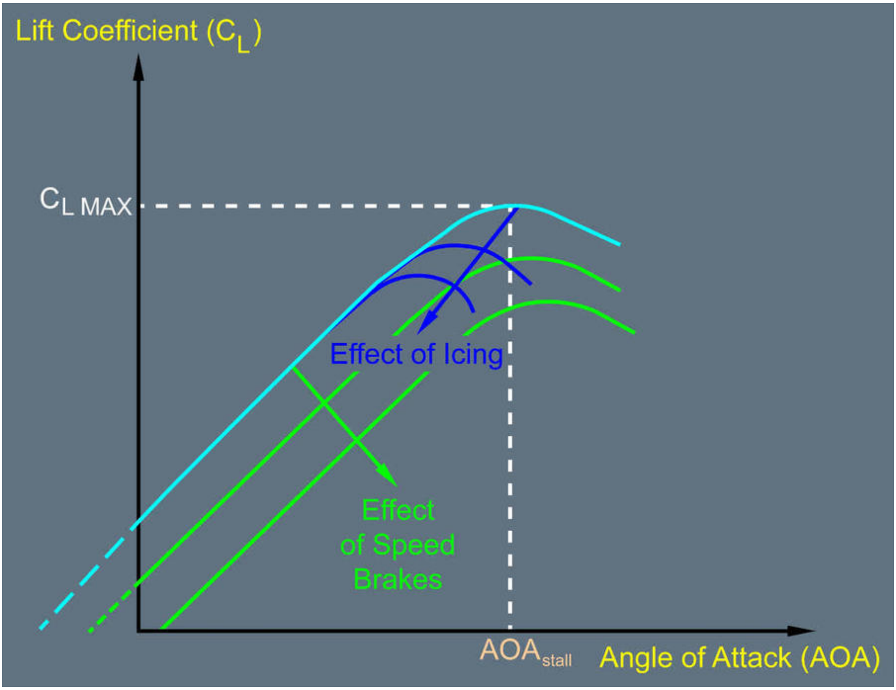
The stall will always occur at the same AOA for a given configuration, Mach number and altitude.

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. If in clean configuration and below FL 200, during flight path recovery, the flight crew must select FLAPS 1 in order to increase the margin to AOA_{stall}.

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.

UPSET PREVENTION AND RECOVERY

DEFINITION OF UPSET

An aircraft upset is an undesired aircraft state characterized by unintentional divergences from parameters normally experienced during operations. An aircraft upset may involve pitch and/or bank angle divergences and may lead to inappropriate airspeeds for the conditions.
An upset condition exists any time an aircraft diverges from what the flight crew is intending to do. Deviations from the desired aircraft state will become larger until the flight crew takes action to stop the divergence. Return to the desired aircraft state can be achieved through natural aircraft reaction to accelerations, auto-flight system response or flight crew intervention.

UPSET PREVENTION

The prevention of an upset situation is possible thanks to an effective monitoring of:
- The environment (turbulences, icing conditions, weather)
- The aircraft energy state
- The aircraft flight path
- The aircraft technical state (Flight controls laws, systems failure).

All flight crew members are responsible of the monitoring to ensure that the aircraft state is understood and correct for the situation.

Each flight crew member should:
- Know and understand the expected aircraft state for the situation
- Communicate expectations
- Keep track of current aircraft state
- Detect and communicate deviations from the intended situation

- Assess risk and decide on a response
- Update and communicate understanding.

An efficient monitoring and effective coordination and communication are keys to prevent upset situations. As such, the flight crew should be able to assess the energy, to stop any flight path divergence, and to recover a stabilized flight path before the upset situation.

RECOVERY TECHNIQUES

The flight crew must be or become aware of the upset situation, i.e. recognize and confirm the situation before they take appropriate actions.

COMMUNICATION

Communication between crew members will assist in the recognition of upset situation and recovery actions. At the first indication of a flight path divergence, the first pilot who observes the divergence must announce it. The flight crew must use the flight instruments as primary means to analyze the upset situation.

SITUATION ANALYSIS

The situation analysis process is to:

- Assess the energy (airspeed, altitude, attitude, load factor, thrust setting, position of drag and high-lift devices and the rate of change of those conditions)
- Determine the aircraft attitude (pitch and bank angle)
- Communicate with other crew member(s)
- Confirm attitude by reference to other indicators:
  - For a nose low upset, normally the airspeed is increasing, altitude is decreasing and the Vertical Speed Indicator (VSI) indicates a descent
  - For a nose high upset, the airspeed normally is decreasing, altitude is increasing and the VSI indicates a climb.

A stalled condition can exist at any attitude and could be recognized by stall buffet and/or stall aural alert. If the aircraft is stalled, apply the stall recovery procedure. *Refer to AO-020 Stall Recovery*

REFERENCES FOR RECOVERY

The Primary Flight Display (PFD) is a primary reference for recovery.
Pitch attitude is determined from the PFD pitch reference scale. Even in extreme attitudes, some portion of the sky or ground indications is present to assist the pilot in analyzing the situation. The bank indicator on the PFD should be used to determine the aircraft bank.

Other attitude sources should be checked: Standby Attitude Indications, the pilot monitoring (PM) instruments, or references outside the cockpit when possible.

ACTIONS FOR RECOVERY

An overview of actions to take to recover from an upset would gather three basic activities:
- Assess the energy (become situationally aware)
- Stop the flight path divergence
- Recover to a stabilized flight path.

The Nose high/Nose low techniques represent a logical progression for recovering the aircraft. They are not necessarily procedural. The sequence of actions is for guidance only and represents a series of options for the pilot to consider and to use depending on the situation. The flight crew may apply these actions or part of these actions, mainly if the recovery is effective.
Depending on the situation, the PF should apply the required actions (See figures "Nose High" and "Nose Low").
During the maneuver, the PM must monitor the airspeed and the attitude throughout the recovery. The PM must also announce the flight path divergence if the recovery maneuver is not efficient.

Nose High Actions

Nose High Actions

- Recognize and confirm the situation
- Takeover and disconnect AP and A/THR (1)
- Apply nose down pitch order (2)

  Note: Excessive use of pitch trim may make the upset situation worse or may result in high structural loads.
- Adjust the thrust (3)
- Adjust the roll not to exceed 60 degrees (4)
- Recover the level flight (5)

Notes:

(1) If the AP and A/THR responses enable to stop the flight path divergence, the flight crew may keep the AP and A/THR engaged.

(2) The flight crew must apply as much nose down pitch order as required to obtain a nose down pitch rate.
In the case of lack of pitch down authority, the flight crew may use incremental inputs on the trim (nose down) to improve the effectiveness of the elevator control.

(3) Select up to maximum thrust available while ensuring adequate pitch control.
Increasing thrust may reduce the effectiveness of nose-down pitch control. It may be necessary to limit or reduce thrust to the point where control of the pitch is achieved.

(4) The bank angle must not exceed 60 degrees.
If all normal pitch control techniques are unsuccessful, the flight crew can keep the current bank or bank the aircraft to enable the nose to drop toward the horizon.
The bank angle should be the least possible to start the nose down and never exceed approximately 60 degrees. If the bank angle is already greater than 60 degrees, the flight crew should reduce it to an amount less than 60 degrees.
The flight crew must avoid entering a stall due to premature recovery at low speed or excessive g-loading at high speed.

(5) Recover to level flight at a sufficient airspeed while avoiding a stall due to premature recovery at low speed, or excessive g-loading at high speed.

Nose Low Actions

Nose Low Actions

- Recognize and confirm the situation
- Takeover and disconnect AP and A/THR (1)
- Recover from stall if required (2)

Note: Excessive use of pitch trim may make the upset situation worse or may result in high structural loads.

- Adjust the roll in the shortest direction to wings level (3)
- Adjust the thrust and the drag (4)
- Recover the level flight (5)

Notes:

(1) If the AP and A/THR responses enable to stop the flight path divergence, the flight crew may keep the AP and A/THR engaged.

(2) Even in a nose low situation, the aircraft may be stalled and it would be necessary to recover from a stall first.

(3) In general, a nose low, high-angle-of-bank requires prompt action, because the decreasing altitude is rapidly being exchanged for an increasing airspeed.
The flight crew must avoid entering a stall due to premature recovery at low speed or excessive g-loading at high speed.

(4) The flight crew should reduce the thrust and/or use the speedbrakes to control the speed.

(5) Recover to level flight at a sufficient airspeed while avoiding a stall due to premature recovery at low speed, or excessive g-loading at high speed.

EXCEEDING VMO/MMO

The flight crew must not intentionally exceed VMO /MMO (350 kt/M 0.82) during the flight. However, during normal operations, the aircraft may temporarily exceed VMO /MMO due to wind gradients.
The flight crew should apply the OVERSPEED PREVENTION procedure to reduce the possibility of overspeed. *Refer to FCOM/PRO-ABN-10 Overspeed Prevention*.
If the OVERSPEED warning is triggered, the flight crew must apply the OVERSPEED RECOVERY warning procedure. *Refer to FCOM/PRO-ABN-10 Overspeed Recovery*.
The aircraft is designed to fly up to the maximum structural speed at which the aircraft structure will not be damaged. However, in the case of overspeed, the aircraft may encounter vertical load factors that may exceed the aircraft limits. In this case, exceeding VMO /MMO requires maintenance inspection.

OVERSPEED PREVENTION

The flight crew should apply the OVERSPEED PREVENTION procedure if the aircraft encounters significant speed variations close to VMO /MMO during the flight.
In this case, the flight crew should keep the Autopilot (AP) and the Autothrust (A/THR) engaged.
The use of AP and A/THR enables the aircraft to remain on the intended flight path while thrust reduces to idle (if necessary).
The flight crew should decrease the speed target in order to increase the margin to VMO /MMO (at high altitudes the flight crew should not reduce the speed below green dot speed). After selection of the lower speed target, the flight crew should monitor the speed trend arrow on the Primary Flight Display (PFD). If the aircraft continues to accelerate, and if the speed trend arrow

approaches or exceeds VMO /MMO, the flight crew should use the appropriate position of the speed brakes, depending on the rate of acceleration. The length of the speed trend is a good indication of the rate of acceleration.

Note: *The use of speed brakes is an efficient way to decelerate that is certified for the entire flight envelope. However, the use of speed brakes increases VLS and reduces the buffet margin at high altitudes. The use of speed brakes results in pitch up for which the AP and the normal law compensate.*

For descents in descent (DES) and managed speed modes, the flight crew should enter descent wind data that is as accurate as possible in the Flight Management and Guidance System (FMGS). The FMGS then computes an optimized vertical profile that offers a better capability to remain in the speed target range.

OVERSPEED RECOVERY

The OVERSPEED warning is triggered when the speed exceeds VMO +4 kt/MMO +M 0.006, and lasts until the speed is below VMO /MMO. In this case, the flight crew must apply the OVERSPEED RECOVERY procedure.
The flight crew should keep the AP engaged in order to minimize the vertical load factors. In order to minimize overspeed, the flight crew should extend the speed brakes to the most appropriate lever position, depending on the overspeed situation. In addition, the flight crew should keep the A/THR engaged and should check that the thrust reduces to idle.
Disconnection of the A/THR has the same effect on the overspeed recovery than the set of the manual thrust on idle. Both techniques result in the same engine response in terms of thrust reduction.
In the case of severe overspeed, the AP automatically disengages and then the High Speed Protection activates (except when in direct law). As a result, the aircraft encounters an automatic pitch up. *Refer to FCOM/DSC-27-20-10-20 Protections - High Speed Protection*.

Note: *The AP does not automatically disengage as soon as the speed reaches the green bars (that represent the threshold when the High Speed Protection activates) on the PFD . The AP disengagement depends on the speed variations and the High Speed Protection logic.*

The High Speed Protection is designed to request the appropriate demand of vertical load factor. Therefore, the flight crew should smoothly adjust the pitch attitude to avoid excessive load factors.

Note: *The flight crew must disregard the Flight Director (FD) orders while the high speed protection is active. The FD orders do not take into account the High Speed Protection.*

The flight crew should keep the speed brakes because the use of the speed brakes is compatible with the High Speed Protection.

WHEN THE SPEED IS BELOW VMO /MMO

When the aircraft speed is below VMO /MMO with a sufficient speed margin, the flight crew should retract the speed brakes and should select a new speed target. If the flight crew retracts the speed brakes when the speed is close to VMO /MMO , the speed may exceed VMO /MMO again at speed brake retraction.
After severe overspeed, the flight crew should recover the flight path smoothly, and then should engage the AP in accordance with the recommended procedure for AP engagement. *Refer to OP-030 Autopilot/Flight Director*.

REPORTING

The flight crew must report any type of overspeed event (i.e. if the OVERSPEED warning is triggered). This report results in the appropriate maintenance actions.

LINK BETWEEN VMO /MMO AND TURBULENCE

The significant speed variations near VMO /MMO and above VMO /MMO may be one of the first indications of possible severe turbulence. *Refer to SI-010 Turbulence*.

HANDLING THE AIRCRAFT IN THE CASE OF SEVERE DAMAGE

In the event of severe damage to the aircraft, the flight crew's immediate action should be to "fly the aircraft". In severe damage cases, it might be necessary for the flight crew to revert to the use of a "back to basics" flying techniques, where bank, pitch, and thrust are the primary parameters to manually control. In addition, as for any flight phase, the flight crew must continue to perform all navigation and communication tasks.
If the damage significantly affects aircraft aerodynamics, flight controls, or engines, then aircraft handling qualities may be affected. Therefore, the flight crew should perform an assessment of aircraft handling qualities as soon as possible, in order to identify how pitch, roll, and yaw are controllable.
During assessment of the flight controls, the flight crew should apply smooth sidestick input and should limit the bank angle to 15°, in order to prevent possible destabilization of the aircraft. In addition, the flight crew should avoid use of the speedbrakes before the end of the flight, unless necessary.

To assess aircraft handling qualities, the flight crew must keep the following basic principles in mind:
- Elevators, ailerons, and rudder are the primary flight controls.
- In addition to use of the elevators, use of the THS (via longitudinal trim control) may also be necessary in order to control pitch.

- On all Airbus aircraft, engines are mounted under the wing. As a consequence a thrust increase results in a pitch-up effect, and a thrust decrease results in a pitch-down effect.
- If damage to the aircraft is severe, it may be necessary to use abnormal flying techniques to maintain control of the aircraft. Each flight control can be used to compensate for an inoperative or damaged surface. For example, the flight crew can compensate for a lack of roll efficiency via the use of rudder input. As another example, the application of asymmetrical thrust enables the flight crew to indirectly control roll, with a slightly delayed response.

CAUTION	Sudden commanded full, or nearly full, opposite rudder movement against a sideslip can generate loads that exceed the limit loads and possibly the ultimate loads and can result in structural failure. This is true even at speeds below the maximum design maneuvering speed, VA.

As soon as control of the aircraft is ensured:
- Depending on the severity of the damage to the aircraft, the flight crew may attempt to use automation. However, if the autopilot and the flight director remain available, their operation may be erratic. Therefore, the flight crew should monitor carefully the AP behaviour, and must be prepared to immediately revert to manual flying techniques.
- The flight crew can start ECAM actions, if applicable. An assessment of the flight deck indications may provide the flight crew with useful information about affected systems. When possible and depending on the situation, a visual check can also provide important information.

Prior to landing and at an appropriate altitude, the flight crew must perform an assessment of aircraft handling qualities in landing configuration in order to help determine an appropriate strategy for approach and landing. The flight crew must perform this analysis at different speeds down to VAPP. If it becomes difficult to control the aircraft when the aircraft goes below a specific speed, the flight crew must perform the approach landing at a speed above this specific speed. The result of the above-mentioned assessments helps to build the correct follow up strategy. The quantity of flight crew workload required to maintain control of the aircraft is one of the decision factors to take into account for this strategy. Good flight crew coordination is essential throughout the assessment process. The flight crew should share their own understanding and view of the situation with their other flight crewmembers.

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FMGC FAILURE

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 FD s and select TRK / FPA to allow the blue track index and the bird to be displayed. The RMP s will be used to tune the NAVAIDs.
The crew will refer to the QRH for computer reset considerations and then will *Refer to FCOM/PRO-SUP-22-10 Automatic FMGS Reset and Resynchronization - FM Reset* to reload both FMGC as required.

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INTRODUCTION TO EMERGENCY ELECTRICAL CONFIGURATION

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

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

As only PFD 1 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*).
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.
The BSCU are lost. Consequently, the NWS and anti skid are lost. Alternate braking with yellow hydraulic pressure modulation up to 1 000 PSI will be used. Additionally, reversers are not available.
RA 1+2 are lost with their associated call out. Call out will be made by PM.
Approaching 50 kt during the landing roll, all CRTs will be lost.

REMAINING SYSTEMS

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	ND 1, FMGC1, RMP 1, VOR 1/ILS 1, DME1
COMMUNICATE	VHF 1, HF 1, ATC1

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

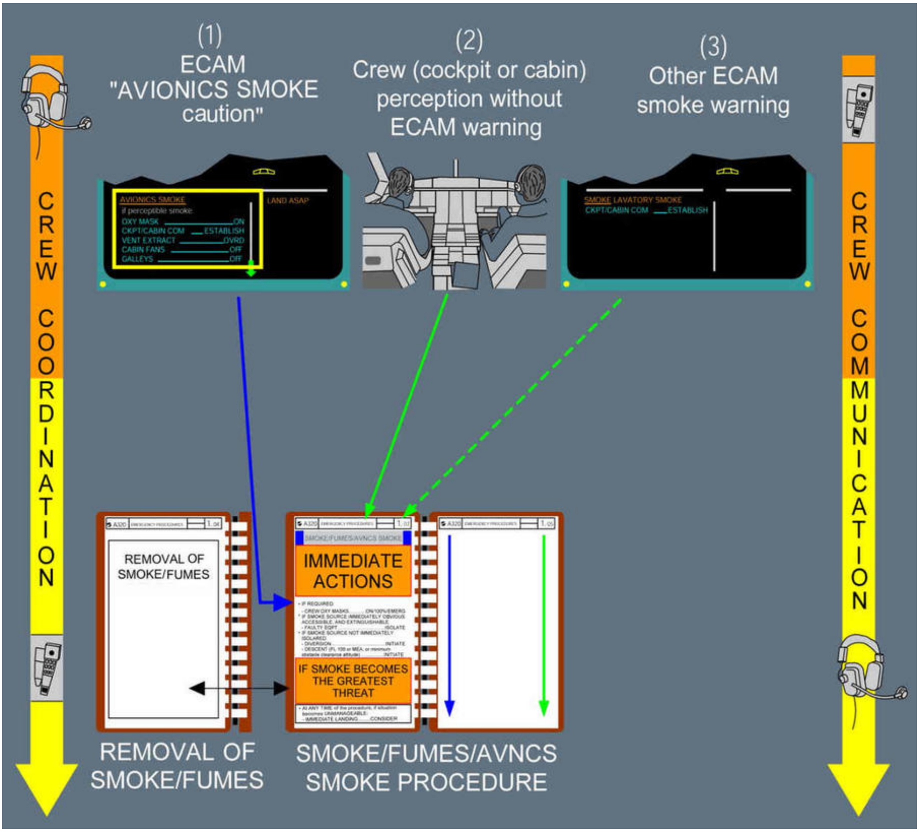
PREFACE

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

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

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

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

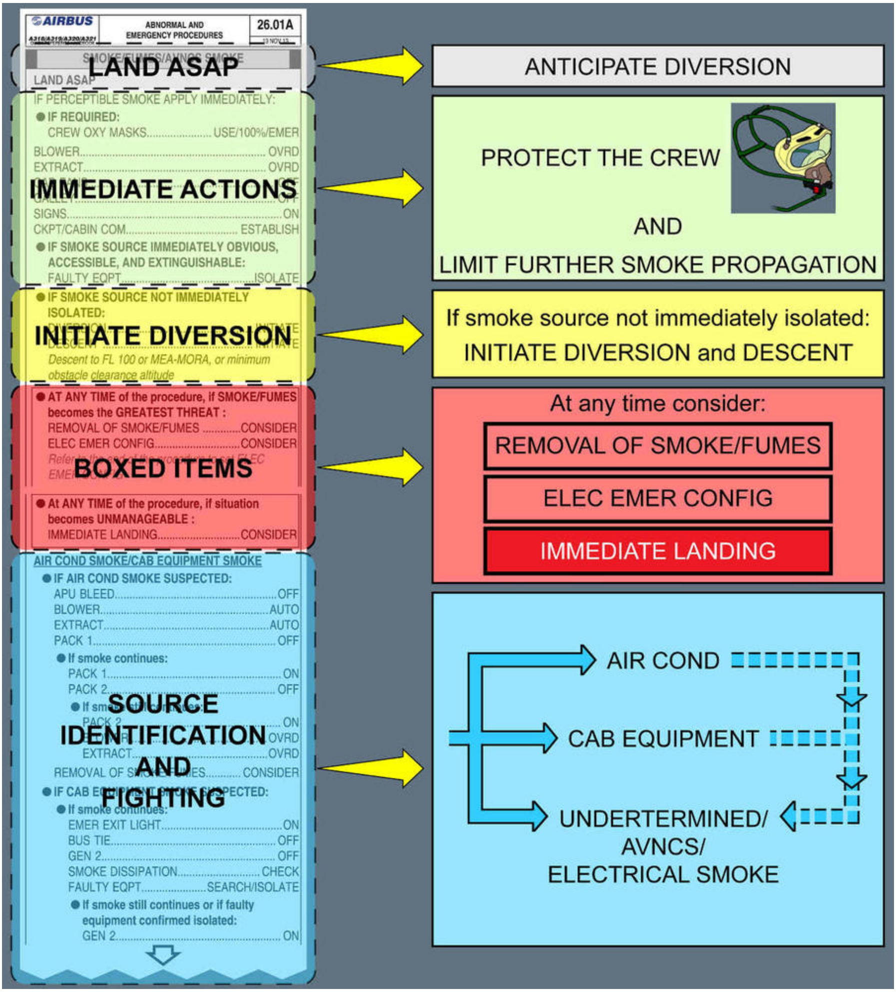
▶ If smoke source not immediately isolated:

- 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:
- Flight crew protection,
- Avoiding any further contamination of the cockpit/cabin,
- Communication with cabin crew.

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 DC 1, DC 2, 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 REMOVAL of SMOKE/FUMES 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 REMOVAL of SMOKE/FUMES 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 REMOVAL of SMOKE/FUMES procedure will be completed.

LITHIUM BATTERY FIRE IN THE COCKPIT

Several electronic devices contain lithium batteries, for example:
- Laptop computers,
- Mobile phones,
- Portable electronic tablets, etc.

Fire or smoke from lithium battery is due to thermal runaway in the battery cells.
It is important to know that halon extinguishers are efficient on flames but cannot stop thermal runaway.
The treatment for thermal runaway of lithium battery is to cool the battery by pouring water or non-alcoholic liquid on the device.
The first step of the procedure establishes appropriate tasksharing and communication.
If necessary, transfer control to the flight crew member seated on the opposite side of the fire.
The Pilot Flying (PF) contacts the cabin crew to request initiation of the CCOM “STORAGE PROCEDURE AFTER A LITHIUM BATTERY FIRE”.
This CCOM procedure specifies that the cabin crew must fill a container with water or non-alcoholic liquid and must immerse the device in it.

If there is no cabin crew on board (e.g ferry flight, etc.), the Pilot Monitoring (PM) must apply the steps of the CCOM procedure.
If there are flames, the PM must use the halon extinguisher.
Before discharging the halon extinguisher, it is important to protect the flight crew respiratory system: the PF must wear the oxygen mask and the PM must wear the smoke hood .
If there are no flames, or when the flames are extinguished, the PM must assess if the device can be removed or not from the cockpit.
If the device is attached to a cable that cannot be easily disconnected, then the device must be considered not removable from the cockpit, and water or non-alcoholic liquid must be poured on it. The device must then be regularly monitored to ensure that the thermal runaway is successfully stopped. If the device is removable, then it must be put in the container prepared in advance by the cabin crew member who takes over the procedure.
If, at any time of the procedure, the smoke becomes the greatest threat, the flight crew must consider applying the SMOKE/FUMES REMOVAL procedure.
Finally, if at any time of the procedure, the situation becomes unmanageable an immediate landing must be considered.

CARGO SMOKE

The crew should be aware that, even after successful operation of the cargo fire bottle, the CARGO SMOKE warning might persist due to the smoke detectors being sensitive to the extinguishing agent. On the ground, the crew should instruct the ground crew not to open the cargo door until the passengers have disembarked and fire services are present.
If SMOKE warning is displayed on ground with the cargo compartment door open, do not initiate an AGENT DISCHARGE. Request the ground crew to investigate and eliminate the smoke source. On ground, the warning may be triggered due to a high level of humidity.

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ABNORMAL FLAPS/SLATS CONFIGURATION

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

Significant fuel leaks although rare, are sometimes difficult to detect. Fuel check will be carried out by

- Checking that the remaining fuel added to the burnt fuel corresponds to the fuel on board at the gate.
- Maintaining the fuel log and comparing fuel on board to expected flight plan fuel would alert the crew to any discrepancy.

Fuel checks should be carried out when sequencing a waypoint and at least every 30 min. Any discrepancy should alert the crew and investigation should be carried out without delay.
Any time an unexpected fuel quantity indication, ECAM fuel message or imbalance is noted, a fuel leak should be considered as a possible cause. Initial indications should be carefully cross-checked by reference to other means, including if possible, a visual inspection.

If a leak is suspected, the crew should action the "FUEL LEAK" abnormal checklist available in QRH:

- If the leak is positively identified as coming from the engine, the affected engine is shut down to isolate the fuel leak and fuel cross-feed valve may be used as required.
- If the leak is not from the engine or cannot be located, it is imperative that the cross-feed valve is not opened.

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HYDRAULIC GENERATION PARTICULARITIES

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 be switched off without delay in case of:

- HYD G(Y) RSVR LO LVL
- HYD G(Y) RSVR LO AIR PR (Only if pressure fluctuates)
- HYD G(Y) RSVR OVHT

DUAL HYDRAULIC FAILURES

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 depending on the affected hydraulic circuits (*Refer to AO-029 Remaining Systems*):

- Loss of AP
- Flight control law degradation
- 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 (HYD G+B SYS LO PR or G+Y SYS LO PR).
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:

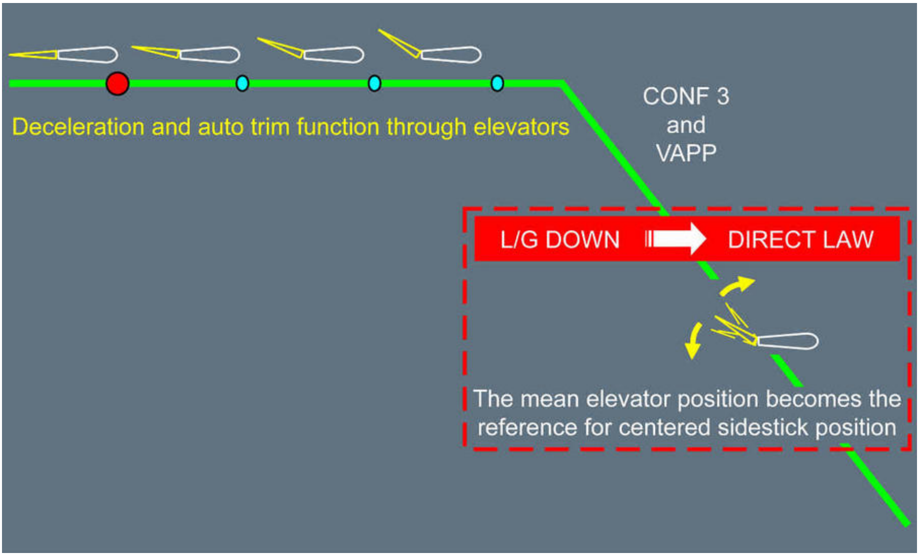
- Use of the selected speeds on the FCU.
- Landing gear gravity extension
- Approach configuration and flap lever position
- Approach speed VAPP
- Tail strike awareness
- Braking and steering considerations
- Go around call out, aircraft configuration and speed

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

Remaining systems				
Flight phase	**Systems**	**HYD G+B SYS LO PR**	**HYD G+Y SYS LO PR**	**HYD B+Y SYS LO PR**
Cruise	Auto pilot	Inop	Inop	Inop
	Yaw damper	YD2 only	Inop	YD1 only
	Control law	ALTN LAW and DIRECT LAW when L/G DN	ALTN LAW and DIRECT LAW when L/G DN	NORM LAW
	Stabilizer	Avail	Inop (1)	Avail
	Spoilers	2 SPLRS/wing	1 SPLR/wing	2 SPLRS/wing
	Elevator	R ELEV only	Avail	L ELEV only
	Aileron	Inop	Avail	Avail

(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.*



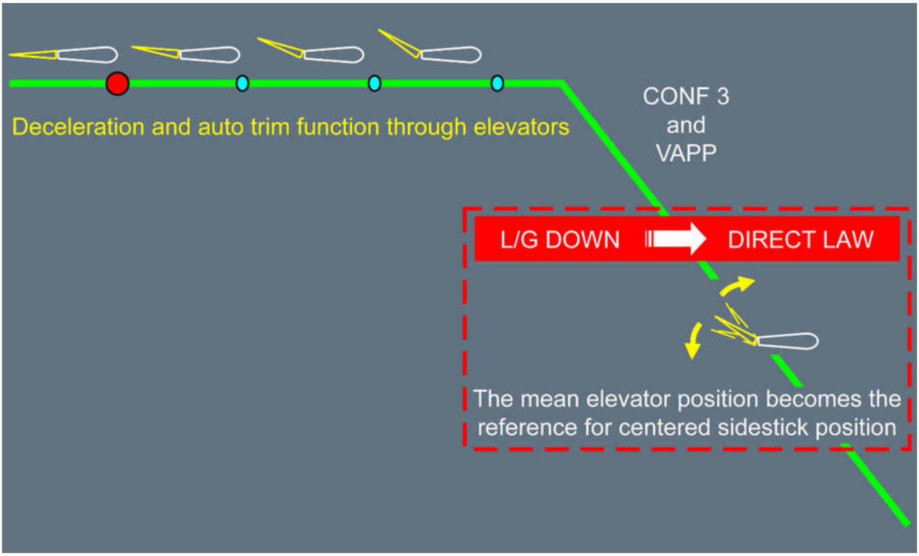
Remaining systems				
Flight phase	**Systems**	**HYD G+B SYS LO PR**	**HYD G+Y SYS LO PR**	**HYD B+Y SYS LO PR**
Landing	Slats/Flaps	FLAPS slow only	SLATS slow only (1)	SLATS/FLAPS slow
	L/G extension	Gravity	Gravity	Gravity
	Braking	ALTN BRK only	Y ACCU PRESS only	NORM BRK only
	Anti skid	Avail	Inop	Avail
	Nose wheel steering	Inop	Inop	Inop
	Reverse	REV 2 only	Inop	REV 1 only
Go/around	L/G retraction	Inop	Inop	Inop

(1) *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

Remaining systems				
Flight phase	**Systems**	**HYD G+B SYS LO PR**	**HYD G+Y SYS LO PR**	**HYD B+Y SYS LO PR**
Cruise	Auto pilot	Inop	Inop	Inop
	Yaw damper	YD2 only	Inop	YD1 only
	Control law	ALTN LAW and DIRECT LAW when L/G DN	ALTN LAW and DIRECT LAW when L/G DN	NORM LAW
	Stabilizer	Avail	Inop (1)	Avail
	Spoilers	2 SPLRS/wing	1 SPLR/wing	2 SPLRS/wing
	Elevator	R ELEV only	Avail	L ELEV only
	Aileron	Inop	Avail	Avail

(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.*



Remaining systems				
Flight phase	**Systems**	**HYD G+B SYS LO PR**	**HYD G+Y SYS LO PR**	**HYD B+Y SYS LO PR**
Landing	Slats/Flaps	FLAPS slow only	SLATS slow only [(1)]	SLATS/FLAPS slow
	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) *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

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.
A fuel imbalance may be considered by the flight crew. Landing with a lighter wing on the affected side allows to keep it up longer and delay the moment of nacelle contact. If the imbalance advisory triggers, the flight crew can disregard it, as the aircraft handling qualities are not significantly affected.
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

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

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 "LOSS OF BRAKING" and the PM 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.

WHEEL TIRE DAMAGED SUSPECTED

GENERAL

The flight crew must apply the WHEEL TIRE DAMAGED SUSPECTED procedure in the case of suspicion of damage on one or several tires.

The crew may suspect tire damaged based on several indications. This include, but are not limited to:

- Information from the ATC of the presence of tire debris on the runway,
- A bang noise during the takeoff roll or just after takeoff,

  Note: *A bang noise may not necessarily indicate tire damages. A bang noise may also have others origins (e.g. engine, nose landing gear retraction).*

- A non-commanded sudden yaw noticed during the takeoff roll,

  Note: *Directional deviation may also come from lateral gusts during the takeoff run.*

- The WHEEL TIRE LO PR alert triggered after takeoff,

  Note: *The WHEEL TIRE LO PR alert may not trigger in all cases as the tire debris may have also damaged the tire pressure sensor.*

- The WHEEL SD page showing amber XX for the tire pressure indication on one or several wheels,

  Note: *The tire debris may have affected other tire pressure sensors (or associated wiring) so amber XX may be displayed for other wheels than the damaged ones.*

- The aircraft has other damages (brakes, slats/flaps, etc.).

Depending on the situation, one or several of the above factors may help the flight crew in the decision to apply the procedure.

PROCEDURE

FOR LANDING

Damage on one or more tires has an impact on the landing distance. The performance impact of a burst tire is equivalent to a brake released.
The flight crew must compute the impact on the landing distance by using the table provided in QRH, *Refer to QRH/PER-32 Landing Distance with Brake System Failure*.

FOR RUNWAY VACATION AND TAXI

After landing, before the taxi in, it is necessary to asses the exact condition of the wheels and landing gear.
To do so, the flight crew must ask for an inspection of the landing gear before the taxi is initiated and make sure the condition of the affected wheels is in accordance with FCOM limitations.

For more information:

- *Refer to FCOM/LIM*,
- *Refer to FCOM/LIM-32 Taxi with Deflated Tires*.

ADR/IRS FAULT

Each ADIRS has two parts (ADR and IRS), that may fail independently of each other. Additionally the IRS part may fail totally or may be available in ATT mode.
Single NAV ADR FAULT or NAV IRS FAULT are simple procedures, and only require action on the switching panel as indicated by the ECAM.
Dual NAV ADR or NAV IRS failures will cause the loss of AP , A/THR and flight controls revert to ALTN LAW.
Due to the low probability of a triple ADR failure, the associated procedure will not be displayed on the ECAM . In this case, the crew will refer to QRH procedure for ADR 1 + 2 + 3 failure.
There is no procedure for IRS 1 + 2 + 3 failure but the ECAM status page will give approach procedure and inoperative systems. In this unlikely event, the standby instruments are the only attitude, altitude, speed and heading references.

Note: To switch off an ADR , the flight crew must use the ADR pushbutton. Do not use the rotary selector, because this would also cut off the electrical supply to the IR part.

UNRELIABLE AIRSPEED INDICATIONS

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 cases where an airspeed and/or altitude output is erroneous, while the ADR s 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 crews must have in mind the typical symptoms associated with such cases in order to detect this situation early and apply the "UNRELIABLE SPEED INDICATION" 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 probe(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 PROBES

All the aircraft systems which use anemometric data, have 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.

NORMAL SITUATION

Each ELAC receives speed information from the three ADR s and compares the three values. The ELACs do not use the pressure altitude.
Each FAC receives speed 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 s 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 ADRS ARE ERRONEOUS, BUT DIFFERENT :

Both the AP and A/THR disconnect. The ELAC s trigger the NAV ADR DISAGREE ECAM caution. The flight controls revert to alternate law without high and low speed protection.

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

This situation is 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 ADR S PROVIDE THE SAME ERRONEOUS OUTPUT, OR IF ALL THREE ADRS PROVIDE CONSISTENT AND ERRONEOUS DATA :

The systems reject the correct ADR and continue to operate using the two erroneous but consistent ADRs. The flight crew can encounter such a situation when, for example, two or all three pitot tubes are obstructed at the same time, to the same degree, and in the same way. (Flight through a cloud of volcanic ash, takeoff with two pitots obstructed by foreign matter (mud, insects)).

EXAMPLE OF FAILURE CASES AND THEIR CONSEQUENCES

The following chart provides a non-exhaustive list of the 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 IAS 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.
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. In climb, IAS increases. In descent, IAS decreases. Abnormal AP /FD and A/THR behavior : a. AP /FD pitch up in OP CLB to hold target IAS. 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 particular meteorological conditions. In-service experience shows that such a contamination typically disappears after few minutes, allowing to recover normal speed indications.

POTENTIAL EFFECTS ON THE BAROMETRIC ALTITUDE

If the barometric altitude is unreliable, the Flight Path Vector (FPV) and the Vertical Speed (V/S) are affected.

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.
Because the barometric altitude may be erroneous, the Autopilot (AP) may not be able to maintain accurately the level flight.

"UNRELIABLE SPEED INDICATION" QRH PROCEDURE

INTRODUCTION

The "UNRELIABLE SPEED INDICATION" procedure has two objectives:
- To fly the aircraft,
- To identify and isolate the affected ADR(s).

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

WHEN TO APPLY THE PROCEDURE?

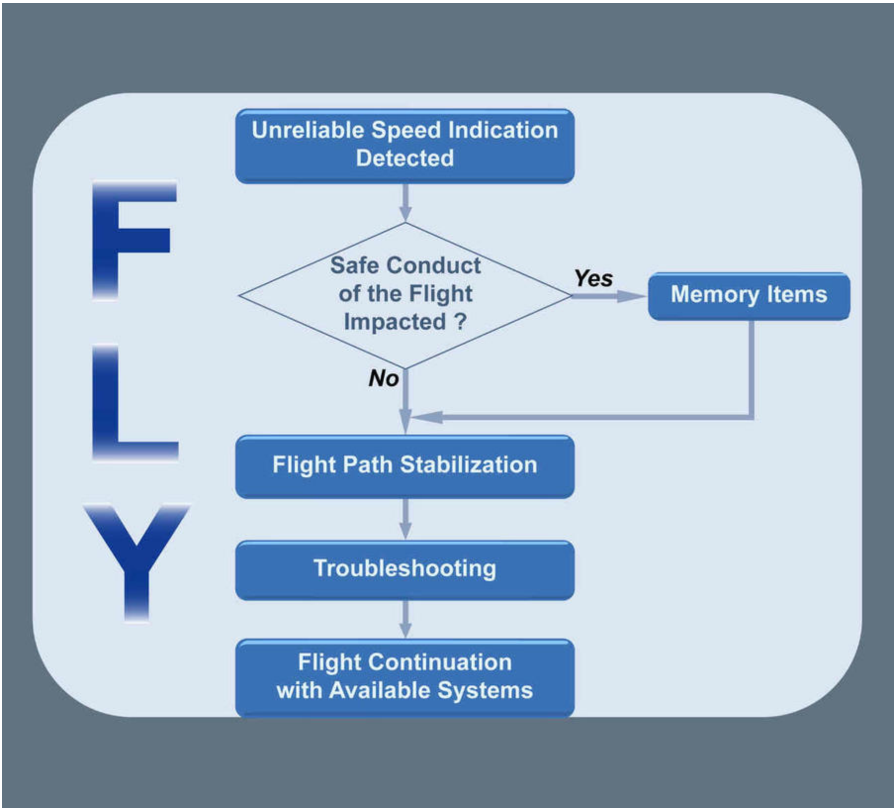
The flight crew should consider applying the “UNRELIABLE SPEED INDICATION” procedure when:
- The “ADR CHECK PROC... APPLY” action line is displayed on ECAM, for example due to the NAV ADR DISAGREE alert, or
- The flight crew suspects an erroneous indication, without any ECAM alert.

The flight crew can suspect an erroneous speed/altitude indication, in the following cases:
- A speed discrepancy (between ADR1, 2, 3 and standby indications),
- Fluctuating or unexpected changes of the indicated airspeed or altitude,
- Abnormal correlation between the basic flight parameters (pitch, thrust, airspeed, altitude and vertical speed indications). For example:
  - The altitude does not increase, whereas there is an important nose-up pitch and high thrust,
  - 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.
- An abnormal behavior of the AP /FD and/or the A/THR,

- 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.
- The barometric altitude is not consistent with the Radio Altimeter (RA) height (when the RA is displayed),
- The aerodynamic noise reduces whereas the indicated airspeed increases, or vice versa,
- In approach, it is not possible to extend the landing gear using the normal landing gear system.

Note: *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.*

HOW TO APPLY THIS PROCEDURE?



MEMORY ITEMS

The flight crew must ensure a safe flight path. If the safe conduct of the flight is affected, the flight crew applies the memory items.
The memory items enable to rapidly establish safe flight conditions for a limited period of time 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, i.e.:

- 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 without delay. 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.*

FLIGHT PATH STABILIZATION

According to the procedure, the flight crew can:
- Level off the aircraft then keep the flight path stabilized, or
- Keep the flight path stabilized.

Note: *If the flight crew has applied the Memory Items, then the flight crew must level off the aircraft to stabilize the flight path.*

The objective of these two conditions is to have a stabilized flight path to start the troubleshooting.
To level off the aircraft, the flight crew uses Pitch and Thrust tables of the QRH, See Pitch/Thrust Tables.
The GPS altitude can be used to confirm that the aircraft is maintaining level flight.

Note: *A difference may exist between the barometric altitude and the GPS altitude.*

The GPS altitude remains available on the MCDU GPS MONITOR page.

TROUBLESHOOTING AND ISOLATION

In order to identify and isolate the faulty ADR (s), the flight crew must crosscheck speed and altitude indications on CAPT PFD , F/O PFD and STBY instruments.
To help the identification of the affected ADR (s), the flight crew can use the Pitch and Thrust tables of the QRH procedure.
The Pitch and Thrust tables provide the resulting speed for a given aircraft weight and flight level.

WARNING	Do not instinctively reject an outlier ADR.

When one indication differs from the others, the flight crew may be tempted to reject the outlier information. However, they should be aware that two or even all three ADRs can provide identical but erroneous data.
When the flight crew has identified the affected ADR (s), they must turn off the affected ADR (s).
As a consequence this triggers the corresponding ECAM alerts. The flight crew must apply the associated procedures 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,
- If the flight crew cannot identify the affected ADR (s) or if all speed indications remain unreliable, the flight crew must turn two ADR s off to prevent the flight control laws from using two consistent but unreliable ADR data. The flight crew must keep one ADR on. For flight continuation, the flight crew uses pitch and thrust tables of the QRH.

FLYING TECHNIQUE

PITCH/THRUST TABLES

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).

- **If the FPV is reliable (i.e. barometric altitude is reliable), or with the GPS altitude information:**
  - Maintain level flight (FPV on the horizon or constant GPS altitude),
  - Adjust thrust,
  - Observe the resulting pitch attitude, and compare it with the recommended pitch target in the table:
    - If the pitch necessary to maintain level flight is above the pitch target of the table, the aircraft is slow. Then increase the thrust.
    - If the pitch necessary to maintain level flight is below the pitch target of the table, the aircraft is fast. Then decrease the thrust.

  When the pitch required to maintain level off gets close to the table pitch target, re-adjust thrust to keep this target pitch.
  When the conditions are stabilized, the resulting thrust should be close to the value provided in the table.
  This technique enables a fast stabilization of 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 QRH tables, and wait for speed stabilization.
  Expect a significant time to stabilize the flight path and important altitude variations during the stabilization.

For the approach, a wide pattern and an early stabilized approach are recommended.
For the final approach, prefer a standard ILS approach with a -3 ° G/S, if available. If the final descent is started with stabilized speed, 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.

DUAL RADIO ALTIMETER FAILURE

The Radio Altimeters (RA s) 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 altimeter 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.

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INTRODUCTION

Most engine malfunctions are taken into account by one or several ECAM alerts that warn the flight crew and provide the flight crew with the actions to perform. However, some engine malfunctions require some knowledge and the analysis of the flight crew, so that the flight crew can recognize, understand, and manage these engine malfunctions.
When the flight crew identifies an abnormal parameter, the flight crew should use all the information available to analyze the engine malfunction. The flight crew should not consider only this abnormal parameter to perform their analysis.
If possible, the flight crew should keep the engine running in flight. Except if a procedure requires an engine shutdown, it is usually preferable to keep the engine running. Even at idle, the engine powers the hydraulic, electric, and bleed systems.
In addition, if the flight crew is not sure which engine has a malfunction, the flight crew should keep the engines running. If really damaged, the affected engine will eventually fail.

ALL ENGINE FLAMEOUT

INTRODUCTION

The all engines failure is the situation where the aircraft entirely or partially loses engine thrust, and is no longer able to maintain level flight.

The all engines failure can be identified by the Flight Warning Computer (FWC) or by the flight crew:

1. In most cases, the FWC detects an all engines failure condition and displays the ENG DUAL FAILURE ECAM alert
2. In some cases, the FWC does not detect the all engines failure condition. In the case of partial loss of thrust (no engine flame out) on one or more engines, the residual N2 may remain slightly above the ENG 1(2) FAIL alert threshold.

Even if the ENG DUAL FAILURE alert is not triggered, the flight crew must rapidly decide to apply either the ENG DUAL FAILURE QRH procedure, or the EMERGENCY LANDING QRH procedure, depending on their assessment of the situation. If the flight crew considers there is sufficient time to attempt an engine relight, they must apply the ENG DUAL FAILURE procedure. However, if the flight crew considers there is not sufficient time to attempt an engine relight, they must apply the EMERGENCY LANDING procedure. For more information, *Refer to AO-090 Emergency Landing*.

TECHNICAL BACKGROUND

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 VHF 1. 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	RMP 1, VOR1
COMMUNICATE	VHF 1/HF 1/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.

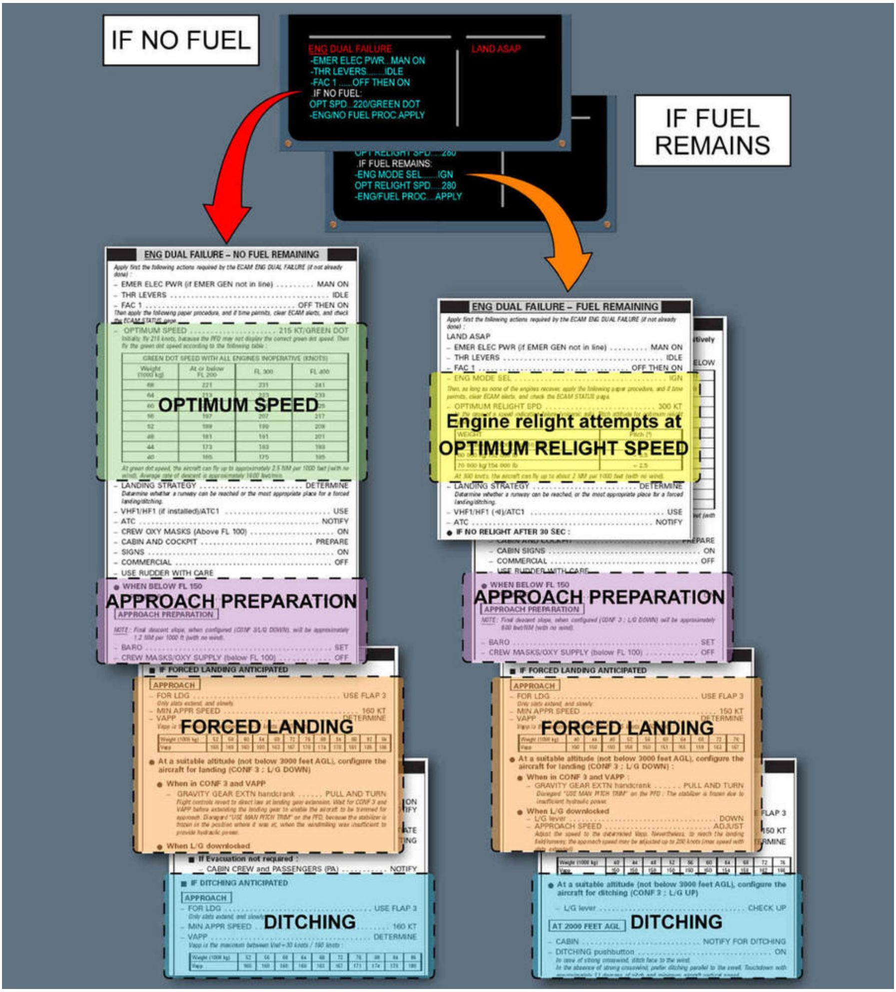
GENERAL PHILOSOPHY

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.

All Engine Flame Out Procedure



ENGINE STALL

An engine stall is the disruption of the airflow in a turbine engine. When the blades of the engine compressors stall, they are no longer able to compress the air from the front to the rear of the engine. In some cases, there may be a breakdown of the airflow, with the high pressure air at the end of the compressor reversing flow, and exiting from the front of the engine. If this occurs, it may result in an immediate and significant loss of thrust.
From the flight crew perspective, the engine stall is one of the most startling events at takeoff or during flight. The engine stall should not take the flight crew away from their primary task that is to fly the aircraft.

An engine stall can be due to any of the following reasons:
- An engine degradation (e.g. compressor blade rupture, or high wear)
- Ingestion of foreign objects (e.g. birds), or ice
- A malfunction of the bleed system
- A malfunction of the engine controls (e.g. fuel scheduling, or stall protection devices)

During takeoff, and at high power settings, the symptoms of an engine stall are the following:
- One or more very loud bangs, usually compared to a shotgun being fired a few meters away
- An instant loss of thrust, or even a reverse thrust, that causes a yaw movement
- Fluctuations of the engine parameters (EPR /N1 , N2, or N3 ⧼). The engine may give the impression to pump
- An increase of the EGT
- Engine vibrations
- Flames may be visible from both ends of the engine (inlet / tail pipe)
- Acrid smell in the cockpit

During cruise, and at low power settings (e.g. at thrust reduction at the T/D), the symptoms of an engine stall are the following:
- One or more muffled bangs
- Slow or no thrust lever response
- Fluctuations of the engine parameters (EPR /N1 , N2, or N3 ⧼). The engine may give the impression to pump
- An increase of the EGT
- Engine vibrations
- Acrid smell in the cockpit

Most of the FADECs have functions that:
- Regulate the airflow through the compressor, to prevent engine stalls
- Are able to detect engine stalls
- Try to recover from an engine stall, without flight crew action, by modifying the airflow

When the FADEC detects an engine stall, the FADEC requests that the ENG 1(2) STALL ECAM alert is triggered.
The FADEC is not able to detect an engine stall in all cases. Therefore, if the flight crew detects one or a combination of the engine stall symptoms, the flight crew should suspect an engine stall, and apply the QRH ENG STALL procedure (*Refer to QRH/ABN-70 Engine Stall*).

The ENG stall procedure is not a memory item. Therefore, if a stall occurs during the cruise phase, the flight crew shall take the time to assess the situation before applying the procedure, as most of the times the FADEC will self-recover from the stall before any flight crew action. The ENG STALL procedure (ECAM or QRH) is as follows:
- When the flight crew has stabilized the aircraft trajectory, the flight crew first reduces thrust to idle on the affected engine.
  This action reduces the differential pressure across the compressor. This helps the engine airflow to become more stable.
- When at idle thrust, the flight crew checks the stability of the engine parameters on the EWD , and particularly the EPR /N1 , EGT , N2 , and N3 . The flight crew should also check the engine vibrations on the ENG SD page.
- The flight crew shuts down the engine if:
  - The fluctuations of the engine parameters, or the high EGT, or the engine vibrations persist, or
  - The symptoms of the engine stall persist at idle thrust.
- If the engine parameters are normal:
  - The flight crew selects the anti-ice on, in order to increase the bleed demand.
    This reduces the pressure at the exit of the compressor, and helps the airflow to circulate in the engine turbine from front to rear.
  - Then, the flight crew slowly advances the thrust levers, as long as the engine stall does not occur again. The engine response may be slow at high altitude.
    - If the engine stall reoccurs, the flight crew keeps the engine thrust below the stall threshold. The flight crew should not shut down the engine if the engine stall can be avoided. The flight crew should manually control the thrust on the affected engine between idle and the identified stall threshold for the remainder of the flight.
    - If the engine stall does not reoccur, the flight crew can resume normal operation of the engine.

The flight crew must report any engine stall for maintenance action.

ENGINE TAIL PIPE FIRE

An engine tail pipe fire can only occur at engine start or at engine shutdown. It is the result of an excess of fuel in the combustion chamber, in the turbine or in the exhaust nozzle, that ignites. A tail pipe fire is an internal fire in the engine, compared with an engine fire that occurs outside the engine core and gas path. No critical areas are affected in the engine in the case of a tail pipe fire. However, it can have an effect on the aircraft (e.g. damage the flaps). The correct method to manage an engine tail pipe fire is to stop the fuel flow, and to ventilate the engine.
In the case of a tail pipe fire, there is no cockpit alert. The only indication can be an increasing EGT due to the fire in the turbine. Therefore, most of the time, the ground crew, cabin crew, or ATC visually detect the tail pipe fire.

In the case of a tail pipe fire, the flight crew must apply the QRH ENG TAILPIPE FIRE procedure (*Refer to QRH/ABN-70 Engine Tailpipe Fire*), which requires the flight crew to:
- Shut down the engine, in order to stop the fuel flow
- Dry crank the engine, to remove the remaining fuel.

The flight crew should not use the ENG FIRE pb. This cuts off the electrical supply of the FADEC , and stops the dry crank sequence performed by the FADEC.
The flight crew should not use the fire extinguisher, as it does not extinguish an internal engine fire. As a first priority, the fuel flow must be stopped, and the engine must be ventilated.
If the tail pipe fire procedure does not stop the fire, or if bleed air is not easily available, the ground crew can use a ground fire extinguisher as a last option. Ground fire extinguishing agent can cause serious corrosive damage to the engine and requires a maintenance action on the engine.

ENGINE VIBRATIONS

Engine vibrations are usually caused by an imbalance of the engine that can be due to many reasons such as:
- A deformation of one or several blades due to Foreign Object Damage (FOD), or a bird strike
- A rupture or a loss of one or several blades
- An internal engine failure (e.g. engine stall)
- A fan icing

High engine vibration alone does not require an engine in-flight shutdown. If the engine needs to be shutdown, other symptoms and certainly an ECAM alert will warn the flight crew, and request them to shut down the engine.
A high N1 vibration level may be accompanied by perceivable airframe vibrations.

When the vibration level exceeds a certain threshold, the ECAM advisory function automatically highlights the affected parameter. When the flight crew identifies high engine vibrations, the flight crew must refer to the ECAM ADVISORY CONDITIONS section of the QRH (*Refer to QRH/ABN-80 ECAM Advisory Conditions - 70 - Engines*). This section guides the flight crew to the QRH HIGH ENGINE VIBRATION procedure (*Refer to QRH/ABN-70 High Engine Vibration*).
On the A320neo, the ECAM advisory is replaced by an ECAM alert that guides the flight crew toward the QRH HIGH ENGINE VIBRATION procedure.
In the case of high engine vibrations, the flight crew first checks the engine parameters, and crosschecks them with the other engine. The flight crew identifies if there are engine vibrations only, or if there is another problem on the engine for which the flight crew may expect an ECAM alert.
Then the flight crew determines if icing is suspected or not. The flight crew should suspect icing if N1 vibrations occur without variation on other engine parameters. If the flight crew notices unexpected behavior on other engine parameters, the flight crew should consider that icing is not suspected.
These checks take into account the cases of engine problems in icing conditions, and also the cases of vibrations due to icing, out of standard icing conditions.

If the flight crew suspects icing, and if flight conditions permit, the flight crew should shed the ice with the following procedure:
- The flight crew disconnects the A/THR
- The flight crew performs several large thrust variations from idle to a thrust compatible with the flight phase.
  It may be necessary to perform several engine run-ups (decrease and then increase of thrust) to fully shed the ice.

If the flight crew does not suspect icing, and if flight conditions permit, the flight crew reduces thrust to make the vibrations decrease, and stay below the advisory threshold.
If the vibrations do not decrease, there may be another problem with the engine. The flight crew should expect an ECAM alert that will provide guidance on the actions to perform.
Finally, during the taxi-in phase, the flight crew may consider to shut down the engine if the flight crew experienced vibrations in flight, or if the flight crew experiences vibrations during taxi. On ground, the flight crew should consider engine shutdown in order to avoid increased damage to the engine.

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COCKPIT WINDSHIELD/WINDOW CRACKED

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 windshield/window is still able to sustain the differential pressure up to the maximum flight level.
- 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 ΔP 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

The emergency descent should only be initiated on positive confirmation that cabin altitude and rate of climb are excessive and uncontrollable. However, the flight crew must rely on the CAB PR EXCESS CAB ALT warning, even if not confirmed on the CAB PRESS SD page. The CAB PR EXCESS CAB ALT warning can be triggered by a cabin pressure sensor, different from the one used to control the pressure and display the cabin altitude on the SD.

The flight crew should perform the actions of the EMER DESCENT in two steps:
- First step: Apply the memory items.
- Second step: Perform the read-&-do procedure (ECAM or QRH).

During the first step, the PM should focus on monitoring the FMA to ensure that the PF had correctly established the aircraft in descent.
During the second step, the PF should refine the settings.
To initiate the emergency descent, the use of autopilot (AP) and autothrust is highly recommended.
At high flight levels, the flight crew should extend the speed brakes while monitoring the VLS . This is in order to avoid the activation of the angle of attack protection which may result in the retraction of the speed brakes and in AP disconnection.

<u>Note:</u> *When in IDLE thrust, high speed and with 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.*

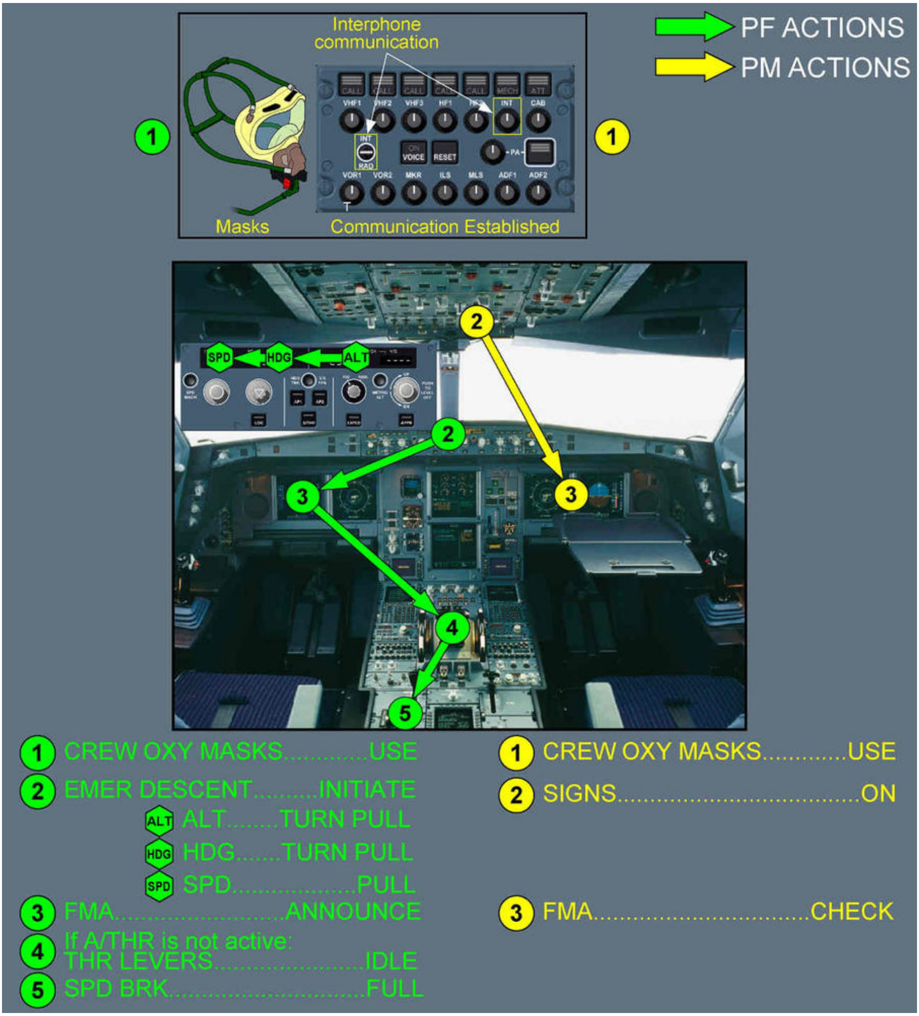
The flight crew should be aware that the MORA displayed on ND is the highest MORA value within a radius of 40 NM around the aircraft.

The flight crew should suspect structural damage in case of a loud bang, or high cabin vertical speed. If the flight crew suspects structural damage, apply both of the following:
- Set the SPEED/MACH pb to SPEED, to prevent an increase in the IAS, or to reduce the speed. This action minimizes the stress on aircraft structure
- Carefully use the speed brakes, to avoid additional stress on aircraft structure.

If the cabin altitude goes above 14 000 ft, the flight crew must press the MASK MAN ON pb. When it is obvious that the cabin altitude will exceed 14 000 ft, the flight crew could press the MASK MAN ON pb, before the cabin altitude reaches 14 000 ft.

Finally, subsequent to an emergency descent, once the oxygen masks are removed, the flight crew should perform all of the following:
- Close the oxygen stowage mask compartment.
- Press the PRESS TO RESET oxygen control slide, to deactivate the mask microphone, and to cut off the oxygen.

Emergency Descent - Memory Items



EMERGENCY LANDING

In some rare cases, the loss of all engines occurs at a very low height above ground level, and there is not sufficient time to attempt an engine relight. Therefore, the flight crew may not be able to apply the ENG DUAL FAILURE procedure. The flight crew must use the remaining time to fly the aircraft to an appropriate landing spot, and to prepare the aircraft for touchdown (ditching or forced landing).

The EMERGENCY LANDING procedure is provided in the QRH close to the EMERGENCY EVACUATION procedure.

The EMERGENCY LANDING procedure provides the flight crew with the following items and actions to perform, for the best possible touchdown:
- The landing gear position
- The slats/flaps configuration
- The speed
- The pitch attitude, in the case of ditching.

Flight crew actions that are considered as basic airmanship (notify the ATC, notify the cabin crew, etc.) are not included in the EMERGENCY LANDING procedure.

WHEN TO APPLY THE EMERGENCY LANDING PROCEDURE

The flight crew must rapidly decide to apply either the ENG DUAL FAILURE procedure, or the EMERGENCY LANDING procedure, depending on their assessment of the situation.

To make their decision, the flight crew should take all the following parameters into account:
- The aircraft altitude
- The remaining time before touchdown
- The rate of descent
- The flight crew workload
- The weather conditions
- The suitable landing surface options
- The technical state of the aircraft, etc.

OVERWEIGHT LANDING

Automatic landing is certified up to MLW , but has been demonstrated in flight up to MTOW.
In determining the best course of action, the flight crew may consider the option to perform an automatic landing, provided the runway is approved for automatic landing.
Should an overweight landing be required, a long straight in approach, or a wide visual pattern, should be flown in order to configure the aircraft for a stabilized approach.
The stabilized approach technique should be used, and VAPP established at the FAF . The speed will be reduced to reach VLS at runway threshold, to minimize the aircraft energy.

The crew will elect the landing configuration according to the "maximum weight for go-around in CONF 3" table provided both in QRH and in FCOM:

- If aircraft weight is below the maximum weight for go-around in CONF 3, landing will be performed CONF full (and go-around CONF 3) as it is the preferred configuration for optimized landing performance
- If aircraft weight is above the maximum weight for go-around in CONF 3, landing will be performed CONF 3 (and go-around CONF 1+F). The CONF 1+F meets the approach climb gradient requirement in all cases (high weights, high altitude and temperature).

If a go-around CONF 1+F is carried out following an approach 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.
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

1 Applicable to: MSN 0517-1060

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:

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FLIGHT CREW INCAPACITATION

GENERAL

Flight crew incapacitation is a real safety hazard that occurs more frequently than many of the other emergencies. Incapacitation can occur in many forms, that range from sudden death to partial loss of function. Sometimes the flight crew does not have any symptom before incapacitation.

DETECTION

In order to help with the early detection of flight crew incapacitation, the Crew Resource Management (CRM) principles should be applied:

- Correct crew coordination that involves routine monitoring and aural crosschecks. The absence of standard callouts at the appropriate time may indicate incapacitation of one flight crewmember
- If one flight crewmember does not feel well, he must inform the other flight crewmember.

Other symptoms, for example incoherent speech, a pale and(or) fixed facial expression, or irregular breathing, may indicate the beginning of incapacitation.

ACTION

In the case of flight crew incapacitation, the fit flight crewmember should apply the following actions:

- Take over and ensure a safe flight path:
  - Announce ″I have control″
  - If the incapacitated flight crewmember causes interference with the handling of the aircraft, press the sidestick pb for 40 seconds (30 seconds for the A350)
  - Keep or engage the onside AP, as required
  - Perform callouts (challenge and response included) and checklists aloud.
- Inform the ATC of the emergency
- Take any steps possible to contain the incapacitated flight crewmember. These steps may involve cabin/supernumerary/courier crew
- In order to reduce the workload, consider:
  - Early approach preparation and checklists reading
  - Automatic Landing
  - Use of radar vectoring and long approach.
- Land at the nearest suitable airport after consideration of all pertinent factors

- Arrange medical assistance onboard and after landing, providing as many details as possible about the condition of the affected flight crewmember
- Request assistance from any medically qualified passenger, except for flight with only two flight crewmembers onboard (i.e. freighter or ferry flight).

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SUPPLEMENTARY INFORMATION

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Continued on the following page

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Localization Title	Toc Index	ID	Reason
SI-020 GO-AROUND	D	1	Effectivity update: The information now also applies to MSN 1060.

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GENERAL

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

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

The holdover time starts from the beginning of the application of the fluid, and depends on the type of fluid, and on the nature and severity of precipitation. The flight crew should refer to applicable tables as guidelines. These tables must be used in conjunction with the pre-takeoff check.

Depending upon the severity of the weather, de-icing/anti-icing procedure must be applied either:
- In one step, via the single application of heated and diluted deicing/anti-icing fluid: This procedure provides a short holdover time, and should be used in low moisture conditions only. The holdover time starts from the beginning of the application of the fluid.
- In two steps, by first applying the heated deicing fluid, then by applying a protective anti-icing fluid: These two sprays must be applied consecutively. The holdover time starts from the beginning of the application of the second fluid.

PROCEDURES

The following outlines the various procedures to be applied before and after spraying:
- All ENG and APU BLEED pushbuttons must be set to OFF and the DITCHING pushbutton must be set to ON, to prevent any engine ingestion of deicing/anti-icing fluid.
- The aircraft can be deiced/anti-iced, with the engine and/or the APU running or off. However, the APU or the engine should not be started during spraying.
- The aircraft must be deiced/anti-iced symmetrically on both sides.
- Keep bleeds off after spraying for a few minutes.
- After spraying, keep bleeds off for a few minutes, and perform a visual inspection of the aircraft surfaces.
- A deicing/anti-icing report must be filled out to indicate the type of fluid and when the spraying began.

AFTER START

- Keep the engine bleeds off, with the engines running at higher N1.
- Keep the APU running with the bleed off for a few minutes after spraying.
- The slats/flaps and flight controls can be moved, because they no longer have ice.

TAXI OUT

On contaminated runways, the 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 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.

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

TAKEOFF

TAKEOFF PERFORMANCES

The use of FLEX thrust for takeoff on contaminated runways is prohibited.
If anti-ice is used at takeoff, the crew will apply the related performance penalty.
Slush, standing water, or deep snow reduces the aircraft takeoff performance because of increased rolling resistance and the reduction in tire-to-ground friction. A higher flap setting will increase the runway limited takeoff weight, but will reduce second segment limited takeoff weight.

TAKEOFF ROLL

Before the aircraft lines up on the runway for takeoff, the flight crew must ensure that the airframe has no ice or snow.

Then, before applying thrust, the Captain should ensure that the nosewheel is straight. If there is a tendency to deviate from the runway centerline, this tendency must be neutralized immediately, via rudder pedal steering, not via the tiller.
On contaminated runways, the flight crew should ensure that engine thrust advances symmetrically to help minimize potential problems with directional control.

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.
If the recommended anti-ice procedures are not performed, engine stall, over-temperature, or engine damage may occur,
Wing anti-ice should be turned on, if either severe ice accretion is expected, or if there is any indication of icing on the airframe.

HOLDING

If holding is performed in icing conditions, the flight crew should maintain clean configuration. This is because prolonged flight in icing conditions with the slats extended should be avoided.

APPROACH

ICE ACCRETION

If significant ice accretion develops on parts of the wing, the aircraft speed must be increased (*Refer to FCOM/PRO-SUP-30 Operations in Icing Conditions*).

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.

Note: *The ADIRS computes the FPA from inertial data and barometric altitude.*

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.

If appropriate, the flight crew should therefore apply corrections on the altitudes and on the FPA (in vertical selected FPA mode), and they should be vigilant on the parameters that are displayed.

Altitude Correction

The flight crew should consider to correct the target altitudes, by adding the values that are indicated in the table below:

Corrections to be Added (ft)			
	Airport Temperature (°C)		
Height (ft)	**-10**	**-20**	**-30**
500	50	70	100
1 000	100	140	190
2 000	200	280	380
3 000	290	420	570
4 000	390	570	760
5 000	490	710	950

These values are calculated for an aerodrome at sea level, and are therefore conservative when applied at a higher altitude aerodrome. For aerodromes at sea level, these corrections corresponds approximately to 4 x Delta ISA x Height (ft)/1000.
The correction depends on the airport temperature, and on the height above the airport. This correction has to be added to the indicated altitude.
Along the Approach and Missed Approach, the flight crew should consider to apply the altitude corrections on the relevant minimum altitudes (all including FAF, Step-down altitudes, minima), and on the altitude for the altitude/distance check.
For Non Precision Approach in vertical managed mode : *Refer to NO-130 Cold Weather Operations*.

FPA Correction

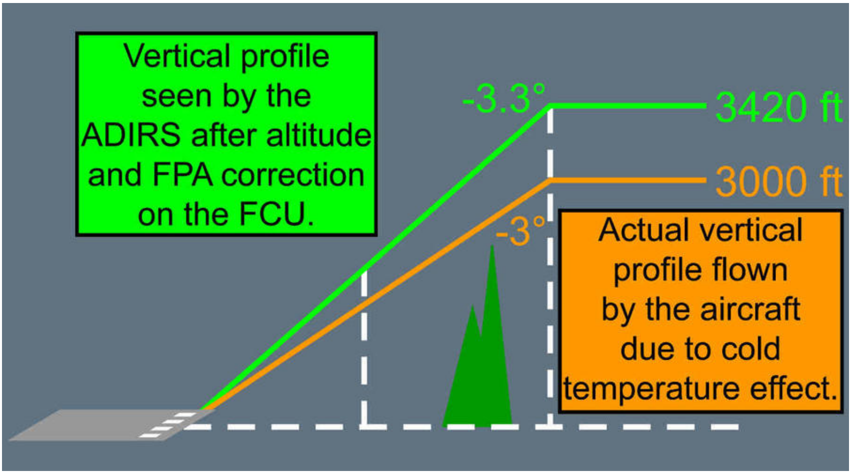
When the temperature is lower than ISA , the FPA that the aircraft actually flies is less steep than the FPA that the ADIRS (ISA referenced) computes.
In vertical selected mode FPA , to correct the FPA for this ISA deviation effect, the flight crew should select on the FCU a FPA slightly different from the FPA that the aircraft needs to fly.
In any case, the check "altitude (corrected in 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. Approach: FAF at 3 000 ft ; Final descent slope 3 °.



LANDING

Obviously, landings should be avoided on very slippery runways. However, if it is not possible to avoid such landings, the following factors (linked to operations on contaminated runways) should be considered:

- Braking action
- Directional control

BRAKING ACTION

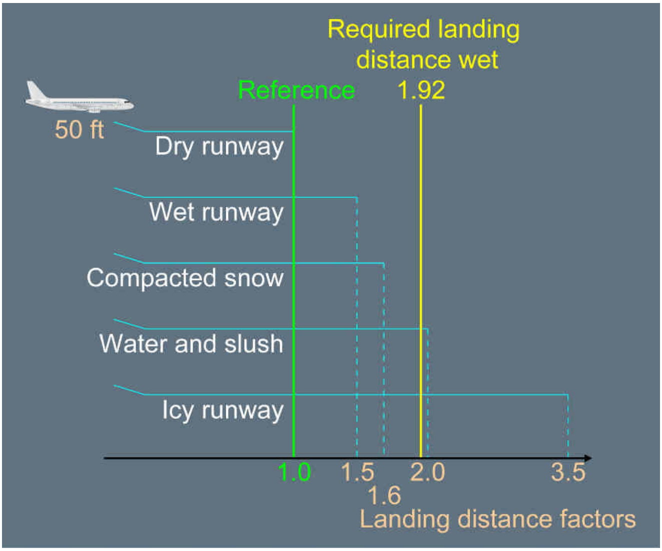
The presence of fluid contaminants on the runway has an adverse effect on braking performance, because it reduces the friction between the tires and the surface of the runway. It also creates a layer of fluid between the tires and the runway surface, and reduces the contact area. The landing distances, indicated in the QRH, provide a good assessment of the real landing distances for specific levels of contamination.

A firm touchdown should be made and MAX reverse should be selected, as soon as the main landing gear is on ground. Using reversers on a runway that is contaminated with dry snow may reduce visibility, particularly at low speeds. In such cases, reverse thrust should be reduced to idle, if necessary.

The use of MED auto-brake is recommended, when landing on an evenly contaminated runway. It is possible that the DECEL light on the AUTO BRK panel will not come on, as the predetermined deceleration may not be achieved. This does not mean that the auto-brake is not working.

In the case of uneven contamination on a wet or contaminated runway, the autobrake may laterally destabilize the aircraft. If this occurs, consider deselecting the autobrake.

Typical Landing Distance Factors Versus Runway Condition



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 Rollout*).

TAXI IN

During taxi-in, after landing, the flaps/slats should not be retracted. This is because retraction could cause damage, by crushing any ice that is in the slots of the slats. When the aircraft arrives at the gate, and the engines are stopped, a visual inspection should be performed to check that the slats/flaps areas are free of contamination. They may then be retracted, with the electric pumps.

PARKING

At the end of the flight, in extreme cold conditions, cold soak protection is requested when a longer stop over is expected.

TURBULENCE

PREFACE

The flight crew must use weather reports and charts to determine the location and altitude of possible CBs, storms, and Clear Air Turbulence (CAT). If turbulence is expected, the flight crew must turn on the seatbelt signs, in order to prepare passengers and prevent injury.

TAKE-OFF

For takeoff in high turbulence, the flight crew must wait for the target speed +20 kt (limited to VFE -5) before retracting the slats/flaps (e.g. the flight crew must wait for F+20 kt before setting Flaps 1).

IN FLIGHT

USE OF RADAR

Areas of known turbulence, associated with CBs, must be avoided. Good management of the radar tilt is essential, in order to accurately assess and evaluate the vertical development of CBs. Usually, the gain should be left in AUTO . However, selective use of manual gain may help to assess the general weather conditions. Manual gain is particularly useful, when operating in heavy rain, if the radar picture is saturated. In this case, reduced gain will help the flight crew

to identify the areas of heaviest rainfall, that are usually associated with active CB cells. After using manual gain, it should be reset to AUTO, in order to recover optimum radar sensitivity.
A weak echo should not be a reason for the flight crew to underestimate a CB, because only the wet parts of the CB are detected. The decision to avoid a CB must be taken as early as possible, and lateral avoidance should, ideally, be at 20 NM upwind.

USE OF AP AND A/THR

If moderate turbulence is encountered, the flight crew should set the AP and A/THR to ON with managed speed.
If severe turbulence is encountered, the flight crew should keep the AP engaged. Thrust levers should be set to turbulence N1 (Refer to QRH), and the A/THR should then be disconnected.
Use of the A/THR is, however, recommended during approach, in order to benefit from the GS mini.
If the aircraft is flown manually, the flight crew should be aware of the fact that flight control laws are designed to cope with turbulence. Therefore, they should avoid the temptation to fight turbulence, and should not over-control the sidestick.

CONSIDERATIONS ON CAT

Clear Air Turbulence (CAT) can be expected by referring to weather charts and pilot reports. However, the radar cannot detect CAT, because it is "dry turbulence".
If CAT is encountered, the flight crew may consider avoiding it vertically, keeping in mind that the buffet margin reduces as the altitude increases.

MISCELLANEOUS

- The flight crew must set the harness to on, check that the seat belts signs are on and use all white lights in thunderstorms.
- Turbulence speeds are indicated in the QRH.

WINDSHEAR

BACKGROUND INFORMATION

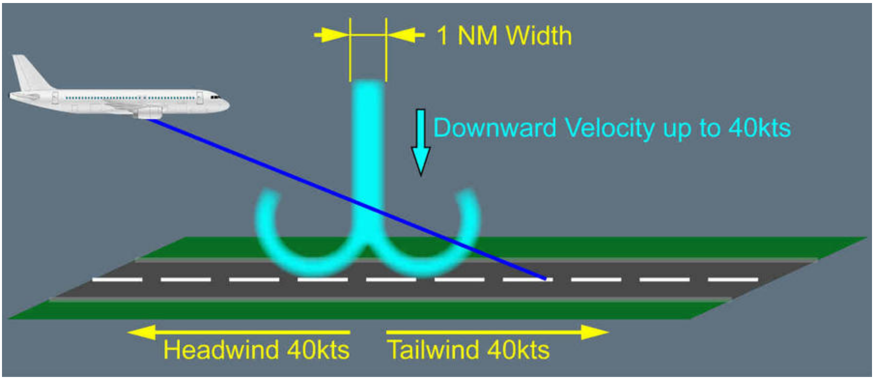
WINDSHEAR PHENOMENON

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.

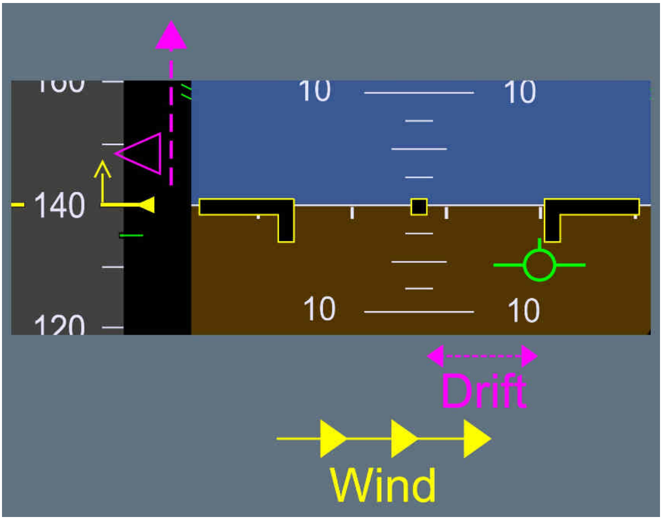
Increasing flight crew awareness (if available)

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 automatically operates below a given altitude (*Refer to FCOM/DSC-34-SURV-30-20 General*), if the radar is ON or OFF, provided that the PWS sw is in the AUTO position.

Informing flight crew

The FPV associated with the approach speed variations (GS mini protection) is an effective means for informing the flight crew of unexpected air mass variations:
Approach speed variations and lateral FPV displacement reflect horizontal wind gradient.
Vertical FPV displacement reflects the vertical air mass movement.

Bird and Target Speed - Wind Interpretation



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

Predictive windshear ("WINDSHEAR AHEAD" aural warning), if available

If predictive windshear aural warning is generated on the runway before take-off, take-off must be delayed.
If a predictive windshear aural warning is generated during the takeoff roll, the Captain must reject the takeoff (the aural warning is inhibited at speeds greater than 100 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

If the windshear starts before V1 with significant speed and speed trend variations and the captain decides that there is sufficient runway to stop the airplane, the captain must initiate a rejected take-off.

If the windshear starts after V1 , the crew will set TOGA and will apply the QRH checklist actions from memory. The following points should be stressed:
- The configuration should not be changed until definitely out of the shear, because operating the landing gear doors causes additional drag.
- The PF must fly SRS pitch orders rapidly and smoothly, but not aggressively, and must consider the use of full backstick, if necessary, to minimize height loss.
- The PM should call wind variation from the ND and V/S and, when clear of the shear, report the encounter to ATC.

APPROACH

Predictive windshear (if available)

In case the "MONITOR RADAR DISPLAY" is displayed or the ADVISORY ICON appears, the flight crew should either delay the approach or divert to another airport. However, if the approach is continued, the flight crew should consider the following:
- The weather severity must be assessed with the radar display.
- A more appropriate runway must be considered.
- A Conf 3 landing should be considered.
- The flight crew should increase VAPP displayed on MCDU PERF APP page up to a maximum VLS +15 kt.
- 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. *Refer to NO-110 FINAL APPROACH* for the applicable technique description.
- In case the "GO AROUND WINDSHEAR AHEAD" message is triggered, the PF must set TOGA for go-around. The aircraft configuration can be changed, provided that the windshear is not entered. Full back stick should be applied, if required, to follow the SRS or minimize loss of height.

Reactive windshear (if available)

In case of the "WINDSHEAR WINDSHEAR WINDSHEAR" aural warning, the PF must set TOGA for go-around. However, the configuration (slats/flaps, gear) must not be changed until out of the shear. The flight crew must closely monitor the flight path and speed.

VOLCANIC ASH

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
  - If engine restart is required, consider delaying engine start and APU start until out of the volcanic ash cloud.
- 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

Two flying references may be used on the PFD:
- The attitude
- The Flight Path Vector (FPV), called the "bird".

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

THE ATTITUDE

When HDG /VS is selected on the FCU , "bird" is off, and the attitude is the flight reference with HDG and VS as basic guidance parameters.
The attitude flight reference should be used for dynamic manoeuvres, for example, take-off or go-around. An action on the sidestick has an immediate effect on the aircraft attitude. The flight crew can monitor this flight reference directly and accurately during these maneuvers.

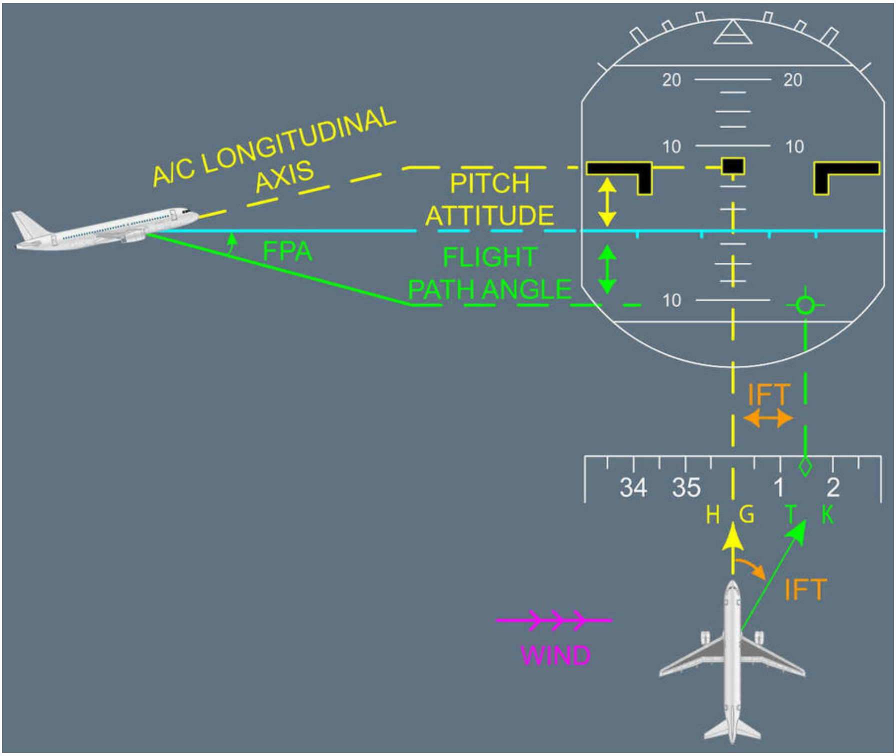
THE FLIGHT PATH VECTOR

When TRK /FPA is selected on the FCU , the "bird" (the FPV) is the flight reference with the TRK and FPA as basic guidance parameters.
In dynamic manoeuvres, the "bird" is directly affected by the aircraft inertia and has a delayed reaction. As a result, the "bird" should not be used as a flight reference in dynamic manoeuvres.
The "bird" is the flying reference that should be used when flying a stabilized segment of trajectory, e.g. a non Precision Approach or visual circuit.

INFORMATION PRESENTATION

The FPV appears on the PFD as a symbol, known as "the bird". The bird indicates the track and flight path angle in relation to the ground.
The track is indicated on the PFD by a green diamond on the compass, in addition to the lateral movement of the bird in relation to the fixed aircraft symbol. On the ND, the track is indicated by a green diamond on the compass scale. The difference in angle between track and heading indicates the drift.
The flight path angle is indicated on the PFD by the vertical movement of the bird in relation to the pitch scale.

Use of FPV



With the flight directors (FD s) selected ON, the Flight Path Director (FPD) replaces the HDG-VS Flight Director (FD). With both FD s pb set to off, the blue track index appears on the PFD horizon.

PRACTICAL USES OF THE FPV

As a general rule, when using the bird, the pilot should first change attitude, and then check the result with reference to the bird.

NON-PRECISION APPROACH

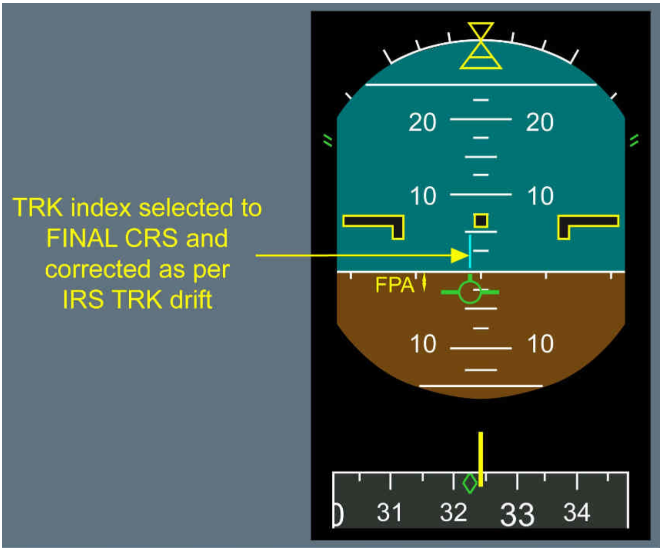
The FPV is particularly useful for non-precision approaches. The pilot can select values for the inbound track and final descent path angle on the FCU. Once established inbound, only minor corrections should be required to maintain an accurate approach path. The pilot can monitor the tracking and descent flight path, with reference to the track indicator and the bird.

However, pilots should understand that the bird only indicates a flight path angle and track, and does not provide guidance to a ground-based radio facility. Therefore, even if the bird indicates that the aircraft is flying with the correct flight path angle and track, this does not necessarily mean that the aircraft is on the correct final approach path.

VISUAL CIRCUITS

The FPV can be used as a cross-reference, when flying visual circuits. On the downwind leg, the pilot should position the wings of the bird on the horizon, in order to maintain level flight. The downwind track should be set on the FCU . The pilot should position the tail of the bird on the blue track index on the PFD , in order to maintain the desired track downwind.
On the final inbound approach, the track index should be set to the final approach course of the runway. A standard 3 ° approach path is indicated, when the top of the bird's tail is immediately below the horizon, and the bottom of the bird is immediately above the 5 ° nose down marker.

Use of FPV in Final Approach

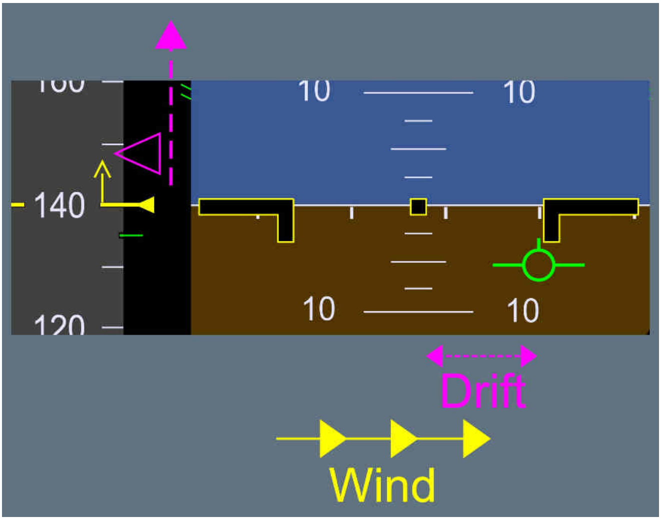


FINAL APPROACH

The bird is a very useful flight reference, because it provides the trajectory parameters, and quickly warns the pilot of downburst. In addition, together with the GS MINI protection, it is an excellent indicator of shears or wind variations. The position of the "bird" in relation to the fixed aircraft symbol provides an immediate indication of the wind direction. Therefore, when approaching the minima, the pilot knows in which direction to search for the runway.

If the target approach speed symbol moves upward, this indicates that there is headwind gust. If the bird drifts to the right, this indicates that 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 bird must be considered as not reliable, if altitude information is not reliable.

GO-AROUND

For the go-around, the appropriate flight reference is the attitude, because go-around is a dynamic maneuver. Therefore, if the "bird" is on, the PF will ask the PM to select HDG /VS, in order to recover the FD bars.

GO-AROUND

1 **Applicable to: MSN 0517, 1060-2396**

For the go-around, the appropriate flight reference is the attitude, because go-around is a dynamic maneuver. Therefore, when performing a go-around, regardless of the previously-selected flight reference, upon selection of TOGA , the FD bars are automatically restored in SRS/GA TRK modes, and the "bird" is automatically removed.

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GENERAL

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

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.

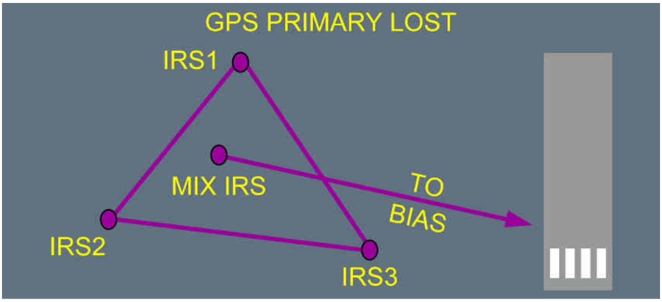
INITIALISATION

Refer to NO-020 ADIRS Alignment or Realignment

TAKE-OFF

Each FMS uses the MIXIRS position as its position, until the thrust levers are pushed forward to TOGA or MCT /FLX . 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.

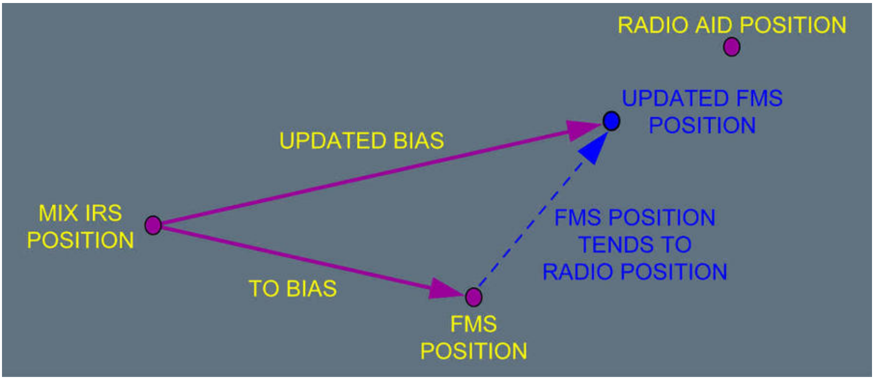
FMS Position Updating at Take Off



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 Alignment or Realignment

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

FM POSITION			
Flight phase		WITHOUT GPS PRIMARY	WITH GPS PRIMARY
On groundbefore Takeoff		MIXIRS	GPIRS
Takeoff		Updated at runway threshold (shift) [(1)]	
In flight	With RADIO	Tends to RADIO	GPIRS
	Without RADIO	MIXIRS + BIAS	GPIRS

(1) *The FMS position update at take-off is inhibited with FMS 2 when GPS PRIMARY is active.*

USE OF FMS

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, GPS PRIMARY 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

NAVIGATION ACCURACY INDICATIONS

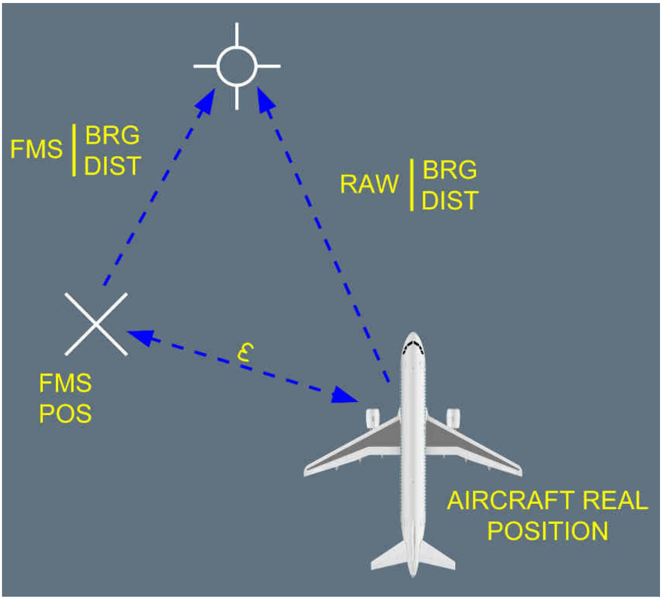
The navigation accuracy indications are available on the MCDU PROG page. The following guidelines apply:

- 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).

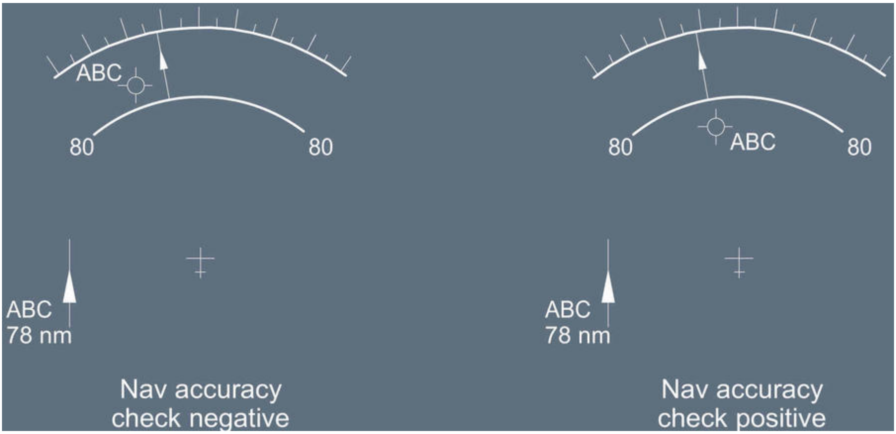
Navigation Accuracy Cross Check Technique 1



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.

			ND		AP /FD mode	EGPWS
			PF	PM		
GPS PRIMARY		-	Arc or Rose NAV with raw data when required		Lateral and vertical managed modes	ON
GPS PRIMARY LOST Or No GPS	Cruise	Navigation accuracy check positive(≤ 3 NM)	Arc or Rose NAV with raw data when required		Lateral and vertical managed modes	ON
		Navigation accuracy check negative(>3 NM)	ARC or ROSE NAV may be used with care and with raw data		Lateral and vertical managed modes with care with raw data	OFF
	Approach (1)	Navigation accuracy check positive(≤ 1 NM)	Arc or Rose NAV with raw data		Lateral and vertical managed modes	ON
		Navigation accuracy check negative(>1 NM)	ROSE VOR or ILS as required		Lateral and vertical selected modes	OFF

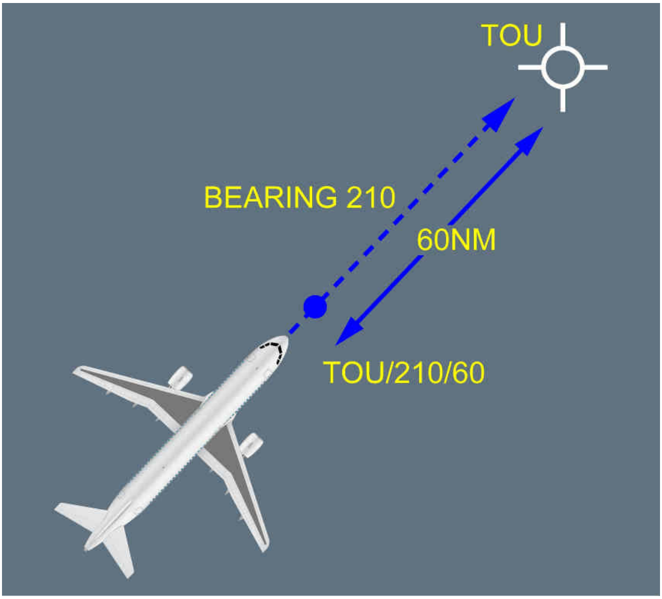
(1) *A GPS defined Non Precision Approach must be interrupted if GPS PRIMARY LOST message is displayed.*

POSITION UPDATE

In case of an obvious and major map shift noticed by specific messages such as "CHECK A/C POSITION, FM 1/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



GENERAL

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:

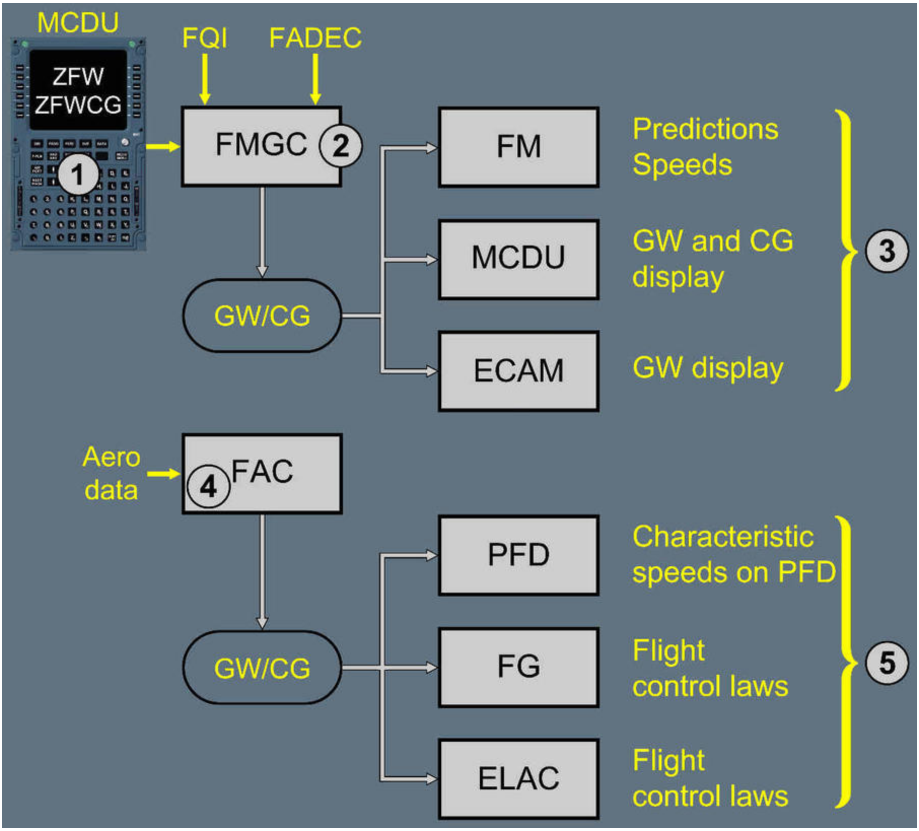
- Flight control laws
- Computation of characteristic speeds (VLS , F, S, GD) for display on PFD

A ZFW or ZFWCG entry error in MCDU INIT B page induces calculation errors that are to be highlighted.

TECHNICAL BACKGROUND

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.



Note: 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

If the pilot enters erroneous ZFW on MCDU INIT B page, this will affect as follows:

GW and, to a lesser degree, CG , computed by FM are erroneous. This induces the following consequences:

- The FM predictions and speeds are erroneous
- Incorrect GW and CG on MCDU FUEL PRED page
- Incorrect GW displayed on ECAM

FAC GW , which is based on FM GW on ground, will be updated only once airborne through a specific slow calculation using AOA information. Consequently,

- Characteristic speeds on PFD at take-off are erroneous, but they are correct in flight
- SRS mode guidance is affected if computed VLS is above V2 as inserted in the MCDU PERF TAKE-OFF page.

Note: *1. In flight, if the FM and FAC GW differ from 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

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

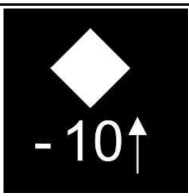
GENERAL

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		No threat	-	-
Proximate		Consider as No threat	-	-
Traffic Advisory (TA)		Potential threat	"TRAFFIC TRAFFIC"	No evasive maneuver

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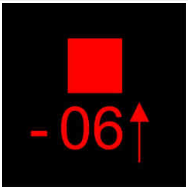
Intruder	Display	Type of collision threat	Aural warning	Crew action
Resolution Advisory (RA)		Collision threat	Preventive, e.g. "MONITOR V/S"	Do not alter your flight path and keep VS out of red sector
			Corrective, e.g. "CLIMB"	Smoothly and firmly (0.25 g) follow VSI green sector within 5 s
			Corrective, e.g. "CLIMB NOW" or "INCREASE CLIMB"	Smoothly and firmly (0.35 g) follow VSI green sector within 2.5 s

OPERATIONAL RECOMMENDATIONS

The flight crew should select

- ABV in climb (+9 900 ft/-2 700 ft or +7 000 ft/-2 700 ft, depending on the type of TCAS control panel)
- ALL in cruise (+2 700 ft/-2 700 ft)
- BELOW , if the cruise altitude is within 2 000 ft of FL 410, or in descent (+2 700 ft/-9 900 ft or +2 700 ft/-7 000 ft, depending on the type of TCAS control panel)
- THRT in heavy traffic terminal area
- 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 not wanted and not appropriate 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:

- The PF announces: "TCAS, I have controls".
- No evasive maneuver should be initiated, only on the basis of a TA.

If a RA is generated:

- The flight crew must always follow the TCAS RA orders in the correct direction, even:
  - If 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.

  <u>Note:</u> *Both FD s 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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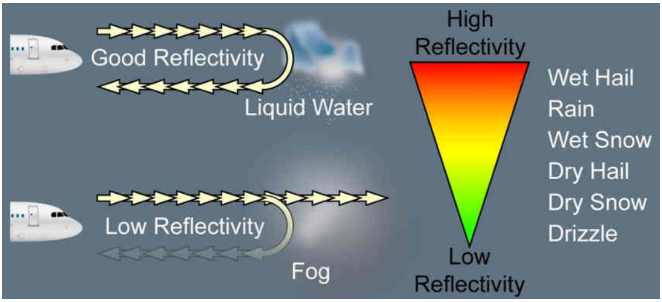
GENERAL

This FCTM chapter provides basic knowledge on the use of onboard weather radars. To get all the information on the characteristics, limitations and operational recommendations of each radar, refer to the user guide of the radar manufacturer.

Weather detection is based on the reflectivity of water droplets. The weather echo appears on the ND with a color scale that goes from red (high reflectivity) to green (low reflectivity).

The intensity of the weather echo is associated with the droplet size, composition and quantity (e.g. the reflectivity of a water particle is five times more than an ice particle of the same size). The flight 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).

Weather Radar Principle



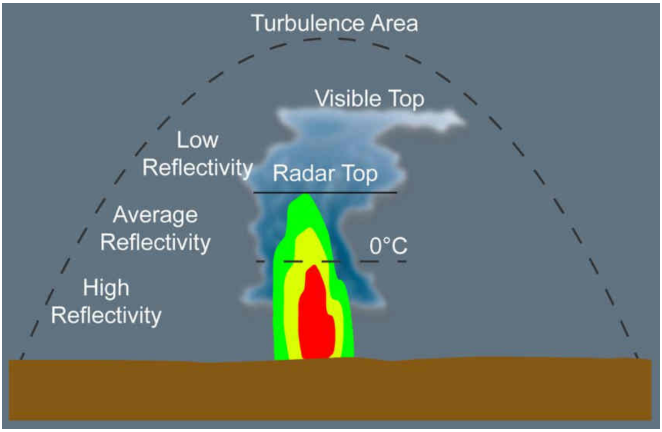
The purpose of the weather radar is to help the flight crew detect and avoid storm cells (e.g. cumulonimbus). Due to its large vertical expansion, a storm cell does not have the same reflectivity depending on the altitude. The quantity of liquid water in the atmosphere decreases with the altitude. Therefore the reflectivity of a storm cell decreases with the altitude.

The upper detection limit of the weather radar is called the radar top.

The flight crew must be aware of both of the following:

- The radar top is not the visible top of the storm cell
- The storm cell and associated turbulence extend significantly above the radar top.

Reflective Image of a Cumulonimbus



WEATHER DETECTION

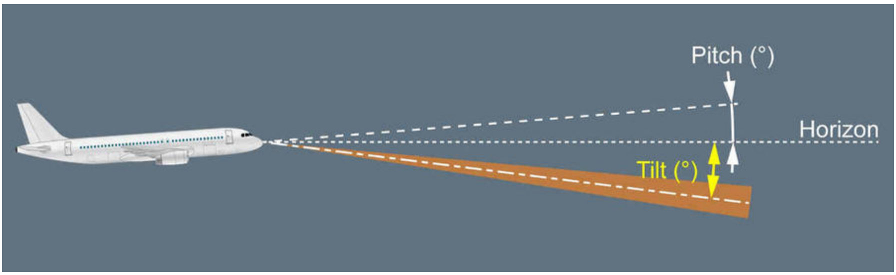
The flight crew uses the following controls and functions to operate the weather radar:

- TILT
- GAIN
- RANGE.

MANUAL TILT MANAGEMENT

The tilt refers to the angle between the antenna beam centerline and the horizon.
The radar uses data from the IRS to stabilize its antenna. Therefore, the antenna tilt is independent of the aircraft pitch and bank angle.

Tilt Angle Definition

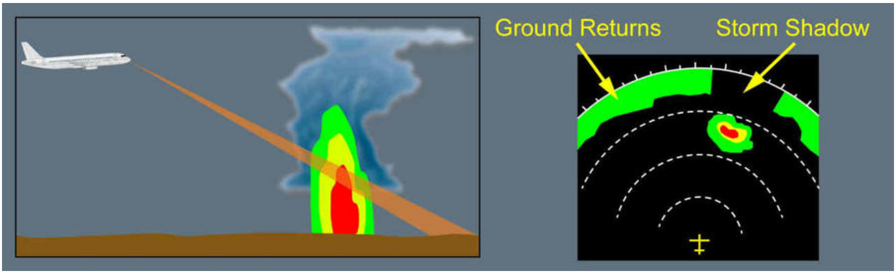


The flight crew should regularly scan the area ahead of the aircraft, at several ND ranges. In order to identify the strongest weather returns, the flight crew should tilt the weather radar antenna up and down.

To obtain a correct display of a storm cell, the flight crew must use the tilt knob to point the weather radar beam to the most reflective part of the storm cell. A correct tilt setting prevents the overscanning of the storm cell.

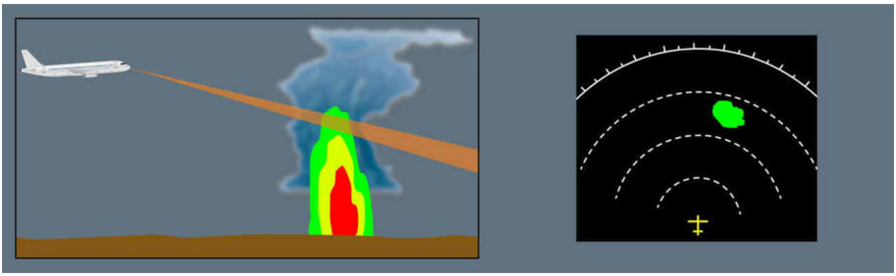
Note: *Common practice is to ensure that the ground return is at the top of the ND screen.*

Correct Storm Display



At high altitude, a storm cell may contain ice particles that have low reflectivity. If the tilt setting is not correct, the ND may display only the upper (less reflective) part of a storm cell (overscanning). As a result, the flight crew may underestimate or not detect a storm cell.

Overscanning



GAIN SETTING FOR WEATHER DETECTION

The flight crew should use the calibrated gain (CAL or AUTO) for weather detection as a default mode for the weather radar. The use of the calibrated gain ensures a standard display of the colors on the ND. The flight crew can manually tune the gain to analyze storm cells. *Refer to SI-070 Analysis of Weather Radar Data*.

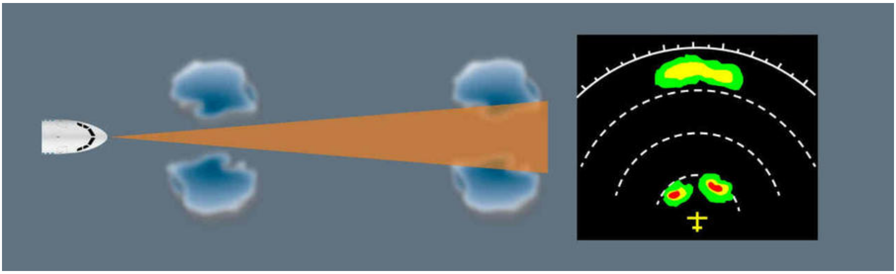
RANGE MANAGEMENT

The flight crew should monitor both the long-distance and short-distance weather, in order to be able to efficiently plan appropriate course changes, and to avoid the “blind alley effect”. *Refer to SI-070 Analysis of Weather Radar Data*.
At long distance ahead of the aircraft, the accuracy of the weather displayed is low, due to both of the following:

- The increase in the width of the weather radar beam
- Signal attenuation.

Therefore, the accuracy of the weather displayed is better for short-distance weather.

Accuracy of the Weather Display



USE OF THE WEATHER RADAR IN ACCORDANCE WITH THE FLIGHT PHASE

Manual Tilt

Manual Weather Radars (or Automatic Weather Radars in Manual Tilt Mode)		
Flight Phase	**Tilt Control**	**Comments**
TAXI	Away from ground personnel, set the ND to the lowest range. Tilt down then up. Check appearance/disappearance of ground returns.	Radar check.
TAKEOFF	In the case of suspected adverse weather conditions, manually and gradually tilt up to scan weather (maximum 15 ° up). In all other cases, set the tilt to 4 ° up.	When lined up, check of the departure path.
CLIMB	Adjust the ND range as required and decrease the tilt angle as the aircraft climbs.	Compensation of the altitude increase to avoid overscanning.

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Manual Weather Radars (or Automatic Weather Radars in Manual Tilt Mode)		
Flight Phase	**Tilt Control**	**Comments**
LEVEL FLIGHT/CRUISE	1. Adjust ND range as required 2. Regularly modify the tilt to scan the weather ahead of the aircraft 3. When the weather scan is completed, adjust the tilt so that the ground returns appear on the top of the ND *(2)(3)*.	In cruise, the combination of the following ND ranges provides good weather awareness *(1)*: - 160 NM on the PM ND - 80 NM on the PF ND. Use shorter ND ranges to track/avoid short-distance weather.
DESCENT	During descent, adjust the tilt to maintain the ground returns on the top of the ND.	-
APPROACH	Set the tilt to 4 ° up.	This tilt setting (4 ° up) prevents the display of too many ground returns.

(1) *For aircraft equipped with a manual weather radar that has only one tilt control knob, use an average tilt value to suit both ND ranges.*

(2) *It is difficult to identify the difference between weather returns and ground returns: A change in the tilt setting causes the shape and color of ground returns to rapidly change. These ground returns eventually disappear. This is not the case for weather returns.*

(3) *For flights above the water, there are no ground returns. Therefore, the flight crew can use any of the following tilt settings at cruise altitude as an initial value before adjustment:*
- *approximately -6 ° for an ND range of 40 NM, or*
- *approximately -2 ° for an ND range of 80 NM, or*
- *approximately -1 ° for an ND range of 160 NM, or*
- *approximately -1 ° for an ND range of 320 NM.*

Automatic Tilt Control

Automatic Weather Radars		
Flight Phase	**Tilt Control**	**Comments**
TAXI	Away from ground personnel, set the ND to the lowest range. Tilt down then up. Check appearance/disappearance of ground returns.	Set manual tilt mode for radar check.
TAKEOFF	In the case of suspected adverse weather conditions, manually and gradually tilt up to scan weather (maximum 15 ° up). Then set tilt to AUTO.	When lined up, check of the departure path. Then, use the automatic tilt mode for takeoff.
IN FLIGHT	Adjust ND range as required. Set tilt to AUTO. Use manual tilt for storm cell analysis, then set tilt back to AUTO. Regularly perform manual scans to enhance weather awareness, then set tilt back to AUTO.	In cruise, the combination of the following ND ranges provides good weather awareness: - 160 NM on the PM ND - 80 NM on the PF ND. Use shorter ND ranges to track/avoid short-distance weather.

ANALYSIS OF WEATHER RADAR DATA

ASSESSMENT OF THE VERTICAL EXPANSION OF A STORM CELL

The assessment of the vertical expansion of a detected storm cell enables the flight crew to assess the convective energy of the storm cell and therefore to identify its potential threat.

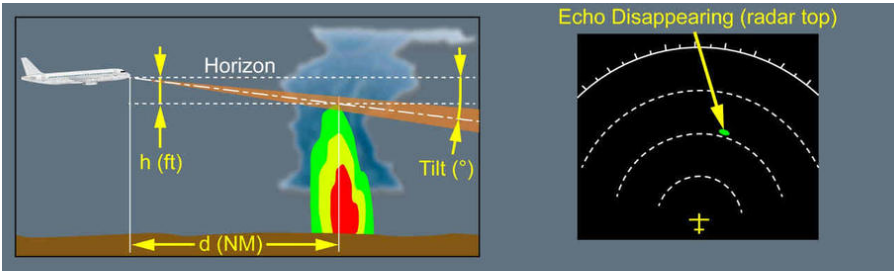
Note: *The flight crew can increase the gain in order to obtain a more visible display of the top of the storm cell (that contains less reflective ice particles).*

When flying towards a cell, the flight crew can estimate the vertical expansion of the cloud above/below the aircraft altitude with the following formula:

$$h(ft) \simeq d(NM) \times Tilt(°) \times 100$$

h(ft) is the difference between the radar top altitude and the aircraft altitude.
d(NM) is the distance between the aircraft and the storm cell.
Tilt(°) is the tilt setting for which the storm cell image disappears from the ND.
Example: A weather return that disappears from the ND at 40 NM with a tilt setting of 1 ° down, indicates that the top of the storm cell is 4 000 ft below the aircraft altitude.

Assessment of the Vertical Expansion of a Storm Cell



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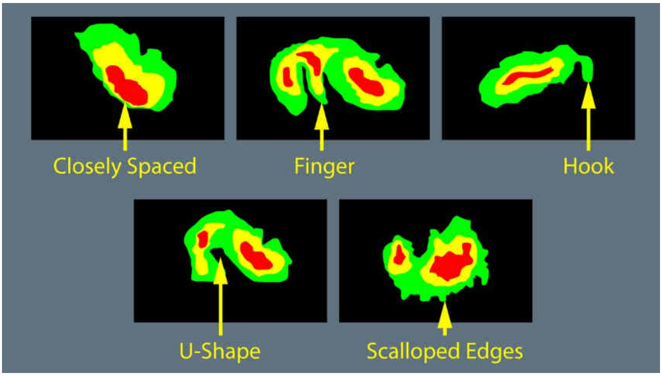
INTERPRETATION OF THE COLORS OF THE WEATHER DISPLAYED ON THE ND

Particle reflectivity of a storm cell is independent of the potential weather hazard in the storm cell. There can be a high percentage of humidity in the atmosphere, when near the sea. In this case, thermal convection will produce clouds that are full of water. These clouds will have a high reflectivity, but may not necessarily be a high threat.
On the other hand, in equatorial overland regions where specific converging winds produce large-scale uplifts of dry air. As a result, these storm cells have lower reflectivity than mid-latitude storm cells, and therefore can be difficult to detect. However turbulence in, or above these clouds may have a higher intensity than indicated by the image on the weather radar display.
The flight crew must not underestimate a storm cell with a high vertical expansion, even if the weather return is low.

SPECIFIC WEATHER SHAPES

The flight crew should carefully observe shapes, more than colors, in order to detect adverse weather conditions.
Areas of different colors that are near to one another usually indicate zones of severe turbulence.
Some shapes are good indicators of severe hail and signify strong vertical drafts. Shapes that change quickly, whatever form they take, also indicate high weather activity.

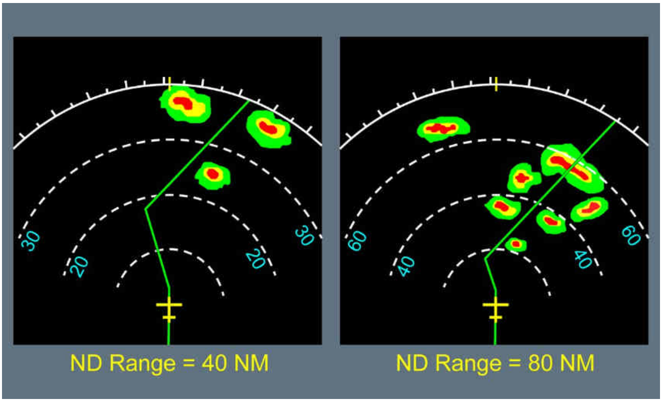
Specific Weather Shapes



BLIND ALLEY EFFECT

The flight crew should determine appropriate course changes to avoid adverse weather conditions, with the use of both high and short ND ranges. This technique avoids the “blind alley effect”, defined by the following: A course change that may appear safe with a short ND range, may be blocked when observed with a higher ND range.

Blind Alley Effect



ATTENUATION EFFECT

In areas of heavy precipitation, an important part of the weather radar signal is reflected by the frontal part of the precipitation due to its strong reflectivity. Therefore, the area behind the precipitation returns low signals, that appears as green or black areas (storm shadows).

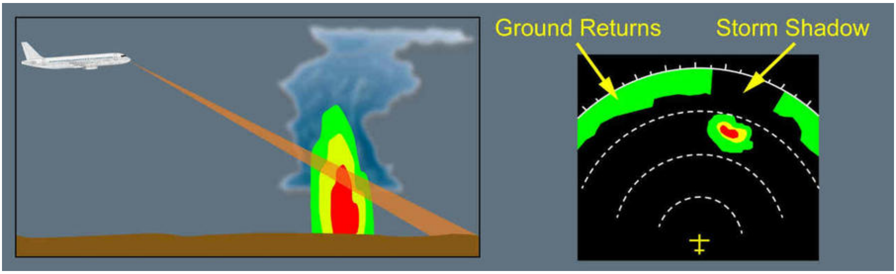
Attenuation of long-distance weather or attenuation of ground returns can help the flight crew to identify an area of heavy precipitation that may be a very active storm cell.

Some radars provide an indication on the ND to highlight areas that may be affected by attenuation:

- PAC alert on Collins radars *Refer to FCOM/DSC-34-SURV-30-30 Weather Radar indication on ND*
- REACT function on Honeywell radars *Refer to FCOM/DSC-34-SURV-30-30 Weather Hazard Prediction Function Indication on ND*.

Note: *On a weather radar display, the flight crew should always consider a black hole behind a red area as a potentially very active zone.*

Use of Attenuation Effect to Identify an Active Storm Cell

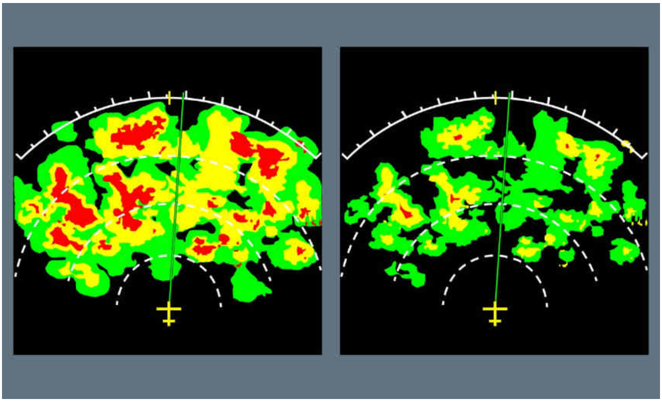


USE OF MANUAL GAIN FOR WEATHER ANALYSIS

To assess the general weather conditions, the flight crew can use manual gain.
Manual gain adjusts the color calibration of the radar. Therefore, the weather will appear either stronger (gain increased) or weaker (gain reduced).
When operating in heavy rain, the weather radar picture can be saturated. In this case, manually reduce the gain will help the flight crew to identify the areas of heaviest rainfall, that are usually associated with active storm cells.

Note: *After a storm cell analysis, the flight crew must set the GAIN knob back to AUTO/CAL.*

Use of Reduced gain to Identify Heaviest Rainfall

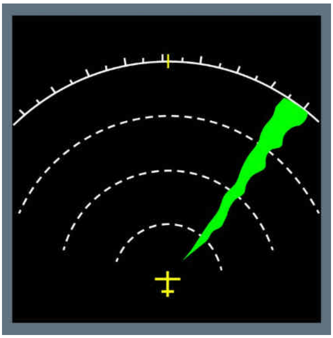


RADAR INTERFERENCE

High power external radio frequency sources that operate at a frequency next to the frequency of the weather radar may create interferences. These interferences may result in a not usual return display on the ND . The radar return will appear as a single wedge that extends out along the ND toward the source of interference.
The width and color of the interference may differ on the ND, depending on the distance to the source and its strength.
This interference does not damage the radar system, and will disappear as soon as the source of interference is outside the limit of the radar scan zone.

Note: *Radar interference may also be known as 'spoking' or 'alien radar'.*

Radar Interference



WEATHER AVOIDANCE

GENERAL RECOMMENDATION

In the case of the detection of a significant storm cell, the flight crew should apply the following recommendations:

- To avoid a large and active storm cell, the flight crew must make a decision at a distance of 40 NM from the storm cell
- The flight crew should deviate upwind instead of downwind of a storm cell (there is less probability of turbulence or hail)
- For storm cell avoidance planning, the flight crew should consider the height of the storm cell and apply the following:
  - Avoid all yellow, red, or magenta areas by at least 20 NM
  - Avoid all green, yellow, red, and magenta areas of storm cells above 28 000 ft by at least 20 NM
  - The flight crew should consider storm cells above 35 000 ft as highly hazardous. Therefore the flight crew should apply an additional separation to the 20 NM already applied
- If the top of the storm cell is at or above 25 000 ft, the flight crew should not overfly, because the aircraft may encounter turbulence stronger than expected
- The flight crew should not attempt to enter a storm cell, or overfly its top by less than 5 000 ft, because the aircraft may encounter severe turbulence
- In addition, the flight crew should not fly under a storm cell, because the aircraft may encounter windshear, microbursts, severe turbulence, or hail
- The flight crew should avoid areas where attenuation is identified:
  - By radar attenuation effect
  - By the attenuation detection function of the radar
- For weather radars equipped with hazard prediction functions, avoidance of the detected weather always has priority over avoidance of the predicted hazards. The flight crew must apply standard storm avoidance recommendations in priority, and hazard areas should be avoided as much as possible. *Refer to FCOM/DSC-34-SURV-30-30 Weather Hazard Prediction Function Indication on ND*.

ENTRY IN TO A STORM CELL

In the case of entry in to a storm cell, the flight crew must take full advantage of the weather radar. For flight crew guidelines, in the case of turbulence, *Refer to SI-010 Turbulence*.

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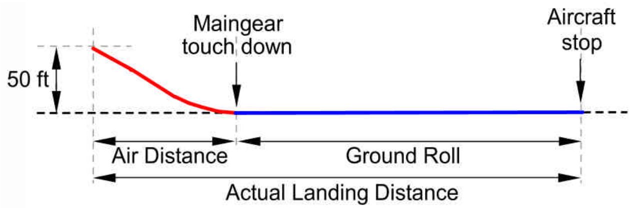
ACTUAL LANDING DISTANCE (ALD)

The ALD is the distance to come to a complete stop from a point 50 ft above the landing surface.
The ALD is a regulatory landing distance established during flight tests in non-operational conditions (rate of descent, piloting skills…), not representative of daily operations.



REQUIRED LANDING DISTANCE (RLD)

The RLD is a regulatory landing distance based on the Actual Landing Distance multiplied by a regulatory coefficient. It is used for dispatch only.
RLD (Dry) = ALD / 0.6
RLD (Wet) = 1.15 x RLD (Dry)
RLD (Contaminated) = greatest of [1.15 x ALD (Contaminated) OR RLD (Wet)]

LANDING DISTANCE (LD)

The LD is the landing distance calculated in-flight (also called in-flight landing distance). It is based on the landing performance model elaborated by the Takeoff and Landing Performance Assessment / Aviation Rulemaking Committee (the TALPA /ARC committee was mandated to find an industry consensus and produce recommendations for new regulation on landing performance assessment). LD wants to be more representative of the landing technique followed by line pilot and so more representative of daily operations.

FACTORED LANDING DISTANCE

The LD calculated in flight does not 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 distance (either determined with or without failure).
It is the airline responsibility to define the margins that the flight crew should apply on top of the in-flight landing distance.

The Airbus recommendation is to add a margin of 15 % 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 (either determined with or without failure).

METHOD TO DETERMINE AIRCRAFT PERFORMANCE AT LANDING WITHOUT OR WITH FAILURE

THE RUNWAY CONDITION ASSESSMENT MATRIX (RCAM)

INFORMATION PROVIDED BY THE RCAM

The RCAM provides the flight crew with a combination of all available information (Runway Surface Conditions: State or / and Contaminant, Pilot Report of Braking Action (PIREP) or Estimated Surface Friction (ESF)) in order to assess the Related Landing Performance Code - Level.

The RCAM provides six Landing Performance Codes - Levels:
- 6 - Dry
- 5 - Good
- 4 - Good to Medium
- 3 - Medium
- 2 - Medium to Poor
- 1 - Poor

The RCAM also provides the maximum demonstrated crosswind value (gust included) for each landing performance.

Note: The RCAM does not show the friction coefficient (Mu) since there is no correlation between the coefficient measured by a vehicle and the actual aircraft braking capability / landing performance.

HOW TO USE THE RCAM

In order to assess the landing distance, the flight crew should determine a Landing Performance Code - Level using the RCAM.
The flight crew makes a primary assessment based on runway state or / and runway contaminant type and depth and the OAT. Then, the flight crew may downgrade this primary assessment if:

- A report (PIREP or ESF) is available and this report corresponds to a lower Landing Performance Code - Level,
- Complementary information is available and is related to a possible degradation of the runway surface conditions.

If the primary means of assessment (runway state or/and runway contaminant type and depth) is not available, the flight crew should request it to the ATC.
The flight crew should not use a report or any other complementary information in order to upgrade a primary assessment (runway covered by treated ice may be an exception, for more information, refer to the example below).

CASE OF LOOSE CONTAMINANT

When a loose contaminant (standing water, slush, dry snow or wet snow) is present on the runway, ICAO Annex 14 recommendations state that no estimated surface friction should be reported as the measurement is not reliable. Therefore, Estimated Surface Friction measurement done on winter contaminated runways should be treated with caution.

MAXIMUM CROSSWIND CONSIDERATION

The maximum crosswind value that the flight crew should retain is the one corresponding to the worse Landing Performance. This means that if the flight crew downgrades the Landing Performance Code - Level after considering additional information, they should also downgrade the maximum demonstrated crosswind value.

Note: *When assessing the maximum demonstrated crosswind value, the flight crew must take into account any available complementary information which is related to a possible degradation of the directional control of the aircraft.*

EXAMPLES OF LANDING PERFORMANCE CODE — LEVEL ASSESSMENT

RUNWAY CONTAMINATED BY COMPACTED SNOW, OAT -10 °C AND PIREP OR ESF MEDIUM

Compacted Snow at or below -15 °C is in the category GOOD TO MEDIUM, above -15 °C it becomes MEDIUM. The report Medium could originate from a PIREP or a friction measurement. This information indicates that the computation should be done with the Landing Performance 3 - MEDIUM and corresponding maximum crosswind condition must be retained.

RUNWAY COVERED BY LESS THAN 3 MM (1/8 INCH) OF WATER BUT HEAVY RAIN WITH STORM CELLS IN THE VICINITY ARE REPORTED

According to the matrix, the expected landing performance on a runway covered by less than 3 mm (1/8 inch) of water (runway is wet) is 5 - GOOD. However heavy rain can saturate the draining capabilities of the runway and lead to standing water. Standing water (more than 3 mm – 1/8 inch of water) is in the category 2 - MEDIUM TO POOR.
This information indicates that it may be appropriate to consider 2 - MEDIUM TO POOR Landing Performance and corresponding maximum crosswind condition must be considered.

RUNWAY COVERED BY TREATED ICE (COLD AND DRY) WITH AN ESTIMATED SURFACE FRICTION MEDIUM

Cold and dry ice is in the category 1 - POOR. However the reported surface friction is much better. This is actually the only case in which an upgrade of the landing performance may be performed by airport authority: if on treated cold and dry ice a surface friction better than Medium is measured on all three thirds of the runway, an upgrade to 3 - MEDIUM is allowed.

Obviously, this upgrade can only be done in an environment experienced in dealing with runway treatment, like Scandinavia, Alaska, Baltic countries...

NORMAL OPERATIONS

PRINCIPLE

In order to assess the landing performance without failure (or in the case of a failure that does not affect landing performance), the flight crew should follow the three main steps described below:

1. Determine the Landing Performance Code - Level using the RCAM,
2. Determine the VAPP by referring to the VAPP computation table without failure of the QRH,
3. Calculate the In-Flight Landing Distance with the In-Flight Landing Distance tables without failure of the QRH.

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VAPP DETERMINATION WITHOUT FAILURE

When the flight crew has determined the Landing Performance Code - Level using the RCAM (*Refer to SI-090 The Runway Condition Assessment Matrix (RCAM)*), they should determine the Approach Speed (VAPP).

GENERAL CONSIDERATIONS

The VAPP is defined by the flight crew to perform the safest approach. It is function of the aircraft landing weight, slats/flaps configuration, wind conditions, use of A/THR, icing conditions. In most cases, the FMGEC provides a correct VAPP value on the MCDU PERF APPR, when tower wind and FLAPS 3 or FLAPS FULL landing configuration have been inserted.
The flight crew can insert a lower VAPP in the MCDU PERF APPR, down to VLS , if landing is performed without A/THR , without wind and no ice accretion. 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 the MCDU PERF APPR 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 estimated 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 guidance, even when the VAPP has been manually inserted.
In 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 QRH TABLE TO DETERMINE THE VAPP WITHOUT FAILURE

VAPP Determination

The QRH provides the table for determining the VAPP without failure in the In-Flight Performance chapter.
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 depends on the A/THR, ice accretion condition or headwind component value.

VLS												
Weight (T)		40	42	46	50	54	58	62	66	70	74	78
VLS CONF FULL (kt) (=VREF)	CG < 25%	108	111	116	121	125	130	134	138	142	146	150
	CG ≥ 25%	106	109	114	119	123	128	132	136	140	144	148
VLS CONF 3 (kt)	CG < 25%	112	115	119	125	129	135	139	143	147	151	155
	CG ≥ 25%	110	113	117	123	127	133	137	141	145	149	153

+

APPRoach **COR**rection	
APPR COR = Highest 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 (excluding gust - maximum 15 kt)

⇩

VAPP
VAPP = VLS + APPR COR

<u>Note:</u> *This example illustrates the method to determine the VAPP. It is not customized to all aircraft configuration.*

<u>Landing distance correction</u>

If the APPRroach CORrection is greater than 1/3 of the headwind component, the flight crew must take into account the increase of the ground speed at touchdown in the in-flight landing distance computation by applying the SPD correction.

LANDING DISTANCE CORRECTION (**SPD** column in Landing Distance table)
• If APPR COR is equal to 1/3 Headwind component: **No SPD**
• If APPR COR is greater than 1/3 Headwind component: **SPD = APPR COR**

Any extra approach speed increment must be taken into account in the in-flight landing distance computation by applying the SPD correction.

IN-FLIGHT LANDING DISTANCE WITHOUT FAILURE

In order to determine the in-flight landing distance, the flight crew should refer to the in-flight landing distance tables of the QRH for the Performance Code - Level that they determined with the RCAM (6 - DRY, 5 - GOOD, 4 - GOOD TO MEDIUM, etc…).

REFERENCE DISTANCE (REF DIST)

The flight crew should determine the REF DIST depending on the landing configuration (CONF 3 or CONF FULL) and the braking mode (Maximum manual braking, Autobrake LOW or MED). The QRH provides REF DIST for a given aircraft landing weight (the Maximum Landing Weight (MLW) of the aircraft family), at sea level, in ISA conditions, no 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 REF DIST

When the REF DIST is determined, flight crew applies, when relevant, the corrections for each parameter having an effect on the in-flight landing distance:

- **WGT** : Weight correction to cover the difference between the actual landing weight and the reference weight used to provide REF DIST. This correction covers the impact on the VLS linked to the actual aircraft landing weight. The correction for a weight below the reference weight is provided at the bottom of the table
- **SPD** : Speed correction calculated during the VAPP determination,
- **ALT**: Airport Pressure Altitude correction,
- **WIND**: Tailwind component correction,
- **TEMP** : Temperature correction for temperatures above ISA condition,
- **SLOPE**: Downward slope correction of the runway,
- **REV**: Reverse thrust correction to take into account the benefit of each available thrust reverser (this correction considers maximum reverser thrust).
- **OVW:** Correction to be applied in the case of an overweight landing using the Overweight Landing Procedure. This correction takes into account the fact that the Overweight Landing procedure requests the pilot flying to “touchdown as smoothly as possible” and to apply brakes “after the nosewheel touchdown”.

<u>Note:</u> *In the case of an overweight landing, both the WGT and the OVW corrections should be applied:*

- *WGT correction to reflect the actual aircraft landing weight*
- *OVW correction to reflect the use of the Overweight Landing Procedure*

The QRH also provides the Automatic Landing Correction that should be applied when an automatic landing is performed.

<u>Note:</u> *Environment effects that reduce the in-flight landing distance (temperature below ISA , “uphill” slope) are not considered in the QRH tables.*

EXAMPLE OF LANDING PERFORMANCE ASSESSMENT WITHOUT FAILURE

The aim of this example is to illustrate the method to assess the landing performance. It is not customized to all aircraft configuration (landing weight, ...).

LANDING DATA

- **Aircraft:** A320
- **Runway Condition:** 2 mm of slush
- **Report:** Good to Medium
- **Runway Slope:** 1 % UP
- **Wind / OAT:** 12 kt headwind / -5 °C
- **Airport Pressure Altitude:** Sea Level
- **Estimated Landing Weight:** 62 t
- **Landing Configuration:** CONF FULL
- **Landing Technique:** Manual landing, A/THR ON
- **A/BRK:** MED
- **Thrust Reversers:** Use of all thrust reversers
- **Ice accretion:** No
- **CG:** 29 %

STEP 1: IDENTIFY THE LANDING PERFORMANCE CODE – LEVEL

2 mm of Slush **Good to Medium**

Runway Surface Conditions		Observations on Deceleration and Directional Control	Related Landing Performance		Maximum crosswind (Gust included)
Runway State or / and Runway Contaminant	**ESF* or PIREP****		**Code**	**Level**	
Dry	-	-	6	DRY	38kt
Damp Wet (3 mm (1/8") or less of water)	Good	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	5	GOOD	38kt
3 mm (1/8") or less of: • Slush • Dry Snow • Wet Snow Frost					29kt
Compacted Snow (OAT at or below -15°C)	Good to Medium	Braking deceleration and controllability is between Good and Medium.	4	GOOD TO MEDIUM	29kt
Dry Snow - between 3 mm (1/8") and 100 mm (4") Wet Snow - between 3 mm (1/8") and 30 mm (1 1/8") Compacted Snow (OAT above -15°C) Slippery when wet	Medium	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be reduced.	3	MEDIUM	
Water - between 3 mm (1/8") and 12.7 mm (1/2") Slush - between 3 mm (1/8") and 12.7 mm (1/2")	Medium to Poor	Braking deceleration and controllability is between Medium and Poor. Potential for Hydroplaning exists.	2	MEDIUM TO POOR	20kt
Ice (cold & dry)	Poor	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.	1	POOR	15kt
Wet ice Water on top of Compacted Snow Dry Snow or Wet Snow over ice	Nil	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	-	-	-

**ESF: Estimated Surface Friction **PIREP: Pilot Report of Braking Action*

STEP 2: DETERMINE THE VAPP

VAPP = VLS + APPR COR

VLS

Weight (T)		40	42	46	50	54	58	62	66	70	74	78
VLS CONF FULL (kt) (=VREF)	CG < 25%	108	111	116	121	125	130	134	138	142	146	150
	CG ≥ 25%	106	109	114	119	123	128	132	136	140	144	148
VLS CONF 3 (kt)	CG < 25%	112	115	119	125	129	135	139	143	147	151	155
	CG ≥ 25%	110	113	117	123	127	133	137	141	145	149	153

VLS (FULL, 62T) =132kt

+

APPRoach **COR**rection

APPR COR = Highest 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
  (excluding gust - maximum 15 kt)

APPR COR (A/THR) =5kt

⇩

VAPP

VAPP = VLS + APPR COR

VAPP = 137kt

⇩

LANDING DISTANCE CORRECTION (**SPD** column in Landing Distance table)

- If APPR COR is equal to 1/3 Headwind component: **No SPD**
- If APPR COR is greater than 1/3 Headwind component: **SPD = APPR COR**

SPD = APPR COR = 5kt

CAUTION	Any extra pilot approach speed increment must be added to VAPP, and must be taken into account in SPD column for Landing Distance computation.

Note: In case of strong or gusty crosswind greater than 20kt, VAPP should be at least VLS + 5 kt. The 5kt increment above VLS may be increased up to 15kt at the flight crew's discretion.

STEP 3: CALCULATE THE IN-FLIGHT LANDING DISTANCE

4- GOOD TO MEDIUM

Corrections on Landing Distance (m)			WGT (2)	SPD	ALT	WIND	TEMP	SLOPE	REV	OVW
Braking Mode	LDG CONF	REF DIST (m) for 66T	Per 10T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C above ISA	Per 1% down Slope	Per Thrust Reverser Operative	If OVW PROC applied
Maximum MANUAL	FULL	1 660	+ 40	+ 90	+ 60	+ 190	+ 60	+ 70	- 70	+ 690
	3	1 810	+ 40	+ 100	+ 70	+ 200	+ 60	+ 80	- 80	+ 840
AUTOBRAKE MED	FULL	1 720	+ 40	+ 90	+ 60	+ 200	+ 50	+ 70	- 90	+ 210
	3	1 870	+ 40	+ 100	+ 70	+ 200	+ 70	+ 90	-110	+ 210
AUTOBRAKE LOW	FULL	1 960	+ 40	+ 140	+ 70	+ 210	+ 70	+ 50	-20	+ 260
	3	2 100	+ 50	+ 140	+ 80	+ 220	+ 70	+ 60	-30	+ 290

(1) Automatic Landing correction: if CONF FULL,add 310m. If CONF 3, add 320m.
(2) Weight correction: if CONF FULL, subtract 10m per 1T below 66T. If CONF 3, subtract 20m per 1T below 66T.

REF DIST (66T) = 1720 m

WGT correction (62T) = -10 x 4 = - 40 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 = -90 x 2 = - 180 m

LD = 1590 m FLD = 1.15 x LD = 1829 m

ABNORMAL OPERATIONS

PRINCIPLE

In order to assess the landing performance in the case of a failure that affects landing performance (LDG DIST … PROC APPLY displayed on ECAM), the flight crew should follow the three main steps described below:

1. Determine the Landing Performance Code - Level using the RCAM,
2. Determine the VAPP by referring to the VAPP computation table with failure of the QRH,
3. Calculate the In-Flight Landing Distance with the In-Flight Landing Distance tables with failure of the QRH.

VAPP DETERMINATION WITH FAILURE

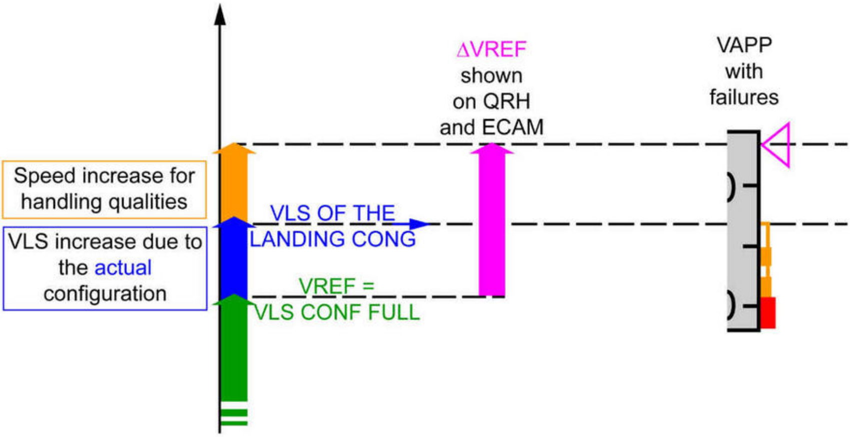
When the flight crew has determined the Landing Performance Code - Level using the RCAM (*Refer to SI-090 The Runway Condition Assessment Matrix (RCAM)*), they should determine the Approach Speed (VAPP).

GENERAL CONSIDERATIONS

Some failures affect the approach speed:

- Some failures (typically slats or flaps 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.

Speed increments on QRH , ECAM and PFD



In order to prepare the approach and landing, the flight crew needs to calculate the VAPP in advance. Because the landing configuration is not yet established, the appropriate VLS is not necessarily available at that time on the PFD.
VAPP is therefore determined from the reference speed (VREF) defined as the VLS in CONF FULL. As a general manner, the VAPP is the sum of VREF and of the effect of the failure on the reference speed (ΔVREF) and of the approach correction (APPR COR):

$$\boxed{\text{VAPP} = \text{VREF} + \Delta\text{VREF} + \text{APPR COR}}$$

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 (Not Applicable) in the in-flight 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 the table for determining the VAPP without failure in the In-Flight Performance chapter.
The flight crew should first determine the VREF as a function of the estimated aircraft weight at landing and of the landing configuration.

Then they should take into account the effect of the failure by referring to the applicable in-flight landing distance table which provides the ∆VREF for each failure.
Finally they should add the APPRoach CORrection which depends on ∆VREF , the A/THR, ice accretion condition or headwind component value.

Note: *This example illustrates the method to determine the VAPP. It is not customized to all aircraft configuration.*

Landing Distance correction

If the APPRroach CORrection is greater than 1/3 of the headwind component, the flight crew must take into account the increase of the ground speed at touchdown in the in-flight landing distance computation by applying the SPD correction.

LANDING DISTANCE CORRECTION (**SPD** column in Landing Distance table)
• If APPR COR is equal to 1/3 Headwind component: **No SPD** • If APPR COR is greater than 1/3 Headwind component: **SPD = APPR COR**

Any extra approach speed increment must be taken into account in the in-flight landing distance computation by applying the SPD correction.

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IN-FLIGHT LANDING DISTANCE WITH FAILURE

In order to determine the in-flight landing distance with failure, the flight crew should refer to the in-flight landing distance tables of the QRH for the aircraft system affected by the failure.
For each aircraft system, the QRH provides tables for the Performance Code - Level determined with the RCAM (6 - DRY, 5 - GOOD, 4 - GOOD TO MEDIUM, etc…).

REFERENCE DISTANCE (REF DIST)

For each recommended flaps lever position for landing, the tables provide, when relevant, the associated effect of the failure on the reference speed (∆VREF), which must be taken into account in the VAPP determination.
The QRH provides REF DIST for a given aircraft landing weight (the Maximum Landing Weight (MLW) of the aircraft family), at sea level, in ISA conditions, no wind, on runway with no slope, without reverse thrust, in manual landing, maximum manual braking and at a VAPP equal to the sum (VREF + ∆VREF).

CORRECTIONS TO BE APPLIED TO THE REF DIST

When the REF DIST is determined, flight crew applies, when relevant, the corrections for each parameter having an effect on the landing distance:

- **WGT** : Weight correction to cover the difference between the actual landing weight and the reference weight used to provide REF DIST. This correction covers the impact on the VLS linked to the actual aircraft landing weight. The correction for a weight below the reference weight is provided at the bottom of the table,
- **SPD** : Speed correction calculated during the VAPP determination,
- **ALT**: Airport Pressure Altitude correction,
- **WIND**: Tailwind component correction,
- **TEMP** : Temperature correction for temperatures above ISA conditions,
- **SLOPE**: Downward slope correction of the runway,
- **REV**: Reverse thrust correction to take into account the benefit of each available thrust reverser (considers maximum reverser thrust).
- **OVW**: Correction to be applied in the case of an overweight landing using the Overweight Landing Procedure. This correction takes into account the fact that the Overweight Landing procedure request the pilot flying to “touchdown as smoothly as possible” and to apply brakes “after the nosewheel touchdown”.

Note: *In the case of an overweight landing both the WGT and the OVW should be applied:*

- *WGT correction to reflect the actual aircraft landing weight.*
- *OVW correction to reflect the use of the Overweight Landing Procedure*

The QRH also provides the Automatic Landing Correction that should be applied when an automatic landing is performed.

Note: 1. *Environment effects that reduce the in-flight landing distance (temperature below ISA , "uphill" slope) are not considered in the QRH tables.*
2. *The REF DIST without failure is also provided at bottom of each table. It corresponds to the reference distance without failure configuration FULL. It enables flight crew to evaluate the impact on in-flight landing distance of a system failure (for more information,* *Refer to SI-090 Method to Determine Aircraft Performance at Landing with Several Failures)*

EXAMPLE OF LANDING PERFORMANCE ASSESSMENT WITH FAILURE

The aim of this example is to illustrate the method to assess the landing performance. It is not customized to all aircraft configuration (landing weight, A/BRK modes...).

LANDING DATA

- **Aircraft:** A320
- **Runway Condition:** Compacted Snow
- **Report:** Good
- **Runway Slope:** No Slope
- **Wind / OAT:** 12 kt headwind / -15 °C
- **Airport Pressure Altitude:** 1 000 ft
- **Estimated Landing Weight:** 66 t
- **In-Flight failure**: ENG 1 SHUTDOWN with ENG FIRE pb pushed
- **Landing Technique:** Manual landing, A/THR ON
- **Landing Configuration:** CONF FULL
- **Thrust Reversers:** Use of all available thrust reversers
- **Ice accretion:** Yes
- **CG:** 29 %

STEP 1: IDENTIFY THE LANDING PERFORMANCE CODE - LEVEL

Compacted Snow
OAT -15°C

Good

Runway Surface Conditions		Observations on Deceleration and Directional Control	Related Landing Performance		Maximum Crosswind (Gust included)
Runway State or / and Runway Contaminant	**ESF* or PIREP****		**Code**	**Level**	
Dry	-	-	6	DRY	38kt
Damp Wet (3 mm (1/8") or less of water)	Good	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	5	GOOD	38kt
3 mm (1/8") or less of: • Slush • Dry Snow • Wet Snow Frost					29kt
Compacted Snow (OAT at or below -15°C)	Good to Medium	Braking deceleration and controllability is between Good and Medium.	4	GOOD TO MEDIUM	29kt
Dry Snow - between 3 mm (1/8") and 100 mm (4") Wet Snow - between 3 mm (1/8") and 30 mm (1 1/8") Compacted Snow (OAT above -15°C) Slippery when wet	Medium	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be reduced.	3	MEDIUM	25kt
Water - between 3 mm (1/8") and 12.7 mm (1/2") Slush - between 3 mm (1/8") and 12.7 mm (1/2")	Medium to Poor	Braking deceleration and controllability is between Medium and Poor. Potential for Hydroplaning exists.	2	MEDIUM TO POOR	20kt
Ice (cold & dry)	Poor	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.	1	POOR	15kt
Wet ice Water on top of Compacted Snow Dry Snow or Wet Snow over ice	Nil	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	-	-	-

**ESF: Estimated Surface Friction **PIREP: Pilot Report of Braking Action*

STEP 2: DETERMINE THE VAPP

Corrections on Landing Distance (m)				WGT[2]	SPD	ALT	WIND	TEMP	SLOPE	REV	OVW
FAILURE	FLAPS LEVER for LDG	ΔVREF	REF DIST (m) for 66T	Per 10T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C above ISA	Per 1% down Slope	Per Thrust Reverser Operative	If OVW PROC applied
SHUTDOWN with ENG FIRE pushbutton pushed and Ice Accretion	FULL	10	1 810	+ 40	+ 100	+ 70	+ 190	+ 70	+ 80	- 80	+ 52
	3	16	1 980	+ 40	+ 100	+ 70	+ 190	+ 70	+ 80	- 90	+ 660

VAPP = VREF + ΔVREF + APPR COR

VREF

Weight (T)		40	42	46	50	54	58	62	66	70	74	78
VREF = VLS CONF FULL (kt)	CG < 25%	108	111	116	121	125	130	134	138	142	146	149
	CG ≥ 25%	106	109	114	119	123	128	132	136	140	144	147

VREF (66T) =136kt

+

ΔVREF

Refer to the applicable Landing Distance table

ΔVREF = 10kt

+

APPRoach **COR**rection

ΔVREF ≤ 10 kt	APPR COR= Highest 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 (excluding gust - maximum 15 kt) *APPR COR + ΔVREF must be limited to 20kt*
10 kt < ΔVREF < 20 kt	APPR COR = 1/3 Headwind component (excluding gust - maximum 10 kt) *APPR COR + ΔVREF must be limited to 20kt*
ΔVREF ≥ 20 kt	APPR COR = 0kt *N/A displayed in the SPD column of the Landing Distance table*

APPR COR (A/THR) = 5kt

VAPP

VAPP = VREF + ΔVREF + APPR COR

VAPP = 151kt

LANDING DISTANCE CORRECTION (**SPD** column in Landing Distance table)

- If APPR COR is equal to 1/3 Headwind component: **No SPD**
- If APPR COR is greater than 1/3 Headwind component: **SPD = APPR COR**

SPD = APPR COR = 5kt

STEP 3: CALCULATE THE IN-FLIGHT LANDING DISTANCE

ENGINE SYSTEM

4- GOOD TO MEDIUM

Corrections on Landing Distance (m)				WGT[2]	SPD	ALT	WIND	TEMP	SLOPE	REV	OVW
FAILURE	FLAPS LEVER for LDG	ΔVREF	REF DIST (m) for 66T	Per 10T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C above ISA	Per 1% down Slope	Per Thrust Reverser Operative	If OVW PROC applied
SHUTDOWN with ENG FIRE pushbutton pushed and Ice Accretion	FULL	10	1 810	+ 40	+ 100	+ 70	+ 190	+ 70	+ 80	- 80	+ 52
	3	16	1 980	+ 40	+ 100	+ 70	+ 190	+ 70	+ 80	- 90	+ 660

FLAPS LEVER for LDG : CONF FULL
REF DIST (66T) = 1810 m
Weight correction (66T) : NO CORRECTION
SPD correction (SPD = 5kt) = + 100 m
ALT correction (1000ft) = + 70 m
REV correction = -80 m
LD = 1900 m FLD = 1.15 x LD = 2185 m

METHOD TO DETERMINE AIRCRAFT PERFORMANCE AT LANDING WITH SEVERAL FAILURES

Due to the low probability of having several in-flight failures leading to an increase of the landing distance, the Airbus Operational Documentation does not address the combination of in-flight failures of different systems (however, dual hydraulic, dual electrical... are covered).
Whereas the probability of having several in-flight failures leading to an increase of the in-flight landing distance is low, the combinations of MEL item(s) that lead(s) to a landing performance impact only when combined to specific single in-flight failure is probable. The method described below provides a method to assess landing distance, in case of multiple failures.

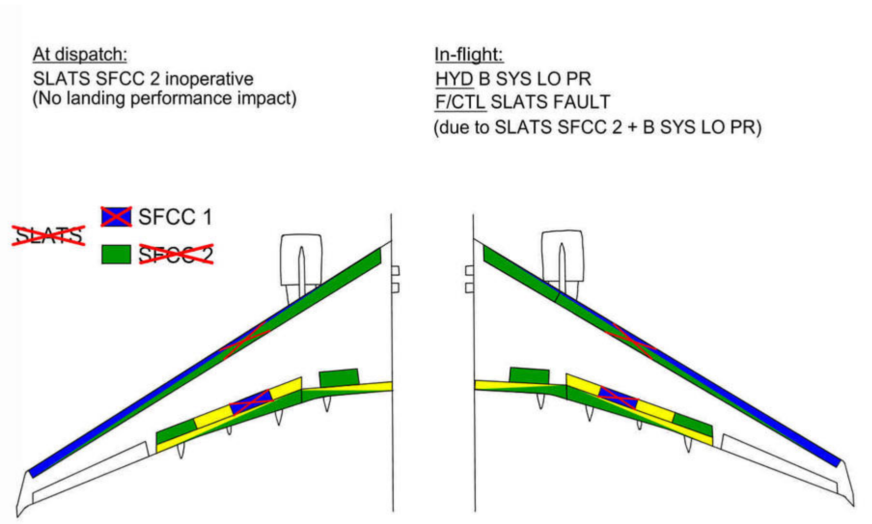
EXAMPLE

The aim of this example is to illustrate the method to assess the landing performance in the case of several failures due to dispatch under MEL. It is not customized to all aircraft configuration (flight control and hydraulic systems architecture, landing weight...).

In this example we consider an A320 dispatched under MEL with the slats channel of the SFCC 2 inoperative (the redundancy of the slats control is lost but no landing performance impact).

In-flight (cruise), the HYD B SYS LO PR triggers (B RSVR LO LVL). Landing performance is impacted as SPLR 3 is inoperative. In addition, due to the fact that the aircraft was dispatched under MEL with the slats channel of the SFCC 2 inoperative, F/CTL SLATS FAULT (S<1) also triggers which has a supplementary landing performance impact (in addition to the loss of SPLR 3).

A320 example of several failures

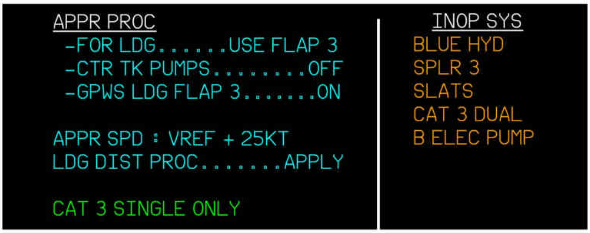


LANDING DATA

- **Aircraft:** A320
- **Landing Performance level:** DRY
- **Conditions:** ISA Conditions, No wind, No slope
- **Estimated Landing Weight:** 62 t
- **Landing Technique:** Manual landing, A/THR ON
- **Thrust Reversers:** Use of all available thrust reversers

FLAPS LEVER POSITION FOR LANDING

The ECAM status page indicates the required flaps lever position for landing if the failure requests it.



If there are no ECAM instructions, the flaps lever position for landing is at flight crew's discretion.

VAPP

Determine the VAPP using the highest ∆VREF

SLATS AND FLAPS SYSTEM

6 - DRY												
Corrections on Landing Distance (m)					WGT [(2)]	SPD	ALT	WIND	TEMP	SLOPE	REV	OVW
FAILURE		FLAPS LEVER for LDG	ΔVREF	REF DIST (m) for 66T	Per 10T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C above ISA	Per 1% down Slope	Per Thrust Reverser Operative	If OVW PROC applied
SLATS FAULT	SLATS < 1	3	25	**1 500**	+ 50	N/A	+ 50	+ 130	+ 50	+ 30	- 20	+ 660
	1 ≤ SLATS ≤ 3	3	10	**1 280**	+ 50	+ 80	+ 50	+ 120	+ 50	+ 30	- 20	+ 850
	SLATS > 3	3	5	**1 220**	+ 40	+ 80	+ 50	+ 130	+ 40	+ 30	- 10	+ 930

HYDRAULIC SYSTEM

6 - DRY											
Corrections on Landing Distance (m)				WGT [(2)]	SPD	ALT	WIND	TEMP	SLOPE	REV	OVW
FAILURE	FLAPS LEVER for LDG	ΔVREF	REF DIST (m) for 66T	Per 10T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C above ISA	Per 1% down Slope	Per Thrust Reverser Operative	If OVW PROC applied
B SYS LO PR	FULL	0	**1 140**	+ 40	+ 70	+ 40	+ 130	+ 40	+ 20	- 10	+ 780
	3	6	**1 230**	+ 50	+ 80	+ 40	+ 120	+ 50	+ 30	- 20	+ 930

In this example, ΔVREF = 25 kt must be used to determine VAPP.

VAPP = VREF + ΔVREF + APPR COR

VREF												
Weight (T)		40	42	46	50	54	58	62	66	70	74	78
VREF = VLS CONF FULL (kt)	CG < 25%	108	111	116	121	125	130	134	138	142	146	149
	CG ≥ 25%	106	109	114	119	123	128	132	136	140	144	147

VREF (62T) =132kt

+

ΔVREF
Refer to the applicable Landing Distance table

ΔVREF = 25kt

+

APPRoach CORrection	
ΔVREF ⩽ 10 kt	APPR COR= Highest 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 (excluding gust - maximum 15 kt) } *APPR COR + ΔVREF must be limited to 20kt*
10 kt < ΔVREF < 20 kt	APPR COR = 1/3 Headwind component (excluding gust - maximum 10 kt) *APPR COR + ΔVREF must be limited to 20kt*
ΔVREF ⩾ 20 kt	APPR COR = 0kt *N/A displayed in the SPD column of the Landing Distance table*

APPR COR = 0kt

⇩

VAPP
VAPP = VREF + ΔVREF + APPR COR

VAPP = 157kt

⇩

LANDING DISTANCE CORRECTION (**SPD** column in Landing Distance table)
• If APPR COR is equal to 1/3 Headwind component: **No SPD**
• If APPR COR is greater than 1/3 Headwind component: **SPD = APPR COR**

SPD = APPR COR = 0kt

In this example, VAPP = 157 kt and SPD = 0 kt.

DETERMINE THE LANDING DISTANCE (LDG DIST) OF THE FAILURE THAT HAS THE MOST EFFECT

To determine LDG DIST, identify the failure having the longest REF DIST, then calculate the landing distance for this failure taking into account all corrections as necessary. The method to calculate the landing distance is unchanged.
In this example, the failure that has the most effect is the F/CTL SLATS FAULT (S<1)

SLATS AND FLAPS SYSTEM													
6 - DRY													
Corrections on Landing Distance (m)					WGT(2)	SPD	ALT	WIND	TEMP	SLOPE	REV	OVW
FAILURE		FLAPS LEVER for LDG	ΔVREF	REF DIST (m) for 66T	Per 10T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C above ISA	Per 1% down Slope	Per Thrust Reverser Operative	If OVW PROC applied
SLATS FAULT	SLATS < 1	3	25	1 500	+ 50	N/A	+ 50	+ 130	+ 50	+ 30	- 20	+ 660
	1 ≤ SLATS ≤ 3	3	10	1 280	+ 50	+ 80	+ 50	+ 120	+ 50	+ 30	- 20	+ 850
	SLATS > 3	3	5	1 220	+ 40	+ 80	+ 50	+ 130	+ 40	+ 30	- 10	+ 930

(1) Automatic Landing correction: add 160m - (2) Weight correction: subtract 10m per 1T below 66T

REF DIST without failure (valid for all FLAPS LEVER positions) = 1 090m

REF DIST (66T) = 1500 m

WGT correction = -10 x 4 = -40 m

REV correction = - 20 x 2 = -40 m

LDG DIST = 1420 m

In this example, LDG DIST = 1 420 m

DETERMINE THE EFFECT OF THE OTHER FAILURE (ΔLD)

To determine the effect of the other failure ΔLD, compare the REF DIST of the other failure (Use the FLAPS lever position selected for landing. If not available, use FLAPS 3) to the REF DIST with no failure that is provided at bottom of the landing distance tables.

In this example, the other failure is the HYD B SYS LO PR

HYDRAULIC SYSTEM											
6 - DRY											
Corrections on Landing Distance (m)				WGT(2)	SPD	ALT	WIND	TEMP	SLOPE	REV	OVW
FAILURE	FLAPS LEVER for LDG	ΔVREF	REF DIST (m) for 66T	Per 10T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10°C above ISA	Per 1% down Slope	Per Thrust Reverser Operative	If OVW PROC applied
B SYS LO PR	FULL	0	1 140	+ 40	+ 70	+ 40	+ 130	+ 40	+ 20	- 10	+ 780
	3	6	1 230	+ 50	+ 80	+ 40	+ 120	+ 50	+ 30	- 20	+ 930

(1) Automatic Landing correction: add 170 -(2) Weight correction: subtract 10m per 1T below 66T

REF DIST without failure (valid for all FLAPS LEVER positions) = 1 090m

ΔLD = REF DIST with failure − REF DIST without failure = 140 m

In this example, ΔLD = 1230 - 1090 = 140 m.

DETERMINE THE LANDING DISTANCE WITH SEVERAL FAILURES (LD)

To determine the landing distance with several failures LD , add the landing distance calculated from the failure with the greatest impact LDG DIST to the effect of the other failure ΔLD.
In this example, LD = LDG DIST + ΔLD = 1420 + 140 = 1 560 m.
In this example, FLD = 1.15 x 1560 = 1 794 m.
The flight crew must also multiply the FLD by the landing penalty factor specified in the MEL, if any.

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GENERAL

The aim of this section is to introduce the Green Operating Procedures (GOP) and to advise operators that Airbus offers a number of fuel-saving procedures.
The operator is responsible for the decision to use these procedures.

DISPATCH

FUEL QUANTITY

The flight crew must determine and monitor the necessary fuel quantity at departure, from accurate and consistent data (weather, performance factor, optimum flight level, average wind speed, etc.)
The weight of any extra fuel will increase fuel consumption.

TAKEOFF CONFIGURATION

Fuel reduction is not a factor for the selection of a takeoff configuration.
The takeoff performance and best takeoff configuration depend on several operational and environmental factors. Select the takeoff configuration that:

- Optimizes takeoff performance (takeoff weight, etc.)
- If possible, increases flexible temperature
- Reduces takeoff speed (higher configuration for a given flexible temperature).

A more extended slats and flaps configuration slightly increases fuel consumption, but with a higher flexible temperature increases cost reduction.

TAKEOFF THRUST

When performance permits, use the highest flexible temperature for takeoff.
Takeoff with Flexible Thrust increases fuel consumption compared to takeoff with TOGA thrust, due to the longer takeoff phase. But the use of flexible thrust reduces engine wear and reduces general costs.

EXTERNAL WALKAROUND

During the external inspection, the flight crew should pay attention to defects that may increase aerodynamic drag, e.g. :

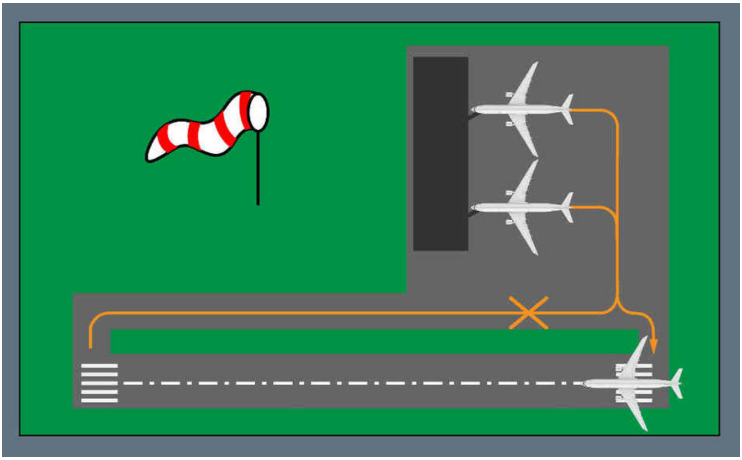
- Mismatch of aircraft fuselage panels
- Flight control surfaces not correctly aligned
- Worn seals on the airframe
- Peeling paint
- Dirt on the aircraft.

COCKPIT PREPARATION

TAKEOFF RUNWAY OPTIMIZATION

The takeoff performance is the first factor to consider in the selection of the takeoff runway. When possible, the flight crew should request takeoff on the runway that minimizes the taxi time and optimizes the departure trajectory, in order to minimize the flight time.

Takeoff runway optimization



BEFORE PUSHBACK OR START

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Applicable to: ALL

PUSHBACK/START CLEARANCE

When conditions and ATC permit, the flight crew should delay the engine start as long as possible. This is to reduce time spent with the engines running before takeoff.

Before any takeoff, the flight crew must ensure engine warm-up, in order to prevent engine wear, and to maintain engine performance.

AFTER START

APU

The flight crew may use APU bleed during taxi phase.
If the APU is necessary during or after taxi (e.g. when takeoff performance requires APU bleed), the flight crew may select APU bleed, in order to reduce engine idle thrust and minimize fuel consumption. However, if the APU is not necessary during or after the taxi phase, it is better to shutdown the APU and to use engine bleeds.
In this case, the engines (with the engine bleeds set to ON) use less fuel than the APU (with the APU bleed set to ON).

TAXI

THRUST MANAGEMENT

Idle thrust is sufficient to move a light aircraft during taxi. If necessary, the flight crew should apply a small thrust increase.
Excessive thrust burns more fuel, requires more brake applications, and results in an increase of brake wear.

BEFORE TAKEOFF

AIR CONDITIONING

Before takeoff, the flight crew can set both PACKs to OFF, in order to:

- Reduce fuel consumption
- Improve performance
- reduce EGT during takeoff, to reduce engine maintenance costs.

LANDING RUNWAY OPTIMIZATION

When landing performance permits, the flight crew should ask ATC to land on the runway that minimizes approach and/or taxi time.

LANDING PREPARATION

To determine the aircraft configuration, autobrake mode, and use of reverse thrust during landing, the flight crew should consider several factors, for example:

- Runway length and state
- Aircraft weight
- Weather conditions
- Runway exit.

Another factor to consider is the brake oxidation, which may be severe in some combinations of the autobrake setting and the reverse thrust:

Brake oxidation for given combination of autobrake and reverse thrust.

		Autobrake Low	Autobrake MED
Conf FULL	Reverse MAX	No Risk	Low Risk
	Reverse IDLE	Low Risk	Risk
Conf 3	Reverse MAX	No Risk	Low Risk
	Reverse IDLE	Risk	High Risk

AFTER LANDING

APU

When both engines are running during taxi-in, the use of the APU is not necessary.

- If electrical supply and/or air supply are available at the gate, the flight crew may keep the APU stopped after landing and during transit.
- If only air supply is available at the gate, the flight crew may keep the APU bleed OFF during transit.
- If neither electrical supply nor air supply are available at the gate, the flight crew may delay the start of APU as long as possible.

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RADIUS TO FIX (RF) LEGS

GENERAL

An RF leg is an arc of circle with a fixed radius coded in the Navigation Data Base. The rounded value of the radius is displayed on the MCDU FLIGHT PLAN page and is called ARC value.

USE OF AP/FD

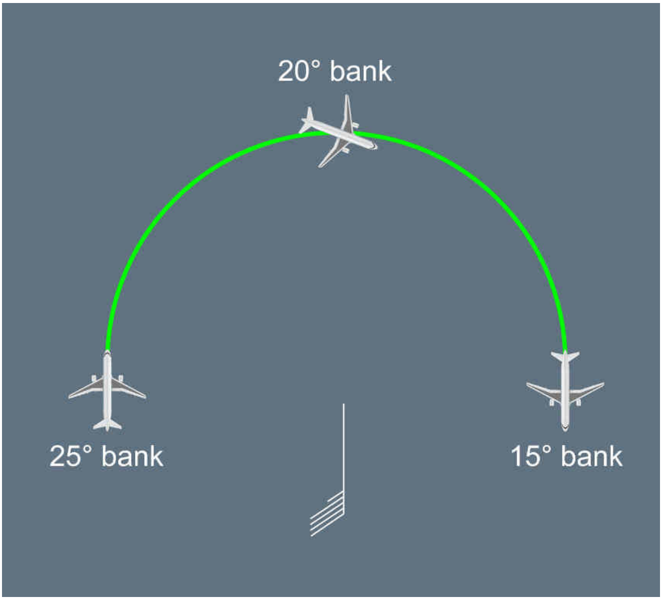
Depending on the RNP operations, use of the FD s or the AP /FD may be mandatory.

SPEED MANAGEMENT ALONG RF LEGS

When flying an RF leg, the FMS adapts the bank angle to fly the arc. The bank angle is a function of the ground speed.
If the ground speed is excessive, the requested bank angle to follow the trajectory can be higher than the maximum bank angle permitted by the Flight Guidance (FG) system (30 ° in normal conditions). In this case the aircraft will overshoot the trajectory.

Therefore, to fly RF legs, the flight crew should be aware of the following operational recommendations:
- Respect speed constraints on RF legs. Use managed speed.
- Pay attention to strong winds, particularly to high tailwinds that increase the ground speed
- Monitor the bank angle, particularly when near 30 ° (i.e. the maximum bank angle with the AP /FD engaged).

Variation of the bank angle due to the wind in RF legs

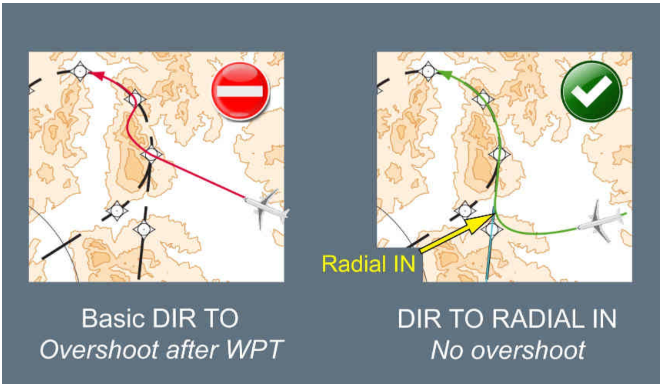


GO-AROUND DURING RF LEG

When the flight crew selects TOGA thrust, particularly in a turn, they must check that the NAV mode immediately engages in order to stay on the desired track.
If NAV mode does not automatically engage, the flight crew must manually engage it.

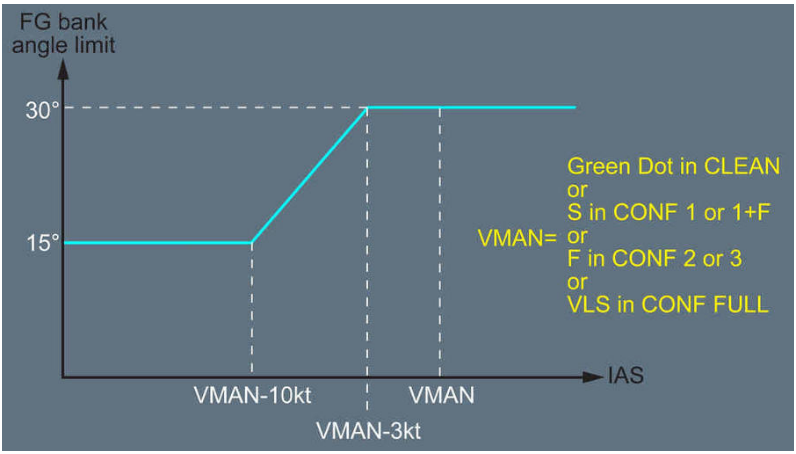
USE OF THE DIR TO FUNCTION

In flight, the flight crew must use the DIR TO function only above the MSA.
The flight crew must use the RADIAL IN function when performing a DIR TO towards a waypoint followed by a RF leg. This enables the alignment of the aircraft with the subsequent RNP F-PLN track.
The flight crew must not descend below the MSA until the aircraft is established on the F-PLN leg.



ENGINE-OUT CONSIDERATIONS

The bank angle limit of the FG is 30 ° with one engine inooperative, when NAV, APP NAV, or FINAL APP modes are engaged.
With one engine inoperative, the bank angle limit of the FG may be lower than 30 ° when the IAS is lower than the maneuvering speeds ("F", "S", or "Green Dot" speed, depending on the flap configuration). The bank angle limit of the FG depends on the IAS as illustrated on the following graph:



During go-around or departure with one engine inoperative, the IAS may be lower than the current maneuvering speed, which will limit the bank angle.

The flight crew must be aware that during acceleration, flaps retraction at the usual speeds (F, then S speed) may affect the turn radius capability and be incompatible with the procedure being flown.

PREVENTING IDENTIFIED RISKS

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PIR-010 PREVENTING IDENTIFIED RISKS

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PREVENTING IDENTIFIED RISKS

INTRODUCTION

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

Flight Phase	Risk	Consequences		Refer toFCTM
PREP	During Exterior Walk-Around, the flight crew does not check that the fan cowl doors are properly closed and latched.	- In-flight loss of the fan cowl doors - Structural damage to the aircraft - Danger to people on ground		*Refer to NO-020 EXTERIOR INSPECTION*
COCKPIT PREP	The flight crew does not correctly adjust the outer ring of the ND brightness knob to the maximum.	The flight crew awareness of the weather and the terrain will be reduced in flight.	NAV	
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 PREP	During descent preparation the flight crew does not properly insert / check the QNH and TEMP in the PERF APPR Page.	If the QNH is not correct, the Cabin Pressure Control (CPC) computes erroneous cabin pressurization segment, that may trigger pressurization related ECAM alert leading to undue emergency descent.		FCOM DSC 22_20_50_10 PERF APPR PAGE
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*

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PREVENTING IDENTIFIED RISKS

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Flight Phase	**Risk**	**Consequences**	**Refer toFCTM**
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	*Refer to NO-010 COMMUNICATION*
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	*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	*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	*Refer to NO-120 FINAL APPROACH*
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-130 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*

PREVENTING IDENTIFIED RISKS

SYSTEM OPERATIONS / FAILURES

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)*
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)*
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		*Refer to NO-130 Intermediate Approach*
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)		

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PREVENTING IDENTIFIED RISKS

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ATA	Risk	Consequences	Csqce type	Refer to FCTM
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 FAILURE AFTER V1*
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 FAILURE 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*

PREVENTING IDENTIFIED RISKS

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