Safety first

The Airbus Safety **Magazine**

Edition July 2011

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Issue **12**

AIRBUS

Safety First

The Airbus Safety Magazine
For the enhancement of safe flight through increased knowledge and communications

Safety First is published by the Flight Safety Department of Airbus. It is a source of specialist safety information for the restricted use of flight and ground crew members who fly and maintain Airbus aircraft. It is also distributed to other selected organisations.

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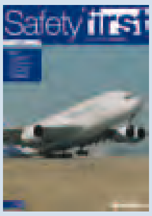

A380
VMU test

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Yannick MALINGE
Chief Product Safety Officer

Editorial

Dear Customers and Aviation Safety Colleagues,

The recent Airbus Flight Safety Conference in Rome concentrated on two recurrent industry topics: Go Around and circling approach. There were fruitful exchanges of views among participants on these generic themes.

The Safety First issue n°10, dated August 2010, included an article on Go Around handling. It concentrated on the correct execution of the maneuver. This issue takes a wider view on the procedure itself, from the Go Around preparation to the PNF's actions and responsibility, describing traps like the false climb illusion.

Circling approaches are challenging maneuvers. In addition they are rarely executed. This magazine includes a paper, which describes the procedures and makes recommendations on how to apply them.

We already announced a new generic standard for assessing landing distance in-flight: the Operational Landing Distance (OLD). As a reminder, this new method is part of the industry effort to help further reduce the runway overruns at landing. It is now entering its implementation phase: the following pages provide a summary of the new Airbus' operational documentation for OLD.

Last but not least, this issue builds on the previous two publications, which featured insights into Airbus test flights, with articles on flutter tests and minimum control speeds computation. You will now be introduced to the determination of the Velocity Minimum Unstick (VMU).

Enjoy your reading !

Yannick MALINGE
Chief Product Safety Officer

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Nils FAYAUD
Director Product Safety Information

Information

Magazine distribution

If you wish to subscribe to Safety First, please fill out the subscription form that you will find at the end of this issue.

Please note that the paper copies will only be forwarded to professional addresses.

Your articles

As already said, this magazine is a tool to help share information.

We would appreciate articles from operators, that we can pass to other operators through the magazine.

If you have any inputs then please contact Nils Fayaud at:

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Safety Information on the Airbus websites

On the AirbusWorld website we are building up more safety information for you to use.

The present and previous issues of Safety First can be accessed to in the Flight Operations Community- Safety and Operational Materials portal-, at **https://w3.airbusworld.com**

Other safety and operational expertise publications, like the Getting to Grips with…brochures, e-briefings etc…are regularly released as well in the Flight Operations Community at the above site.

If you do not yet have access rights, please contact your IT administrator.

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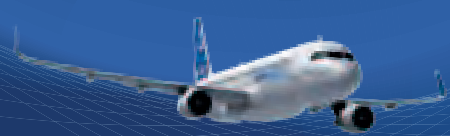
17th Flight safety conference
Rome, 21-24 March 2011

The presentations made during our last event in Rome will shortly become available on our AirbusWorld web site, in the Flight Operations Community- Conferences portal. (**https://w3.airbusworld.com**).



News SAVE THE DATE

18th Flight safety conference
Berlin, 19-22 March 2012

We are pleased to announce that the 18th Flight Safety Conference will take place in Berlin, Germany, from the 19th to the 22nd of March 2012. The formal invitations with information regarding registration and logistics, as well as the preliminary agenda will be sent to our customers in December.

The Flight Safety Conference provides an excellent forum for the exchange of information between Airbus and customers. The event is a dedicated forum for all Airbus operators. We do not accept outside parties. This ensures that we can have an open dialogue to promote flight safety across the fleet.

As always we welcome presentations from you, the conference is a forum for everybody to share information.
If you have something you believe will benefit other operators and/or Airbus or need additional invitations or information, please contact Nuria Soler at:
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Lars KORNSTAEDT
Performance Expert, Flight Operations Support

Airbus New Operational Landing Distances

1. Introduction

The Operational Landing Distances (OLD) were described in an article titled "Operational Landing Distances - A New Standard for In-Flight Landing Distance Assessment" published in the tenth issue of Safety First, dated August 2010. This new standard is the outcome of the FAA Takeoff and Landing Performance Assessment Aviation Rulemaking Group (TALPA ARC), and considered a strong industry consensus. The article concluded that Airbus supported the OLD concept and would anticipate FAA rulemaking by providing operational documentation and computation tools to customers in the course of this year.

This paper describes the way the OLDs will be published from the end of the year by Airbus. Airlines should start planning the integration into their operations, especially concerning publication of the information and training of the concerned personnel.

2. Major Conceptual Changes

The TALPA ARC rulemaking recommendations to the FAA are a tightly integrated package of three sets of regulation proposals:

► To AIRPORTS, on the runway condition assessment and reporting mechanisms,

► To AIRCRAFT MANUFACTURERS, on the publication of in-flight landing performance assessment data,

► To OPERATORS, on the time of arrival assessment.

Airbus is tackling the adaptation of its ground and on-board performance computation tools, and of the operational documentation to comply with the principles set down in the proposals. They will as well recommend best practices to their customers on how to use this information and take most advantage of the concept.

However, the regulatory framework for the OLD concept is not in place yet, even under FAA rule. The major consequence is that the use of the OLDs has to fit into an environment where runway condition reporting practices will not necessarily comply with the recommendations.

Another aspect is that the new in-flight performance assessment may, under some conditions, be more constraining than currently applicable dispatch requirements. This is especially true under JAR/EASA rule. As a result, a runway that is dispatched to according to the current factored Available Landing Distances (ALDs) requirement may, as soon as the aircraft leaves the ground, become inappropriate according to the OLDs.

Airlines will have to put into place policies and training to enable crews to compensate for these shortcomings, until the rulemaking processes that have been initiated by FAA, ICAO and EASA come to fruition.

3. The Matrix

The Runway Condition Assessment Table is the cornerstone of the OLD concept. It provides a mechanism for mitigation of a number of real-life risks associated with performance computations based on contaminant type and depth only. These risks include:

► Disregard or wrong interpretation by the flight crew of reports of runway contaminants not covered in the performance computation options, like frost/rime or slippery when wet .

► Disregard or wrong interpretation by the flight crew of reported estimated friction or braking action (Pilot Report).

► Contaminant phase change around freezing point.

► Layered contaminants.

► Rapid change in conditions under active precipitation.

The TALPA ARC runway condition reporting process intends to cover a maximum of possible conditions, and to make a safe report to flight crew by considering all information that may be available. This does not mean that credit of accuracy is given to the subjective assessment made by a preceding pilot or to a continuous friction measurement, for which the lack of correlation with aircraft performance has been extensively discussed over the years. However, the indicators given by such information, when available, should be used to downgrade a primary assessment made on the basis of the contaminant type and depth.

Code	Runway Condition Description	Deceleration and Directional Control Observation	Reported Braking Action
6	Dry		Dry
5	Wet • Water up to 1/8" (3mm) • Damp *1/8" (3mm) or less of* • Slush • Dry Snow • Wet Snow	Braking deceleration is normal for the wheel braking effort applied. Directional control is normal.	Good
4	Frost Compacted Snow ***(OAT at or below -15ºC)***	Brake deceleration and controllability is between Good and Medium.	Good to Medium
3	Slippery when wet ***More than 1/8"(3mm)*** • Dry Snow – max 5" (130mm) • Wet Snow – max 1 1/8" (30mm) Compacted Snow ***(OAT above -15ºC)***	Braking deceleration is noticeably reduced for the wheel braking effort applied. Directional control may be noticeably reduced.	Medium
2	***More than 1/8" (3mm)*** • Water – max 1/2" (12.7mm) • Slush – max 1/2" (12.7mm)	Brake deceleration and controllability is between Medium and Poor. Potential for hydroplaning exists.	Medium To Poor
1	Ice ***(cold & dry)***	Braking deceleration is significantly reduced for the wheel braking effort applied. Directional control may be significantly reduced.	Poor
0	• Wet Ice • Water on top of Compacted Snow • Dry Snow or Wet Snow over Ice	Braking deceleration is minimal to non-existent for the wheel braking effort applied. Directional control may be uncertain.	Nil

Figure 1
TALPA ARC runway condition matrix

In fact, as long as international standards do not exist for the airports to fulfill their role in the TALPA ARC system, the flight crew will have to do their best, from their imperfect vantage point in the cockpit, to make a full runway condition assessment with all the information they have at their disposal without being able to inspect the runway themselves. This is a compulsory first step in performing the time-of-arrival performance computation, more so since Airbus has decided to present landing distances against the 6 operable levels of Reported Braking Action (RBA) that make up the matrix.

4. Implementation

4.1. Certified Airplane Flight Manual (AFM)

The Operational Landing Distances are purely advisory and do not have an impact on aircraft certification. However, since the OLDs are a new reference for in-flight landing performance assessment, Airbus has decided to use this reference under all circumstances, including when a system failure has occurred during the flight, which affects approach speed and/or landing distance. This information is subject to approval by the authorities, and the OLD concept will thus find its way into the AFM in this area. We have taken this opportunity to move it into the digital AFM, thus permitting optimized computations for failure situations, including in case of multiple failures.

4.2. Documentation

Airbus currently publishes the certified Actual Landing Distances (ALDs) in the Quick Reference Handbook (QRH) and the Flight Crew Operating Manual (FCOM). The ALDs serve as a basis for in-flight landing distance assessments both without and with in-flight system failures. The shortcomings of this policy were described in depth in the previously mentioned article published in Safety First n°10.

The switch to the OLDs for the assessment at time-of-arrival involves a number of changes to the Airbus operational documentation: FCOM, QRH and also FCTM (Flight Crew Training Manual) for background explanation and examples.

Perhaps unexpectedly, these changes also concern the dispatch information, which must be derived by the user from the ALD by applying the appropriate factors. To allow complete removal of the ALD tables, it is thus necessary to switch to a publication of Required Landing Distances (RLD) that are already factored.

A major change in publication practices is the replacement of corrections for variations from reference conditions as increments in meters rather than in percent. This allows a more straightforward computation by the flight crew.

Notably, the RLDs are shown against the usual runway description terms of contaminant type, since this data is certified and must follow existing JAR/EASA regulation. Conversely, the OLDs will be shown against the Reported Braking Action (RBA) terms of Dry, Good, Good to Medium, Medium, Medium to Poor and Poor to allow the full benefit of the matrix used in reporting runway condition.

For each of the RBA, two consecutive tables for both certified landing configurations will show all required information for:

- Manual and automatic landing
- Manual and automatic braking
- Normal and overweight landing.

On top of the usual parameters, the new OLD will include accountability for outside temperature and runway slope, in full compliance with the recommendations formulated by the TALPA ARC.

The use of these tables will be associated to a new and simplified flow chart for approach speed determination. This will take into account the appropriate requirements

Required Landing Distances (m)

Runway state / Weight (1000 kg)	Dry	Wet	Compacted snow	Slush	Water
46	1170	1340	1370	1360	1410
50	1220	1400	1450	1450	1500
54	1270	1460	1540	1540	1590
58	1330	1530	1620	1630	1690
62	1390	1600	1700	1730	1820
66	1510	1730	1780	1820	1950

Figure 2
Required Landing Distances (RLDs) table

Corrections on landing distances (m)

Runway state		Dry	Wet	Compacted snow	Slush	Water
Altitude	Per 1000ft above SL	+ 60	+ 60	+ 80	+ 110	+ 40
VAPP	Per 5 kt	+ 90	+ 110	+ 90	+ 100	+ 110
Wind	Per 5 kt TW	+ 280	+ 320	+ 280	+ 380	+ 440
REV	all reversers operative	-	-	-140	-140	-160

Figure 3
RLDs correction table

Figure 4
Operational Landing Distances (OLDs) table

GOOD

CONF FULL

Corrections on landing distance (m) / Braking mode	REF DIST (m) for 66T	WEIGHT corr* Per 1T below 66T	WEIGHT corr* Per 1T above 66T	SPD corr Per 5kt	ALT corr Per 1000ft above SL	WIND corr Per 5kt TW	TEMP corr Per 10°C above ISA	SLOPE corr Per 1% down slope	REV corr Per thrust reverser operative
Manual	1420	- 20	+ 30	+ 90	+ 80	+ 150	+ 40	+ 30	- 50
Autobrake MED	1470	- 20	+ 30	+ 90	+ 80	+ 160	+ 40	+ 30	- 40
Autobrake LOW	1970	- 20	+ 40	+ 120	+ 90	+ 180	+ 60	+ 30	- 10
Autoland corr (m)	+ 340								

** In case of an overweight landing, add 100m.*

CONF 3

Corrections on landing distance (m) / Braking mode	REF DIST (m) for 66T	WEIGHT corr* Per 1T below 66T	WEIGHT corr* Per 1T above 66T	SPD corr Per 5kt	ALT corr Per 1000ft above SL	WIND corr Per 5kt TW	TEMP corr Per 10°C above ISA	SLOPE corr Per 1% down slope	REV corr Per thrust reverser operative
Manual	1570	- 20	+ 20	+ 100	+ 90	+ 170	+ 50	+ 40	- 60
Autobrake MED	1620	- 20	+ 20	+ 100	+ 90	+ 180	+ 60	+ 40	- 40
Autobrake LOW	2130	- 20	+ 30	+ 130	+ 100	+ 180	+ 60	+ 20	- 10
Autoland corr (m)	+ 340								

** In case of an overweight landing, add 150m.*

for autothrust use, ice accretion and wind, including their effect on the landing distance.

The same format will be used for landing distance determination with in-flight failures, thus directly providing a distance for the relevant aircraft condition instead of a correction factor to be applied to the appropriately determined reference distance without failure. This presentation no longer requires pilots to refer to two different sections of the QRH to make this computation, everything is available in one place.

5. FlySmart with Airbus

For all users of the Airbus Electronic Flight Bag solutions, collectively known as FlySmart with Airbus (FSA), the Landing module is being fully redesigned to implement the OLDs for the in-flight computations, while dispatch remains largely unchanged.

The on-board platform with full optimization capability allows an enhanced implementation when compared with the charts of the QRH. For example, the approach speed can be determined in full compliance with those computed by the Flight Management System (FMS) and displayed on the Primary Flight Display (PFD) to the pilots.

HYDRAULIC SYSTEM

** In case of an overweight landing, add 120m.*

				WEIGHT corr*		SPD corr	ALT corr	WIND corr	TEMP corr	SLOPE corr	REV corr
FAILURE	FLAPS LEVER for LDG	D VREF APPR SPD INCR	REF DIST (m) for 66T	Per 1T below 66T	Per 1T above 66T	Per 5kt	Per 1000ft above SL	Per 5kt TW	Per 10° above ISA	Per 1% down slope	Per thrust reserver operative
DRY											
GREEN	FULL	-	1280	- 10	+ 20	+ 90	+ 50	+ 100	+ 40	+ 20	- 40
	3	6	1350	- 10	+ 20	+ 90	+ 60	+ 120	+ 50	+ 30	- 40
BLUE	FULL	-	1150	- 10	+ 30	+ 80	+ 50	+ 110	+ 40	+ 20	- 20
	3	6	1240	- 10	+ 30	+ 90	+ 50	+ 130	+ 50	+ 30	- 20
YELLOW	FULL	-	1180	- 10	+ 30	+ 90	+ 50	+ 110	+ 50	+ 30	- 20
	3	6	1270	- 10	+ 30	+ 90	+ 60	+ 120	+ 50	+ 30	- 30
GREEN + BLUE	3	25	1680	- 10	+ 30	-	+ 60	+ 130	+ 60	+ 40	- 50
GREEN + YELLOW	3	25	2430	- 20	+ 40	-	+ 80	+ 190	+ 90	+ 110	-
BLUE + YELLOW	FULL	-	1290	- 10	+ 20	+ 30	+ 40	+ 110	+ 50	+ 30	- 30
	3	6	1320	- 10	+ 30	+ 90	+ 50	+ 110	+ 50	+ 40	- 30
GOOD											
GREEN	FULL	-	1740	- 10	+ 30	+ 130	+ 70	+ 200	+ 70	+ 50	- 100
	3	6	1920	- 10	+ 30	+ 140	+ 80	+ 230	+ 90	+ 90	- 110
BLUE	FULL	-	1520	- 10	+ 30	+ 110	+ 60	+ 180	+ 70	+ 50	- 60
	3	6	1690	- 10	+ 30	+ 120	+ 70	+ 200	+ 80	+ 60	- 70
YELLOW	FULL	-	1610	- 20	+ 30	+ 120	+ 70	+ 190	+ 70	+ 50	- 80
	3	6	1790	- 20	+ 30	+ 130	+ 80	+ 210	+ 80	+ 70	- 100
GREEN + BLUE	3	25	2540	- 20	+ 40	-	+ 80	+ 210	+ 110	+ 120	- 170
GREEN + YELLOW	3	25	2740	- 30	+ 50	-	+ 110	+ 270	+ 120	+ 150	-
BLUE + YELLOW	FULL	-	1800	- 10	+ 30	+ 50	+ 70	+ 210	+ 80	+ 80	- 100
	3	6	1910	- 10	+ 40	+ 150	+ 80	+ 220	+ 90	+ 80	- 110
GOOD to MEDIUM											
GREEN	FULL	-	1890	- 10	+ 30	+ 120	+ 70	+ 190	+ 70	+ 90	- 100
	3	6	2050	- 10	+ 30	+ 120	+ 80	+ 190	+ 80	+ 100	- 110
BLUE	FULL	-	1770	- 10	+ 30	+ 90	+ 60	+ 170	+ 70	+ 70	- 80
	3	6	1940	- 10	+ 30	+ 100	+ 70	+ 180	+ 80	+ 80	- 100
YELLOW	FULL	-	1870	- 20	+ 30	+ 100	+ 70	+ 180	+ 70	+ 80	- 100
	3	6	2050	- 20	+ 30	+ 110	+ 70	+ 180	+ 80	+ 90	- 120
GREEN + BLUE	3	25	2580	- 20	+ 30	-	+ 80	+ 210	+ 90	+ 120	- 160
GREEN + YELLOW	3	25	2750	- 20	+ 40	-	+ 90	+ 210	+ 100	+ 140	-
BLUE + YELLOW	FULL	-	2070	- 10	+ 20	+ 40	+ 70	+ 190	+ 80	+ 100	- 120
	3	6	2180	- 10	+ 30	+ 120	+ 80	+ 190	+ 80	+ 110	- 140

Figure 5
In-flight failures correction table

But it is in case of in-flight failures that the capabilities are greatly enhanced by FSA: the computation of the landing performance in these cases will be based on a physical model of the aircraft in the degraded condition. It will be possible to combine them with automatic landing and breaking, overweight landing, and eventually dispatch under Minimum Equipment List (MEL) or Configuration Deviation List (CDL).

Furthermore, FSA provides flexibility to operators to enforce their company policy regarding margins to be taken on landing distances. While the paper charts in the QRH reflect the realistic maximum aircraft performance capability, materialized by the OLD, the Landing module will systematically consider the Factored OLD (FOLD). Only if the available margins are below the company requirements will the computation return a result based on the unfactored OLD, and clearly inform the crew with standard color coding of this reduced margin operation, as illustrated in fig 6,7 and 8.

Figure 6
RWY COND: 3-Medium
Runway not limiting, results displayed in green and MLW(perf) limited by FOLD

Figure 7
RWY COND: 2- Medium to poor
FOLD longer than Landing Distance Available (LDA), but OLD less than LDA, results displayed in amber and MLW(perf) limited by OLD.

Figure 8
RWY COND: 1-POOR
Runway too short even for OLD, no result and MLW(perf) limited by OLD less than actual landing weight shown in red.

6. Status

Airbus is working to a target date end of September this year for the EFB (Flysmart with Airbus) and the revision of the digital FCOM and QRH:

► The new electronic flight manual (OCTOPUS V28) has received approval from EASA end of April 2011. Aircraft database production has started. This is the basis for all the other work packages, since it provides the capability to actually calculate OLDs.

► For the operational documentation, the new layout of the landing distance tables is finalized. Internal tools for the semi-automatic computation of the tables are under development. Full scale production will start by June.

► The EFB Landing module for L3 standard is undergoing internal validation at this time. Several additional iterations seem likely to allow us to iron out any issues and make it robust for entry into service with the operators.

An update to the Flight Operations Information Letter should be issued beginning of summer, which will include a more detailed view on the final products.

7. Conclusion

Runway excursion is currently the number one safety risk in terms of occurrences according to ICAO accident statistics.

Let us hope that this risk will be significantly reduced thanks to the combination of:

► The implementation of the OLD concept.

► The introduction of upcoming design features that assist crews in the Go Around decision making process, by providing runway overrun warning (see article on Runway Overrun Prevention System in the eighth Safety First issue, dated July 2009).

David OWENS
Senior Director Training Policy

The Go Around Procedure

1. Introduction

Go Around is an essential safety maneuver for all pilots. It is regularly practiced in the simulator, but often with engine failure, and often from minima.

By contrast, most real-world Go Arounds are:

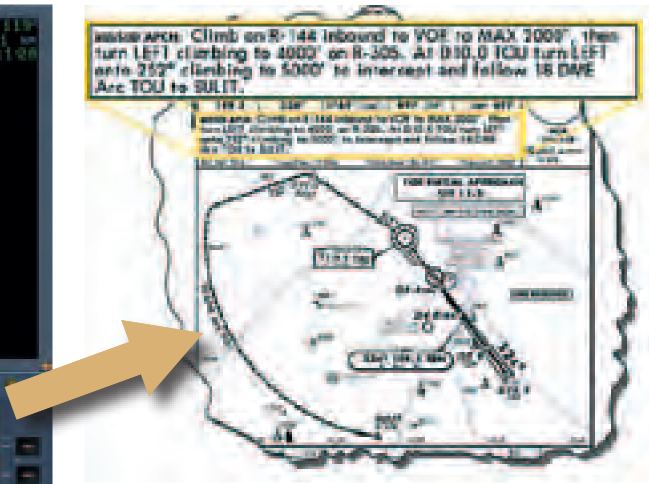
- Light weight
- High thrust
- From any other point on the approach.

Pilots must be familiar and confident with all aspects of the Go Around maneuver. However, recently, we have seen several examples where a safe Go Around was not achieved, and following these in-service incidents, we must review Go Around management and flight crew task sharing for the Go Around.

This article will review the normal Go Around, and examine several other different Go Around situations.

2. Go Around Preparation

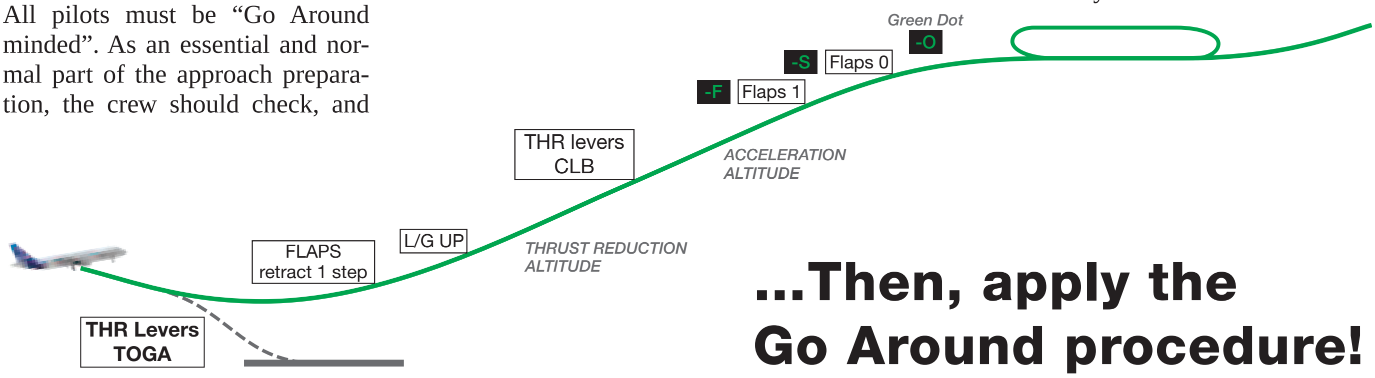
All pilots must be “Go Around minded”. As an essential and normal part of the approach preparation, the crew should check, and brief, the missed approach. We recommend that the Pilot Flying (PF) reads the missed approach from the MCDU, while the Pilot Non Flying (PNF) confirms by reading the missed approach section of the chart. Use of the ND in plan mode will give a good visual confirmation at the same time.



3. Why Go Around?

If:

- The approach is not properly stabilized, or
- You have doubts about your situational awareness, or
- A malfunction occurs below 1000ft AAL, or
- Adequate visual cues are not obtained at minima, or
- Any GPWS/TCAS or windshear alert occurs…
- On ATC request
- Whenever the crew considers it necessary.

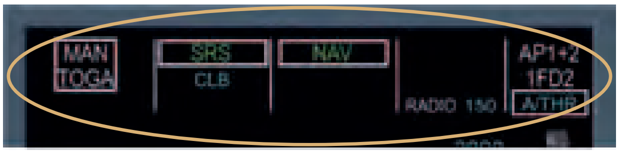


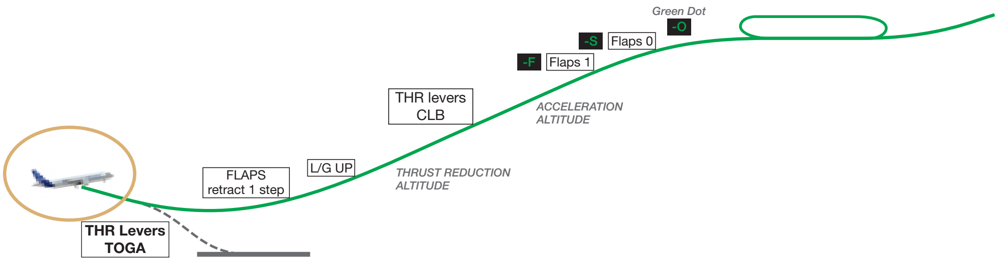
...Then, apply the Go Around procedure!

4. How?

The PF announces **"Go Around… Flaps!"**, and, simultaneously:

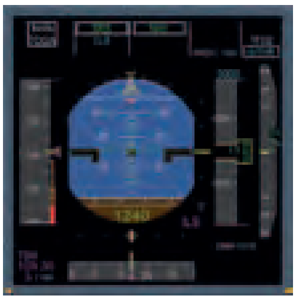
- Sets TOGA thrust
- If in manual flight, rotates to the Go Around pitch target (see right), or monitors the Auto-Pilot (AP) response
- Checks the Flight Mode Annunciator (FMA).



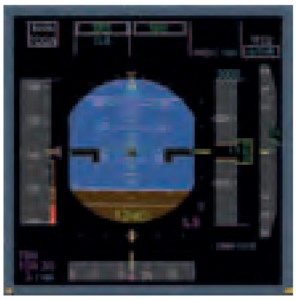


5. What about Pitch?

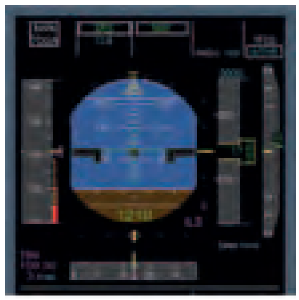
All pilots must know the required initial pitch target for their aircraft BEFORE commencing a missed approach. They must maintain that pitch target by following the SRS commands in manual flight. With the autopilot engaged, they should use this knowledge to confirm the autopilot behavior.



A320
15°



A320
Single Engine
12.5°



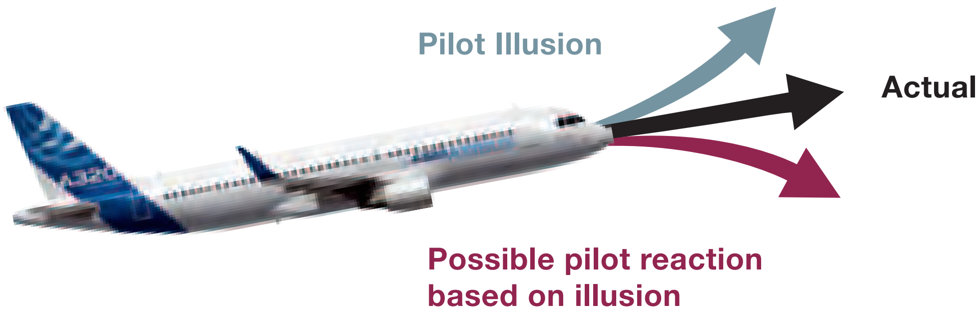
A380
12.5°

Know your pitch target
Fly the pitch
Keep the pitch!

6. Why is the Pitch Important?

6.1. Spatial Disorientation - False Climb Illusion

During a manual Go Around, if the required pitch is not reached or maintained, linear acceleration will result. Research has shown that this may cause a "**false climb illusion**". The false climb illusion may lead a pilot to believe that the aircraft is already **above** the required pitch. Consequently, a pilot may respond with an opposite and dangerous pitch down input.



This is best prevented by flying the correct pitch

6.2. Potential Overspeed – Manual Flight

If the correct pitch attitude is not maintained, the aircraft will accelerate towards the flap limit speed.

There is **NO** speed protection when the auto-thrust indication (A/THR), on the Flight Mode Annunciator (FMA), is blue, meaning that the A/THR is not active.

This is best prevented by maintaining the correct pitch

note

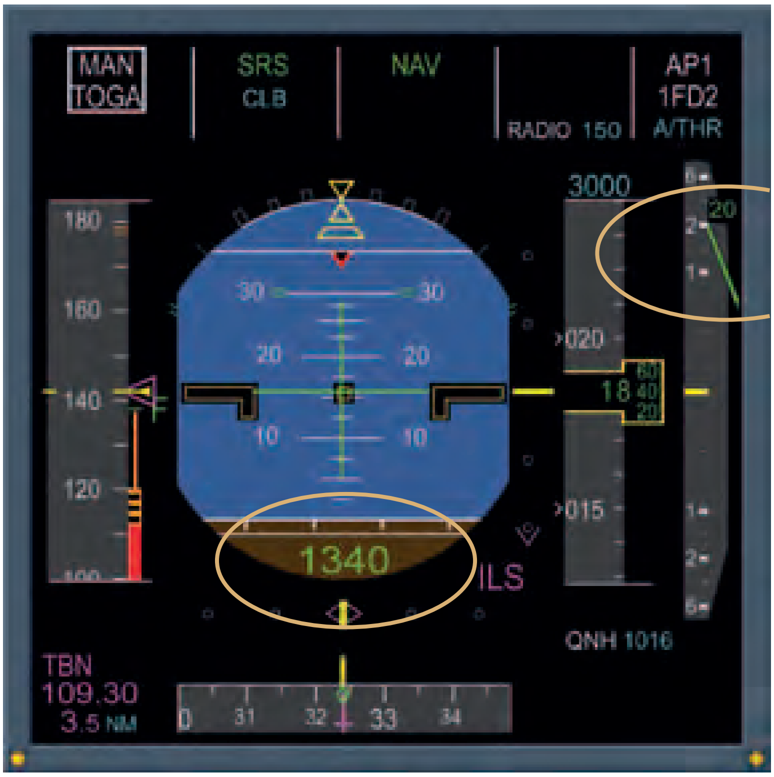
SPEED REFERENCE SYSTEM (SRS) pitch orders, when followed accurately, should ensure that the aircraft remains at the correct speed during the Go Around.

7. PNF's Actions and Responsibility

As soon as the PF announces the Go Around, the PNF retracts FLAPS one step.

The PF orders **"Gear up!"**, when a positive climb is confirmed by the PNF.

The PNF's prime responsibility remains the monitoring of PF's flying.

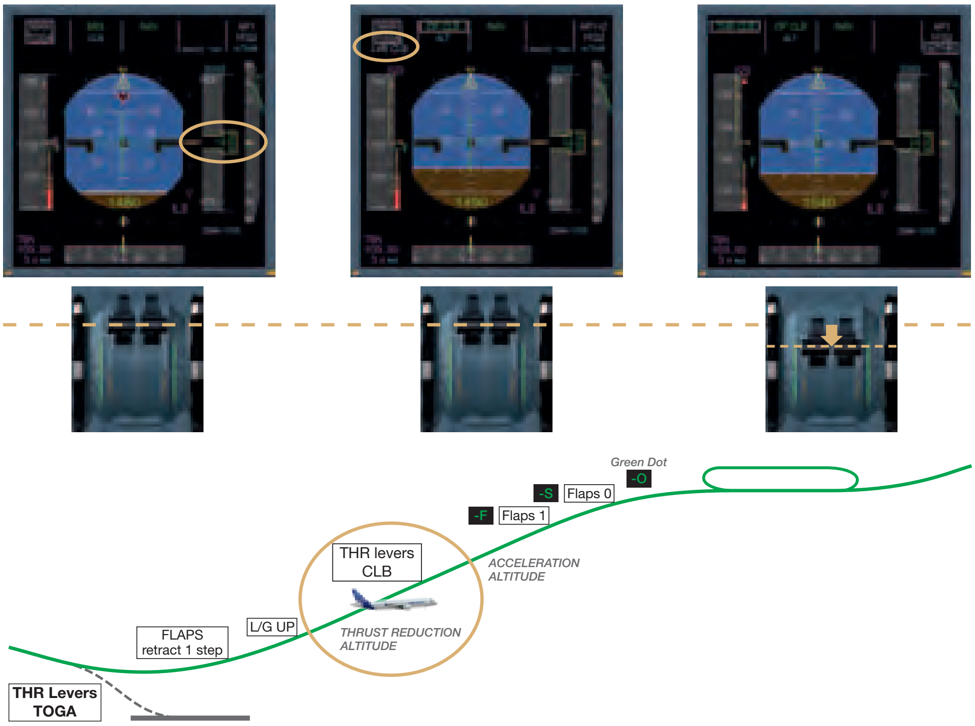


The PNF must make callouts if any flight parameters deviate from standard or safe values.

This is done to enhance the situational awareness of the PF and to trigger a corrective action by the PF.

8. Thrust Reduction Altitude

The PF sets the thrust levers to the CLB detent when the aircraft reaches the thrust reduction altitude.

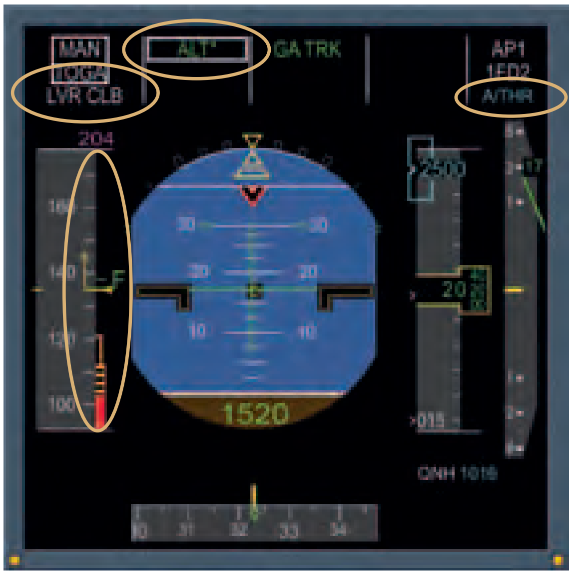


9. Acceleration Altitude

RAPID ALT* ENGAGEMENT – WITH AUTOPILOT

In the event of an early capture of altitude (ALT*), for example if the Go Around is initiated close to the altitude selected on the Flight Control Unit (FCU) or in case of a high rate of climb, rapid acceleration towards a potential overspeed may occur.

As soon as ALT* engages, the autopilot lowers the aircraft pitch and the aircraft accelerates without any A/THR protections (A/THR blue). At that time, "LVR CLB" flashes on the FMA. The PF reacts by setting the thrust levers from TOGA detent to CL detent, without delay, in order to activate the A/THR, thus enabling A/THR protections. These protections include a flap overspeed protection.



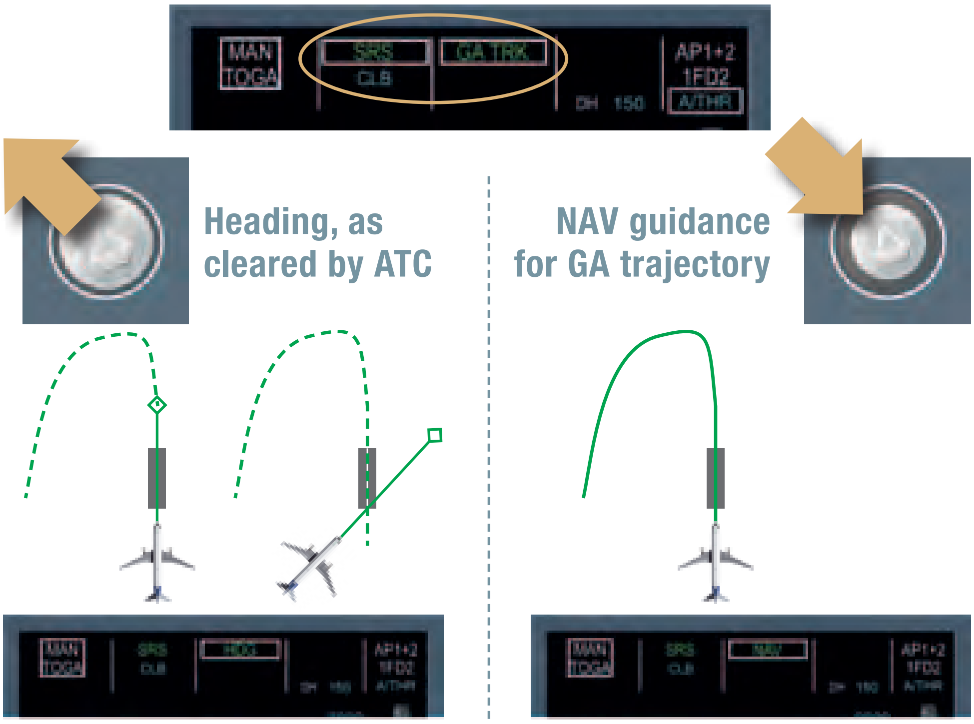
Set THR LVRs from TOGA to CL detent without delay

10. Notes on Lateral Guidance:

► Recent Airbus aircraft are fitted with an automatic re-engagement of NAV mode at Go Around.

► For other aircraft the FMA will show GA TRK

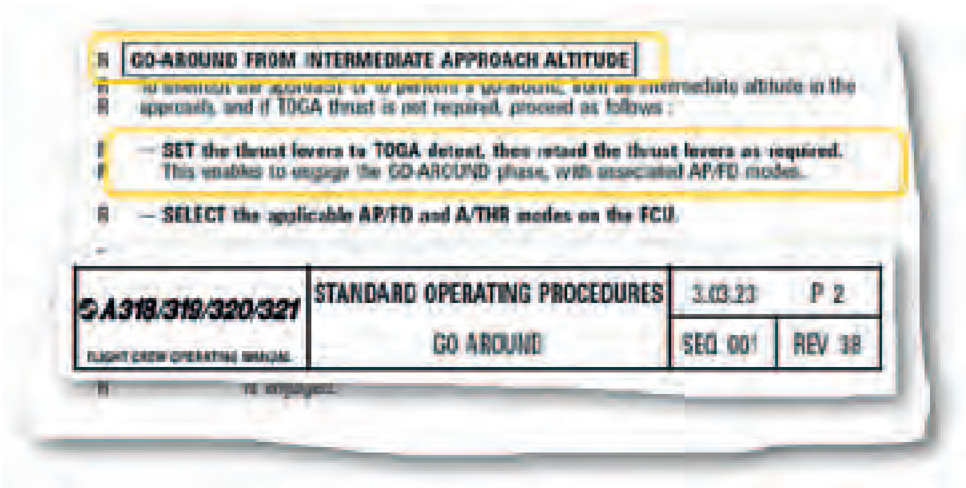
This GA TRK will be the aircraft track at the instant that the thrust levers are placed to TOGA. If a heading is required by ATC, or a track different to the GA TRK, then, pull HDG for HDG mode, and set the correct heading as required. If a managed Go Around is required, then, push HDG for NAV.



11. Missed Approach – other Altitudes

11.1. Go Around from Intermediate Approach

All missed approaches must include the initial use of TOGA thrust to ensure the Go Around phase is engaged. Once TOGA is confirmed on the FMA, THR CLB may be selected.



R GO-AROUND FROM INTERMEDIATE APPROACH ALTITUDE

R approach, and if TOGA thrust is not required, proceed as follows :

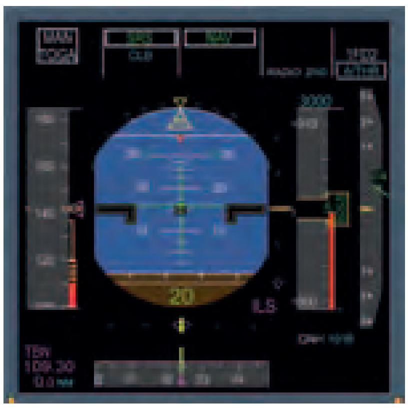
— SET the thrust levers to TOGA detent, then retard the thrust levers as required. This enables to engage the GO-AROUND phase, with associated AP/FD modes.

R — SELECT the applicable AP/FD and A/THR modes on the FCU.

A318/319/320/321 FLIGHT CREW OPERATING MANUAL	STANDARD OPERATING PROCEDURES	3.03.23	P 2
	GO AROUND	SEQ 001	REV 38

11.2. Go Around Close to the Ground

If you are close to the ground, initiate a "**standard Go Around**", and avoid rapid rotation and excessive pitch. This low Go Around may result in a runway contact, If it does, continue with the standard Go Around.



5. Conclusion

We must train for different Go Arounds

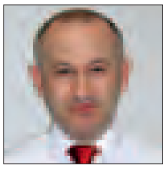
- Light weight and heavy
- Available thrust both high (all engines) and low (engine failure)
- High energy (Close to missed approach altitude)
- Different configurations
- From intermediate, decision and low altitude

Familiarity, and confidence, will only come with practice.

For a Safe Go Around

Know the pitch Target

PF	PNF
Set the pitch and Toga	Monitor the pitch and thrust
Maintain the Pitch (follow SRS)	Call any deviations
Check the FMA and when required promptly select Climb	Confirm the FMA



David OWENS
Senior Director Training Policy

The Circling Approach

1. Introduction

The circling approach used to be a frequent and normal part of standard airline operations. Today, it is not flown as frequently, and is no longer part of recurrent training for everyone. Yet, it remains a challenging maneuver.

2. What is a Circling Approach?

Airbus Definition:

When landing runway is different from instrument approach runway.

JAR Ops Definitions:

► Circling: 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.

► Visual approach: an approach when either part or all of an instrument approach procedure is not completed and the approach is executed with visual reference to the terrain.

JAR-OPS 1 E 1.435 (1) and (8)

3. The Circling Approach Rules

From the beginning of the level flight phase, at or above the Minimum Descent Altitude/Height (MDA/H), the instrument approach track determined by radio navigation aids should be maintained until:

► The pilot estimates that, in all probability, visual contact with the runway or runway environment will be maintained during the entire procedure;

► The pilot estimates that his aircraft is within the circling area before commencing circling; and

► The pilot is able to determine his aircraft's position in relation to the runway with the aid of the external references.

If the above conditions are not met by the Missed Approach Point (MAPt), a missed approach must be carried out in accordance with the instrument approach procedure.

If the instrument approach procedure is carried out with the aid of an ILS, the MAPt associated with an ILS procedure without glide path (GP out procedure) should be taken in account.

IEM to Appendix 1 to JAR-OPS 1.430, 4.2 and 3.2

The flight maneuvers should be conducted within the circling area, and in such a way that a visual contact with the runway, or the runway environment, is maintained at all times.

The same flight maneuvers should be carried out at an altitude/height which is not less than the circling MDA/H.

A descent below MDA/H should not be initiated until the threshold of the runway to be used has been identified and the aeroplane is in a position to continue with a normal rate of descent and land within the touchdown zone.

IEM to Appendix 1 to JAR-OPS 1.430, 4.4, 4.5 and 4.6

4. What about the Missed Approach?

**JAR Ops Definitions:
Visual Maneuvering (circling)**

If visual reference is lost while circling to land from an instrument approach, the missed approach specified for that particular instrument approach must be followed. It is expected that the pilot will make an initial climbing turn toward the landing runway and overhead the aerodrome where he will establish the aeroplane in a climb on the missed approach track. In as much as the circling maneuver may be accomplished in more than one direction, different patterns will be required to establish the aeroplane on the prescribed missed approach course depending on its position at the time visual reference is lost **unless otherwise prescribed.**

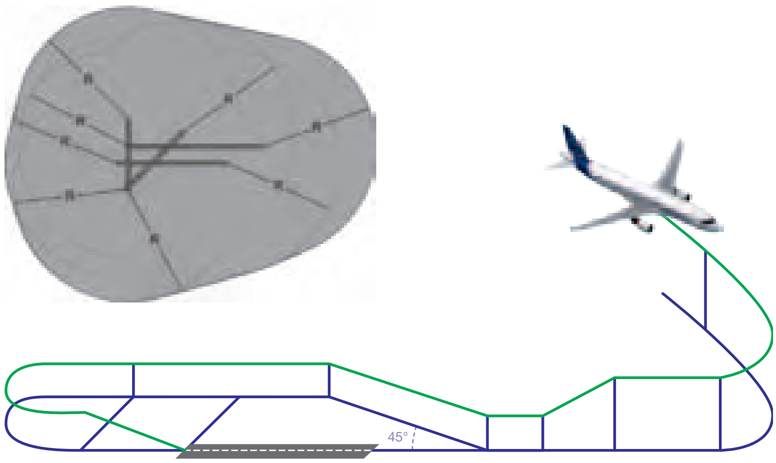
IEM to Appendix 1 to JAR-OPS 1.430, 3.1

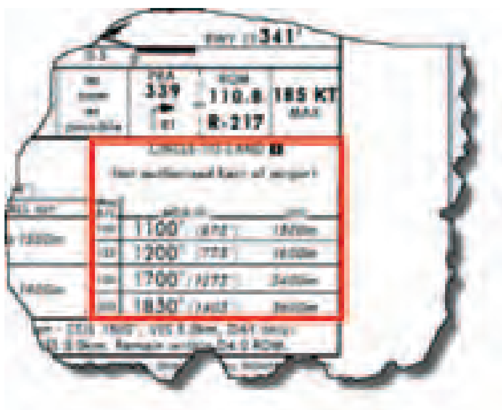
5. Standard Circling Approach – Step by Step

5.1. Approach Preparation:

First of all, start with the chart, check the protected area and terrain and look for any special notes or restrictions. Check the MDA for circling (circling minima) for your category of aircraft and brief the approach configuration. Prepare the secondary flight plan (SEC F-PLN): copy active and change runway to actual landing runway. Ensure that the use of ND during the approach is fully briefed.

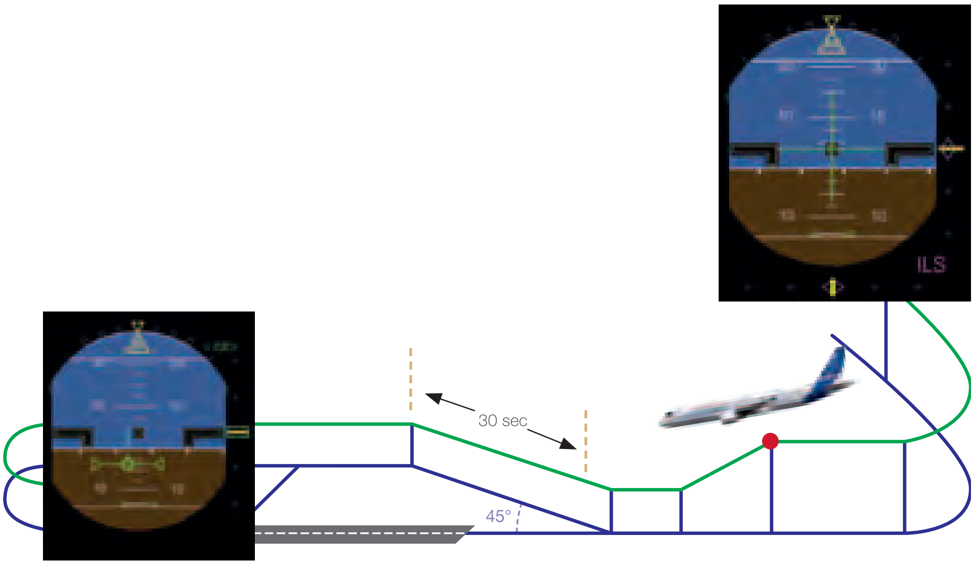
	Cat C		Cat D	
	ICAO	TERPS	ICAO	TERPS
Maneuvering Speed	180 kt	140 kt	205 kt	165 kt
R	4.20 nm	2.83 nm	5.28 nm	3.7 nm
Minimum Visibility	1 600 m	2 400 m	2 400 m	3 200 m
Minimum HAA	500 ft	450 ft	600 ft	550 ft





5.2. Instrument Approach:

Airbus SOP is that the initial part of the normal circling approach is flown with gear down and CONF 3. We recommend that, for an ILS, pilots should use the Flight Directors (FD) in HD/VS mode, whereas, for a non-precision approach, the FD mode should be TRK/FPA.



5.3. At MDA for Circling:

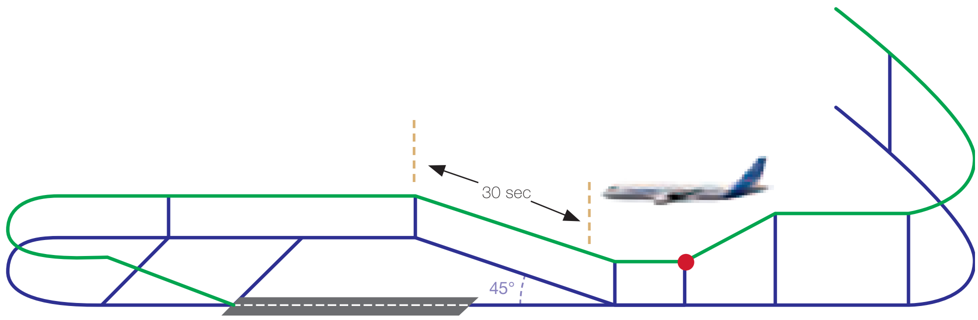
Level-off and fly not lower than MDA (Anticipate the level-off; this is a minimum descent altitude and the pilot must not descend below). Level-off using the VS knob (PUSH TO LEVEL OFF), or by pushing the ALT push-button, depending on your aircraft option and company SOP. If you are flying an ILS, select TRK/FPA and arm the 45 degree track turn, left or right, as appropriate.

► If visual reference is achieved (see diagram): commence the turn by pulling HDG knob for track.

► If not: Go Around.
Note: at this stage, the Go Around is still in the active F-PLN of the FMS, and may be flown automatically.

The pilot is abble to determine his aircraft's position in relation to the runway with the aid of the external references.

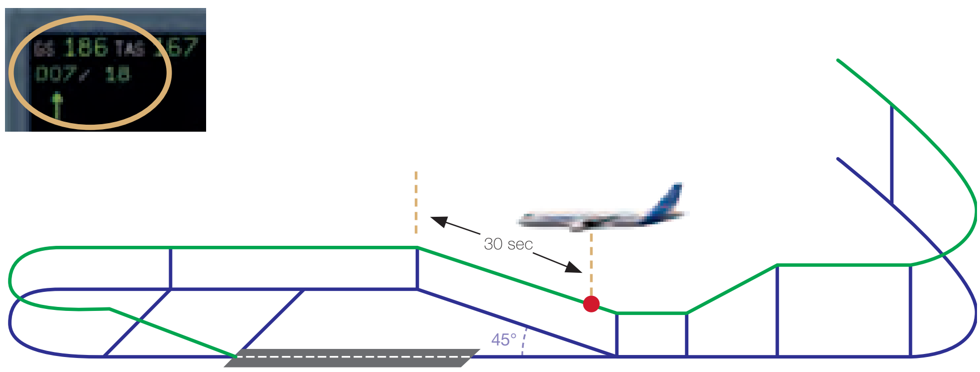
IEM to Appendix 1 to JAR-OPS 1.430, 4.2 and 3.2



5.4. Timing for Circling:

The timing Airbus recommends is 30 seconds from wings level, adjusted for strong Head or Tail wind, by reference to the ND wind indicator.

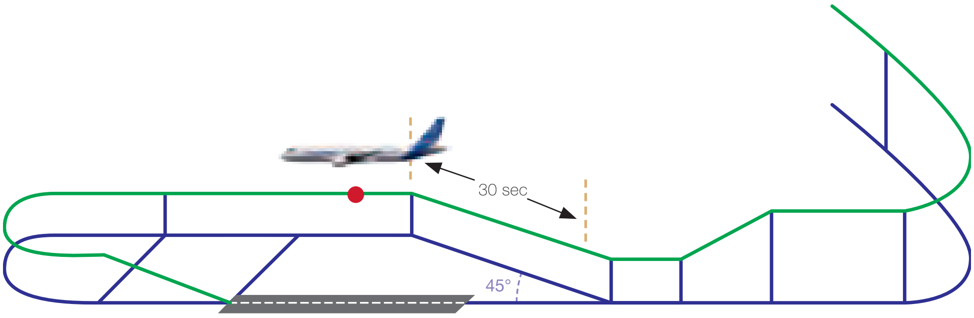
However, this is a visual exercise: **Timings are approximate only**.



5.5. Downwind:

Maintain visual reference with the runway environment. Monitor both lateral distance and track, with the aid of the ND, and adjust track for wind, as necessary. In particular if the aircraft is too close to the runway.

At an appropriate point, activate the SEC F-PLN (**Keep** the DISCONTINUITY). Disconnect the AP and remove FD, at the latest before commencing any further descent.

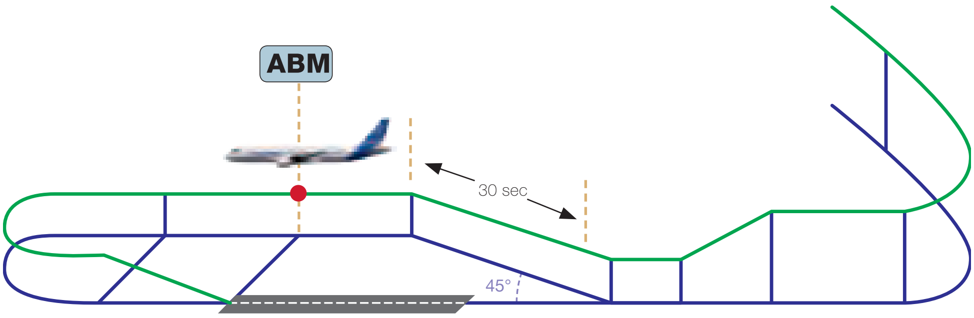


When the secondary F-PLN is activated, the valid missed approach procedure is no longer available.

5.6. Downwind ABM:

Start timing when abeam the threshold (3 sec per 100 ft is a guide).

But what about airspeed and tail wind? Remember: this is a visual exercise and timings are approximate only! The ND may be used as an aid to initiating and judging the base turn.



5.7. Visual Aid:

Once again, all timings are approximate, and use the ND as a guide ONLY, for:

- 2.5 Nm offset?
- Position downwind?
- Track downwind?
- Abeam threshold?
- Tailwind for timing?
- Crosswind?
- Terrain?

► **2.5 Nm offset?** Remember the maximum for TERPS airfields and category C aircraft may be as little as 1.7 Nm. The small white marks of the range ring in this diagram represent 2.5 Nm. A normal circling approach at 150kts should result in a downwind offset of around 1.6 Nm and enable a rate 1 continuous base turn.

► **Position downwind?** The ND is a guide to the progress of the aircraft downwind but only a guide!

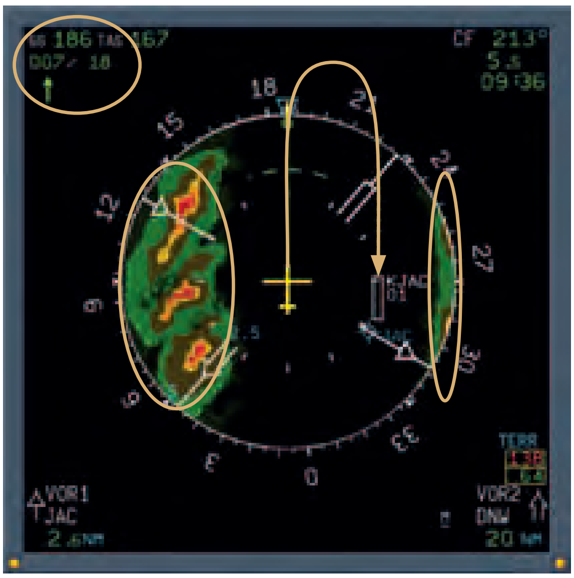
► **Track downwind?** The ND may be used as an immediate cross-check that the correct downwind track has been selected, and maintained.

► **Abeam threshold?** The threshold abeam point is best recognized visually but the ND may be used as a confirmation of the visual observation.

► **Tailwind for timing?** The ND wind arrow is a valuable and continuous measure of the wind situation during a circling approach. It enables the crew to observe, and react, to a changing wind situation including any…

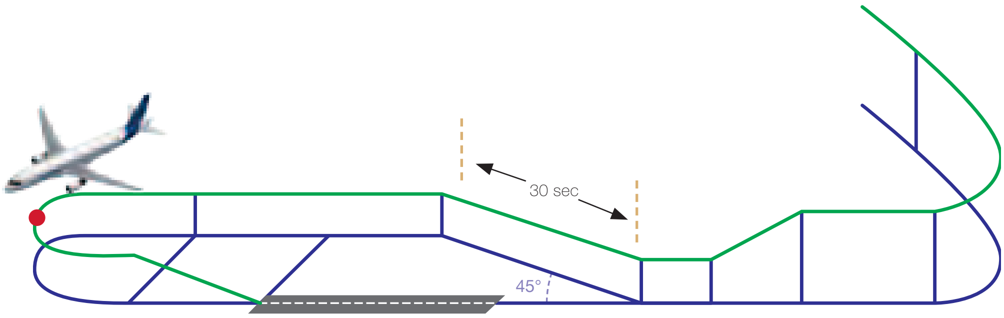
► **Crosswind?**

► **Terrain?** The ND is an excellent aid to situational awareness at all times.



5.8. Final Turn:

Initially, maintain a bank angle of 25° and maintain altitude until the runway threshold is identified. The definition of Visual Reference is given here below. Set the LDG configuration when appropriate, but ensure the aircraft is stable by 400ft aal.



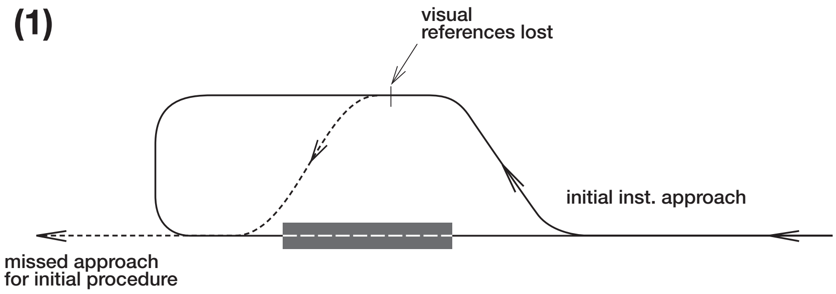
5.9. JAR Ops Definitions: Visual Reference

A pilot may not continue an approach below MDA/MDH unless at least one of the following visual references for the intended runway is distinctly visible and identifiable to the pilot:

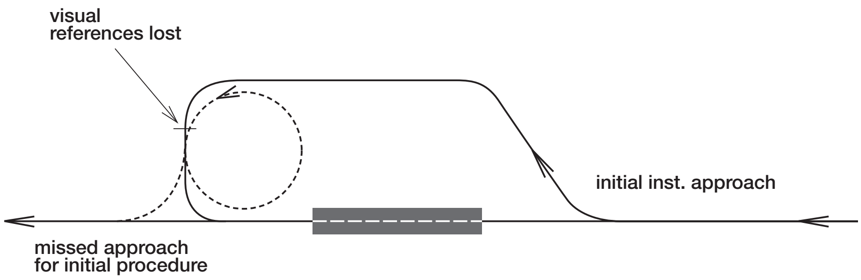
- I) Elements of the approach light system;
- II) The threshold;
- III) The threshold markings;
- IV) The threshold lights;
- V) The threshold identification lights;
- VI) The visual glide slope indicator;
- VII) The touchdown zone or touchdown zone markings;
- VIII) The touchdown zone lights;
- IX) Runway edge lights; or
- X) Other visual references accepted by the Authority.

Appendix 1 to JAR-OPS 1.430, (b) (3)

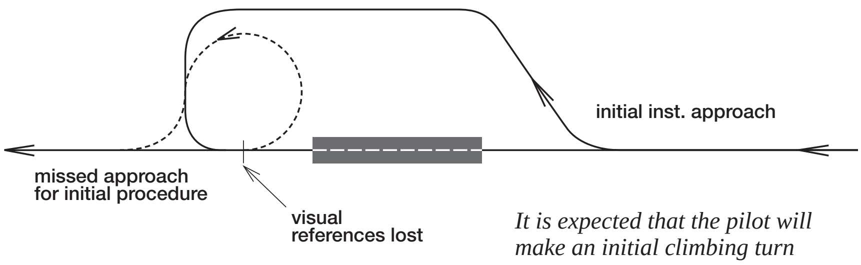
(1)



(2)



(3)

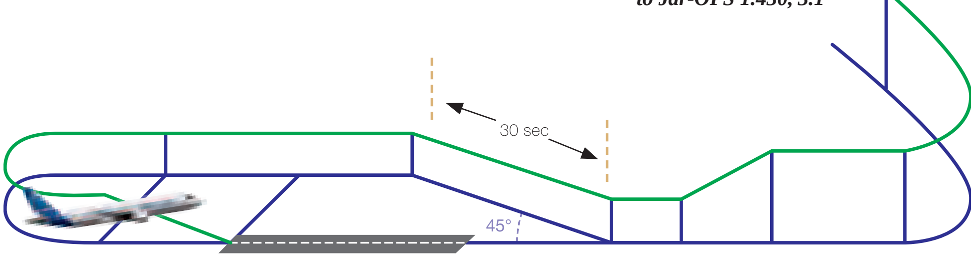


It is expected that the pilot will make an initial climbing turn toward the landing runway and overhead the aerodrome where he will establish the aeroplane in a climb on the missed approach track.

IEM to Appendix 1 to Jar-OPS 1.430, 3.1

5.10. Go Around:

After the secondary flight plan has been activated, remember that the Go Around will have to be flown selected. Always fly the Go Around of the **initial** instrument approach, **unless otherwise instructed**. The pilot is expected to maneuver to enable this, but always remaining within the protected area.



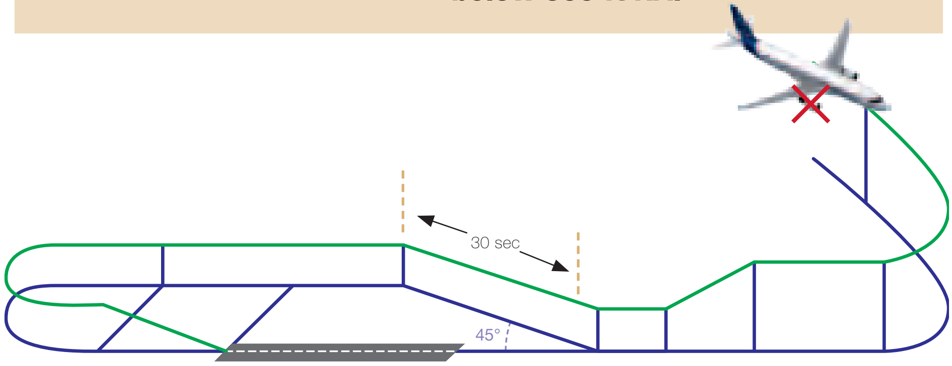
6. What about Engine Out?

In case of Engine Out, for all Airbus aircraft: Use the QRH, check the table for weight (A320/A330) and delay gear extension.

If the approach is flown at less than 750 ft RA, the "L/G NOT DOWN" warning will be triggered:

This warning can be cancelled.

The "TOO LOW GEAR" warning will be triggered below 500 ft RA.



7. What about the Use of NAV?

A standard circle to land is a VISUAL approach.

So, DO NOT USE:

- **Pilot WPTs (PBDs), or**
- **NAV mode, or**
- **AP below circling minima**

8. Conclusion:

Airbus recommends that all operators examine their operations and the associated training regarding the circling approach…

What about other types of approach? RNP APCH or RNP AR APCH may replace a circling approach and create a lower minima.

Claude LELAIE
Experimental Test Pilot

VMU Tests on A380

Introduction

Almost all pilots have seen astonishing pictures of a test aircraft taking off with the tail scraping the runway with a lot of sparks coming from the rear fuselage during the testing for development and certification. The truth is that a specific tail bumper is added to protect the tail from any damage! But why do we need to do that?

Definition of the VMU

This test allows to determine speeds which are called VMU (Velocity Minimum Unstick). A given VMU is a function of weight, thrust, altitude, and CG. The aircraft actually gets airborne in a similar manner to a Piper J3 (even if not the standard procedure!), with a simultaneous lift-off of the main gears and the "tail wheel", which is replaced by the tail bumper on the A380. There is no way to get airborne at a lower speed and this is the reason for the denomination.

We need to know the VMU because the computed take off speeds incorporate some margin above VMU, just as they also do for VS (Stall speed), VMCG (Minimum control speed on the ground) and VMCA (Minimum control speed in the air). These "V" speeds therefore form the basic building blocks of take-off performance.

On the A380, there was not only a need to establish the VMU for computation of the take off performance, but it was also necessary to perform some tests at the very beginning of the development for the optimisation of the take-off aerodynamic configuration. This was done in the first three months of the development.

Optimization of Take-Off Performance

The optimization of take-off performance is complex. Firstly, the aircraft must be able to get airborne safely, even in the case of failure of one engine. It may also have to overfly obstacles, close or far from the runway end, with sufficient margin, still with an engine failed. The optimization has to be performed for all weights, altitudes and temperatures and obviously some compromises have to be made, as no aircraft can be perfect for all conditions. On all Airbus FBW aircraft, the crew has the choice between three take-off slats / flaps positions: 1+F, 2 and 3. Configuration 3 gives more lift and therefore allows the take-off at a lower speed with a reduced runway length. Alternatively, the minimum deflection, 1+F, gives a lower drag and a better rate of climb with one engine out. It is well adapted to the situation where there are obstacles far away, however, the take-off distance is increased. Configuration 2 is used to cover intermediate situations.

For the optimisation phase, we were able to "play" with slats and flaps deflection and with the size of the strake on the engines nacelle, and we had initially to compare two characteristics: stall speeds and rate of climb with one engine out.

The first stalls were performed on flight 3 with more being carried out in the following days. It allowed us to make a first choice among the configurations to be retained. Globally, the results were very good, even better than expected. The

stalls with a reduced slat deflection were not so satisfactory as it was possible to generate too much side-slip. With the initial position the stall characteristics were excellent. Easy choice!

Without strakes, the stall appeared earlier, with a definite loss of lift. Obviously strakes were needed. We tried several shapes of strake, some with a larger surface, without clear improvement, so we came back to those that had been fitted initially.

The measurements of the rate of climb with one engine out started the first month of flight tests (flights 9 to 12). Again the target was to check that, in all configurations, the performance was in line with the expectations, which proved to be the case.

Finally, for the flaps, we had to make a choice for the configuration 3 for take-off. When coming out of the assembly line, the initially planned deflection was 22°, but in the mean time the aerodynamicists have found that 26° or 29° would be better. However, after the stalls and the rate of climb measurements, we were still not sure which setting was the best. Therefore we had to perform the VMU tests for a final assessment.

The Difficulties of the VMU Tests

Among all development and certification tests, VMU are probably among the most spectacular for observers, with the small "firework" below the tail just before lift-off. For crew members, they are also one of the most stressful, as the risk of damage to the aircraft is rather high. Few pilots can say that they have performed VMU tests on several programs without damaging anything!

In the case of the A380, some structural reinforcements were made during the installation of the tail bumper so that it could sustain a force up to 160 tons (we reached 100 tons during our tests). Because the rearmost part of the plane was made of carbon, the bumper was installed slightly further forward in a metallic section. This had adverse consequences, as the protection of rear fuselage was not as good as if it had been mounted in an ideal position. It left a slight risk of contact after take-off behind the bumper. To cover this case, metallic protection was also installed over the carbon in the lower area of the aft fuselage.

There are several difficulties in carrying out VMU tests. The first one is to perform a soft touch down of the tail bumper, as the structure is not designed for a strong impact. This is even more difficult with high thrust and strong acceleration, as there is sometimes not more than one second between touch down of the bumper and lift-off. This particular test, when performed, is done at the end of the sequence, when the crew is well trained and practised in the technique.

For tests with a very low thrust setting, the rate of climb may be very small, and the aircraft could be flying rather low for a long time after getting airborne. It is also possible that the aircraft can be "caught up" in ground effect where it maintains flight in a kind of "air cushion", being unable to climb further. In this situation, there is no other solution than to perform a Go Around.

But the key issue is the fact that the regulations request that the pitch attitude must not be decreased below the value at lift-off. To perform a successful test, the pilot generally increases it slightly. However, the margin is only around 1° to 1.5° of additional pitch before touching with the tail, behind the tail bumper. This is the most frequent cause of damage, depending on individual aircraft flying characteristics. There is the challenge!

We need perfect weather conditions, with no turbulence and wind less than 5 kts, to insure the precision of the measurements. Another good reason is that we are flying close to the limits and we must not be destabilized by turbulence.

For these tests, all the audio warnings are "killed" by the crew prior to the test, otherwise the crew receive a stream of continuous warnings: "Thrust not set", then "Stall, stall" and possibly some others. We must be able to work in a quiet environment.

The Flight Test Technique

The flying technique, as developed by Airbus, is really specific to this type of test and airlines pilots will surely find that rather strange.

The left hand seat pilot is responsible for flying the pitch. His seat is in the lowest position as he does not need to see the runway. He adjusts the attitude using the horizon of the PFD, performing a smooth touch-down of the tail bumper, keeping the tail on the ground until lift-off and maintaining the pitch attitude after take-off until out of the ground effect (one wing span) or 400 ft.

The right hand seat pilot has his seat in the upper position to be able to see the runway even with a high pitch attitude. On the ground, he maintains the aircraft on the runway. When in flight, he keeps the roll close to zero using very small inputs on the rudder (induced roll), and not with ailerons and spoilers to avoid a drag increase. Finally, he is responsible for safety, which means that he can take over anytime, typically if the aircraft is not climbing in ground effect.

The Test Flight Engineer on the flight deck is in charge of setting very precisely the thrust, which is important when we are performing tests at very low ratio thrust over weight.

In the cabin, in front of all their screens, two Flight Test Engineers are monitoring the test, and thanks to the traces, they validate it (or not!).

Now, who is really the Captain? Is it the guy who can damage the aircraft while flying the pitch or the other one in charge of the safety? We have never really decided, but what is important is that the success is coming from a close team work as always in flight tests.

The Tests on A380

As explained previously, the first tests had to be performed rather early in the program in order to optimize the configuration 3. We began on July 13th 2005 at Istres Air Force Base (South of France) where there is a 5 km runway and no houses or other obstacles on the runway axis for several kilometres. It was flight 41 and the first take-off weight was 526 tons (followed obviously later by an overweight landing). Unfortunately, due to traffic then weather conditions we had to stop after only four tests.

During the first test, I was surprised by the reactions of the airplane, which was different from the simulator, and the metallic part behind the tail bumper touched the runway. The damage was minor and we were able to continue the tests, taking into account the lessons learned from the first one!

The following day, July 14th, was the French National Day. So apart from two KC145 taking off for the parade on the Champs Elysées, there was no traffic and we were able to progress quickly. We exchanged seats between the two pilots. In the mean time, we found a method of changing the protection under the tail bumper without shutting down the engines. This saved time so that eventually seven successful tests were performed, mainly with the two possible settings for configuration 3.

The final result was the choice of a deflection of 26° for configuration 3, but with only a very small difference from the 29° setting. We planned initially four months to optimize the aerodynamic configuration, but all the characteristics were really excellent and everything was completed in less than three months.

Later in the development campaign, some more VMU had to be performed for the take-off performance computations. These were done on March 25th and 26th 2006. Eleven more tests were done in total, including those at very low thrust, down to 48 % of maximum thrust at 440 tons. For this last test we were still at 200 ft about 4 NM from brakes release, when finally we were able to climb out of ground effect!

A total of 22 VMU tests were executed including both development and certification.

Capt. Christian NORDEN
A350 Flight Crew Training Policy and Development

Automatic Landings in Daily Operation

1. Introduction

On January 9, 1969, the first-ever fully-automatic landing of a commercial aircraft with passengers - a French domestic service on a Caravelle III - was conducted in Paris-Orly.

Today, "Autoland" is one of the key elements enabling standard and reliable flight operations, even in low visibility conditions. All Airbus aircraft, from the A300 to the A380, are certified to perform Automatic Landings (Autoland).

Although Autoland is commonly associated with bad-weather (Low Visibility Operations – LVO), there is a wider range of benefits applicable to the performance of automatic landings, even in good weather. This article will illustrate cases where Autoland provides such safety advantages, and will indicate the prerequisites required to ensure that the procedure is safely conducted.

2. Operational Advantages of Autoland

Low Visibility Operations (LVO) is the most commonly used (and known) reason for the performance of an automatic landing. But there are many other situations where the use of Autoland provides operational advantages, and where the decision to perform an Autoland is a smart flight crew decision.

Here are some examples of the cases for which an Autoland can prove beneficial:

- Flight crew fatigue (e.g. an early-morning landing after a long and tiring night flight).
- Unfavorable operational conditions (e.g. Overweight landings. Autoland has been demonstrated with weights much above "Max Landing Weight", as specified in the FCOM).
- Poor visual conditions (e.g. even if the reported weather conditions are VMC, a landing that faces a low-rising or a setting sun, aligned on the runway axis, can seriously affect and reduce the flight crew's vision).
- Crew Incapacitation (e.g. the unaffected pilot could decide to exercise their emergency authority and use the Autoland function in order to benefit from the potential assistance and relief).

3. Prerequisites for Autoland

3.1. Aircraft Limitations

As mentioned above, all Airbus aircraft are certified to land automatically. However, limitations and conditions specified in the FCOM must be taken into account. Be aware that other not-so-obvious Autoland-limitations, such as maximum airfield altitude, maximum (minimum) GS angle or maximum runway slope, must also be considered.

In addition, the flight crew must monitor possible day-to-day technical restrictions (stated in the MEL), or the consequence(s) of a failure that may have occurred during the flight and that may downgrade landing capability.

On a few Airbus aircraft an other restriction concerning the ADIRS might also be a factor: they are (until a modification to come) fitted with ADIRS part numbers with out-of-date magnetic variation tables. If the ADIRS magnetic variation differs by more than 2 or 3 deg. (depending on aircraft type) compared to the airport current magnetic variation, the lateral performance of the Autoland and automatic rollout is significantly affected. Each year Airbus publishes in the AFM/FCOM a list of airports where the automatic landing is no more authorized with these ADIRS part numbers.

3.2. Airport Limitations

In other words, and to clarify a common misunderstanding, Low Visibility Operations (CAT III) require Autoland, but the use of Autoland is not limited to Low Visibility Operations. Autolands are also permitted on CAT II/CATIII runway when the ILS protection is not activated (LVP not in force) and even on CAT I runways, unless explicitly forbidden by local procedures or authorities.

Before making benefit of this extended operational use, operators must establish a list of runways authorized for automatic landing. This list will contain airports that have been checked for the AFM/FCOM limitations, including the specific precautions required for an Autoland on CAT I runways. For example, for the A330 (FCOM 3.01.22): Operators must check the runway ILS beam quality and the effect of the terrain profile.

CAT I runways, approved for Autoland by the operator, may be used provided:

► The flight crew is aware of possible beam fluctuations, and must be ready to disconnect the AP and take appropriate action(s) if guidance becomes affected

► The FMA displays at least CAT II landing capability, and the flight crew applies CAT II or CAT III task-sharing procedures (refer to FCOM)

► The flight crew makes visual contact at the latest at CAT I minimum.

Beware:

If Low Visibility Operating procedures (verified on the ATIS, or by the ATC) are not in force, even a runway that is CAT II or CAT III capable must be considered to be a CAT I runway. When performing an automatic landing in such conditions, the crews should be particularly alert, as the integrity of the LOC/GS signal is not guaranteed, hence the risk of beam fluctuations.

3.3. Flight Crew Training

Obviously, flight crews must be trained to perform Autoland in Low Visibility Operation (LVO). However, training is also necessary before conducting Autoland in other operational cases. If an operator is not LVO-certified, it is the Operator's responsibility to obtain any approval that might be required by Airworthiness Authorities and to conduct appropriate flight crew training to perform automatic landings.

Airbus offers a specific training program for LVO operation that includes self-study Computer-Based-Training (CBT) modules and one simulator session for practical training. This LVO training program complies with ground training requirements, in accordance with EU-OPS 1.450.

Operators that do not have LVO should apply a syllabus that is similar to the Airbus LVO course, and omit all LVO-specific items.

4. Reliability of Autoland

Autoland is very reliable. If Operators comply with applicable limitations and correctly apply procedures, they can achieve an Autoland success rate of approximately 100%.

Here is a typical practical example: A European Operator recently recorded the performance of 725 automatic landings over a three-year period. Only 5 of the approaches were considered unsuccessful, but they did not have any significant consequences (e.g. landing capability changed from CAT III DUAL to CAT III single at 500 ft). This results in an impressive 99.3 % technical success rate.

Nevertheless, automatic landings must be carefully conducted. This is clearly illustrated by the following three examples reported by our Operators:

4.1. Case One

Crew practicing automatic landing on runway 04L JFK (ILS CAT I) in visual conditions with AP/FD 1+2 and A/THR engaged.

At 500ft AGL, the aircraft was on G/S and LOC, in Landing Configuration. CAS was still 165kt (Vapp + 23). The crosswind component was approximately 22 kt from the left, and the drift angle was approximately 9° (aircraft heading was to the left of the track). Three minutes before TD, the ATC tower reported surface wind at 340/18 and METAR wind at 320/23G28.

At 50 ft, the CAS was VAPP + 10 kt. At 30 ft, ALIGN and RETARD modes engaged. At the same time, the LOC deviation started to increase, the aircraft was to the right of the beam, and the drift angle was 6.5° (aircraft heading was to the left of the track).

The aircraft touched down on the left-hand (LH) Main Landing Gear (MLG) with a 2° left bank angle. The thrust levers were retarded at touchdown.

The right-hand (RH) MLG touched down one second later, and ground spoilers extended. LOC deviation reached 1.5 dot, and was increasing (aircraft was to the right of beam). The rudder deflected left to 33°. The aircraft veered to the left (the heading changed from 40° to 32°).

The flight crew applied full right pedal input and disconnected the AP (three seconds after the first TD). The nose landing gear touched down. During the deviation to the left, the aircraft hit two runway edge lights on the left-wheel bogey, just above the wheel-jacking point.

The aircraft taxied to the gate, using its own power. Post-flight inspection revealed that the aircraft incurred paint-scrape damage, but no structural damage. The aircraft was certified to return to service on the next scheduled flight. The pilots reported that a narrow-body jet had lifted off from 04L just as they were passing below 200' -100' RA.

Commentary:

This incident highlights the importance of observing the limitations of the Autoland system: The crosswind was around the maximum permissible component (23kts for the A340-500 at that time), in combination with a not properly stabilized approach and a slight (externally-caused) LOC deviation.

This incident is also a good example of the importance of taking a decisive decision: the flight crew should manually take over as soon as things start to go wrong, and should not try to "assist" the Autopilot by making rudder inputs.

4.2. Case Two

SIN RWY 02L (CAT II RWY): Autoland not successful. The red AUTO LAND warning light came on at approximately 200 ft AGL. The flight crew disconnected the autopilot and performed a manual landing (Remark: The flight crew had visual contact above 200 ft).

Findings:

Flight Recorder data revealed that both LOC signals suddenly became unreliable (down to -137 microA / up to +36 microA), with similar values on both sides for approximately 10 seconds, starting at 300 ft RA.

When crossing 200 ft RA, the LOC signals reached up -137microA. The red AUTO LAND warning triggered for three seconds, as per design, and the LOC deviations were more than 20microA in LAND mode. Then, LOC deviations returned to approximately 0 microA and the flight crew manually performed the landing without any consequences.

Commentary:

This case illustrates a typical example of externally-caused disturbances of the LOC signal: the system worked as per design (AUTO LAND warning triggered) and the flight crew made an appropriate decision.

4.3. Case Three

Autoland TPE RWY 06 was not successful.

After a correct touchdown, and during the rollout, the aircraft began to deviate to the left, and then to the right. To correct this deviation, the flight crew disconnected the AP, and manually continued the rollout.

Commentary:

This case was also caused by external LOC deviations. Again, the flight crew reacted perfectly and manually took over the controls. This demonstrates that an Autoland is not completed until after the aircraft has reached taxi speed.

5. Conclusion

► Autoland is a very dependable operational technique. Operational- and system limitations have to be observed nevertheless.

► The main operational use is for Low Visibilty Operations (LVO). However, there are many other operational scenarios that can benefit from the use of automatic landings.

► Autoland on CAT I ILS, or CAT II/III (without LVP) are possible provided precautionary measures are taken.

► Autolands must be carefully performed, at all times. If anything goes wrong, the flight crew must manually take over with decisiveness (i.e. disconnect the AP and manually fly the aircraft – as per Airbus Golden Rule).

► In all cases, effective and sufficient training is a requirement for the safe performance of automatic landings. Airbus provides Operators with appropriate solutions to perform this training.

Additional References

► AFM/FCOM/FCTM chapters on Automatic Landing

► FCOM Bulletin "Automatic Landing Performance" (A320 Family Bulletin N°803; A330 Bulletin n°816; A340 Bulletin N°816)

► Airbus "Getting To Grips with CAT II /CAT III Operations" available on the AirbusWorld website (Fight Operations portal)

► Airbus Operations Policy Manual (AOPM- Chapter 8.3. ALL WEATHER OPERATIONS), available on the AirbusWorld website (Fight Operations portal).

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