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).

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.

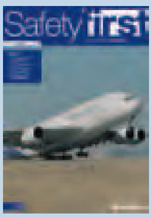
Material for publication is obtained from multiple sources and includes selected information from the Airbus Flight Safety Confidential Reporting System, incident and accident investigation reports, system tests and flight tests. Material is also obtained from sources within the airline industry, studies and reports from government agencies and other aviation sources.

All articles in Safety First are presented for information only and are not intended to replace ICAO guidelines, standards or recommended practices, operator-mandated requirements or technical orders. The contents do not supersede any requirements mandated by the State of Registry of the Operator's aircraft or supersede or amend any Airbus type-specific AFM, AMM, FCOM, MEL documentation or any other approved documentation.

Articles may be reprinted without permission, except where copyright source is indicated, but with acknowledgement to Airbus. Where Airbus is not the author, the contents of the article do not necessarily reflect the views of Airbus, neither do they indicate Company policy.

Contributions, comment and feedback are welcome. For technical reasons the editors may be required to make editorial changes to manuscripts, however every effort will be made to preserve the intended meaning of the original. Enquiries related to this publication should be addressed to:

Airbus
Product Safety department (GS)
1, rond point Maurice Bellonte
31707 Blagnac Cedex - France
Fax: +33(0)5 61 93 44 29
safetycommunication@airbus.com



A380
VMU test

Safety First, #12 July 2011. Safety First is published by Airbus S.A.S. - 1, rond point Maurice Bellonte - 31707 Blagnac Cedex/ France. Editor: Yannick Malinge, Chief Product Safety Officer, Nils Fayaud, Director Product Safety Information. Concept Design by Airbus Multi Media Support Ref. 20110975. Computer Graphic by Quat'coul. Copyright: GS 420.0021/11. Photos copyright Airbus. Photos by ExM Company: P. Masclet, Photos by Jonathan Le Gall. Printed in France by Airbus Print Centre.