

Safety First

The Airbus Safety Magazine



04 | June 2007 |



AIRBUS

Editorial

04 | June 2007



Yannick MALINGE

Vice President

Flight Safety



Content

Dear Customers and Aviation Safety colleagues,

It is not a secret that Airbus has encountered some turbulence as you have undoubtedly seen in the press.

Despite this challenging period of time, I hope this 4th issue of our Safety Magazine will reassure you that Flight Safety remains as one of our prime Corporate priorities.

Let me take the opportunity of this 4th issue of Safety First to share with you the Safety Vision at Airbus that our President and CEO – Mr Louis Gallois – delivered to all Airbus employees:

“Hundreds of millions of people fly on Airbus aircraft every year, and their safety must be foremost in our minds and actions. We will need to be flexible, adaptable and creative in meeting the multiple challenges our company faces, but we must never compromise when it comes to questions of safety. It is our highest duty, and as your CEO, I promise to do my part, and expect each of you to do the same.”

As another commitment to Safety, our customers have received an invitation for our annual Flight Safety Conference. Refer to the News chapter that follows for more information.

I hope you will enjoy reading this 4th issue and share it within your airline.

Yours sincerely

Yannick MALINGE
Vice President Flight Safety

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Safety First

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

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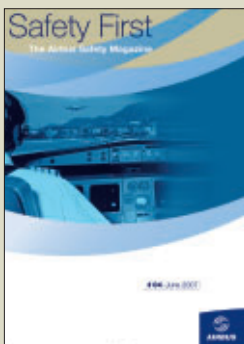
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14th Flight Safety Conference



The planning for this year's conference is well underway. It will be held from the 15th to 18th October in Barcelona. A provisional agenda has been defined and the invitations are being sent out in June. If you are an Airbus customer, have not yet received an invitation and you would like one then please contact Nuria Soler at the addresses below. Note that this is a conference for Airbus and our customers only. We do not accept outside parties into the conference so as to ensure that we can have an open as possible forum for everybody to share information.

As always we welcome presentations from you. The conference is a forum for everybody to share information, so if you have something you believe will benefit other operators and/or Airbus then contact us.

We always look forward to the conference so that as well as sharing information in the conference itself we can all meet and talk on an informal basis.

Your articles

As already said this magazine is a tool to help share information. Therefore we rely on your inputs. We are still looking for articles from operators that we can help pass to other operators through the magazine.

If you have any inputs then please contact us.

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If you have any questions about the distribution of the magazine either electronically or in hard copy then please contact us. Please use the proforma format that you will find towards the back of the magazine. Send the complete information to the e-mail address or fax below.

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Operations Engineering Bulletin reminder function



By: Ludovic BOSELLI
Flight Operations Engineer

1 | Introduction

The OEB reminder function provides help to the flight crew by enabling them to clearly identify the ECAM messages affected by an OEB.

Airbus strongly supports the use of this device since it reduces the flight crew workload, decreases the possibility to forget an OEB procedure and keeps the flight crew confidence in the ECAM. This article intends to further promote this function and its use.

2 | Operations Engineering Bulletin

Operations Engineering Bulletins are issued by Airbus in parallel to the FCOM / QRH in order to provide temporary operational procedures that address any deviation, from initial design objectives, having an operational impact. OEB procedures are recommended by Airbus, and should be followed immediately.

There are two types of OEBs, distinguished by their RED or WHITE color code.

RED OEBs

are issued to highlight procedures having a significant impact on the aircraft airworthiness and are subject to an Airworthiness Directive.

Red OEBs are included in the FCOM Volume 3, and a copy of their procedure is copied in the QRH OEB chapter.

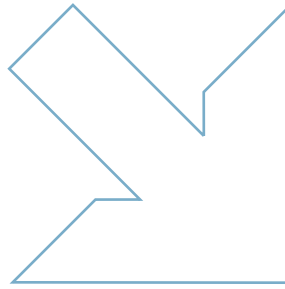
WHITE OEBs

are issued to highlight information or procedures having an impact on the aircraft airworthiness.

White OEBs are included in FCOM Volume 3. If the OEB procedure is a deviation to ECAM, the OEB procedure is also copied in the QRH OEB chapter.

During the preliminary cockpit preparation, the flight crew must review all OEBs applicable to the aircraft. It must pay a particular attention to the red OEBs, and more particularly to the red OEBs that override an ECAM procedure.

Note: Airbus is currently working on a new QRH List of Effective OEB (LEOEB) layout that will provide our operators with the list of all applicable OEB versus their color and their impact on ECAM, if any (for additional information, please refer to the Operations Liaison Meeting 2006 presentation).



3 | Operations

Engineering Bulletin reminder function

The Flight Warning Computer (FWC) OEB reminder function is implemented to enable the flight crew to clearly identify on the ECAM, all the procedures / status messages affected by an OEB.

When a warning / caution occurs, a message informs immediately the flight crew that an OEB exists for the corresponding displayed alert / status. In this case, the flight crew must refer to the QRH instead of the ECAM procedures.

Three cases may arise:

- Only the ECAM procedure is affected
- Only the status message is affected
- Both the ECAM procedure and the corresponding status messages are affected

Only the ECAM procedure is affected:

The ECAM alert title and related status messages do not change. All the corresponding actions are suppressed and replaced by a "REFER TO QRH PROC" message.

Example:

AIR PACK1 OVHT -REFER TO QRH PROC		ECAM UPPER DISPLAY (E/WD)
STATUS .WHEN PACK OVHT OUT: <u>INOP SYS</u> -PACK1.....ON		PACK1 ECAM LOWER DISPLAY (SD)

Only the ECAM status messages are affected:

The ECAM alert title and related status messages do not change. The corresponding procedure does not change, except for the additional "FOR STS REFER TO QRH" line. The related status messages on the ECAM do not change, except for the additional "REFER TO QRH PROC" title.

Example:

<u>AIR PACK1 OVHT</u> -PACK1.....OFF .WHEN PACK OVHT OUT: -PACK1.....ON -FOR STS REFER TO QRH		ECAM UPPER DISPLAY (E/WD)
STATUS <u>REFER TO QRH PROC</u> .WHEN PACK OVHT OUT: -PACK1.....ON		PACK1 ECAM LOWER DISPLAY (SD)

Both the ECAM procedure and the corresponding status messages are affected:

The ECAM alert title does not change. All the corresponding actions are suppressed and replaced by a "REFER TO QRH PROC" message. The related status messages on the ECAM do not change, except for the additional "REFER TO QRH PROC" title.

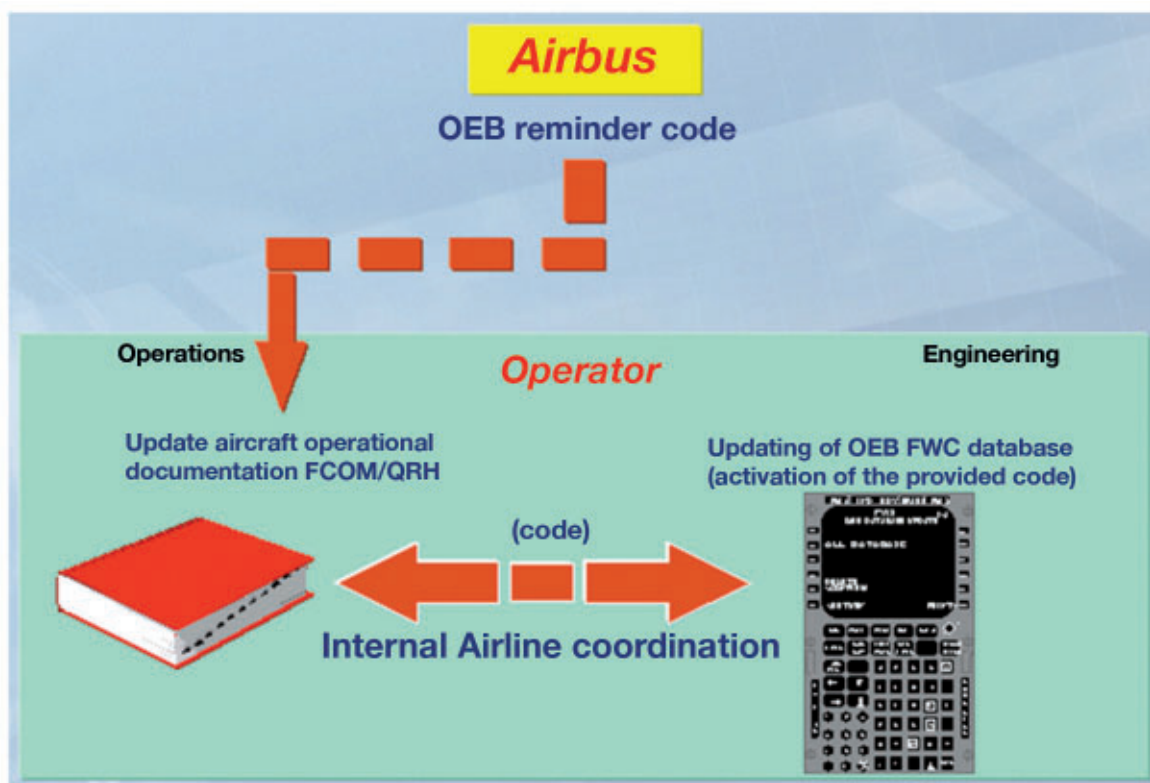
Example:

AIR PACK1 OVHT -REFER TO QRH PROC		ECAM UPPER DISPLAY (E/WD)
STATUS <u>REFER TO QRH PROC</u> .WHEN PACK OVHT OUT: -PACK1.....ON		<u>INOP SYS</u> PACK1 ECAM LOWER DISPLAY (SD)

4 | Activation / deactivation of the OEB Reminder function:

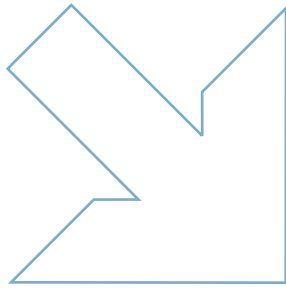
Activation of the OEB Reminder function:

When an ECAM warning / caution is affected by an OEB, an OEB Reminder code is provided in the operational documentation (FCOM Vol.3 & QRH). This code allows the operator to activate the OEB Reminder function for the concerned ECAM warning / caution, according to the AMM task (Load OEB Reminder information into FWC using MCDU).



It is important to note that the aircraft operational documentation has to be updated before or at the same time as the activation of the OEB Reminder function since the actions of the affected ECAM alert may be suppressed (the flight crew is asked to refer to the QRH).

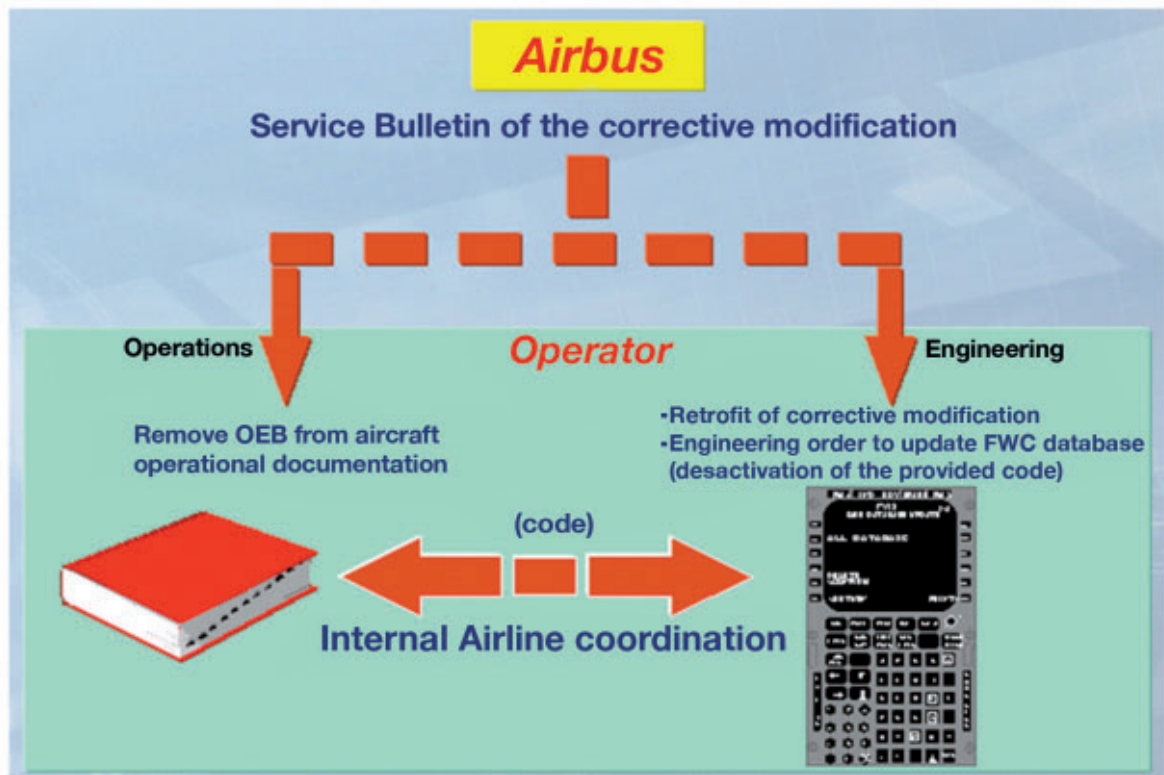




Deactivation of the OEB

Reminder function:

Once a corrective solution is available, Airbus provides an associated SB that allows the retrofit of the corrective modification. As soon as the SB is retrofitted, the OEB Reminder function has to be deactivated according to the AMM task (Delete OEB REMINDER information into FWC using MCDU).



It is important to note that the aircraft operational documentation has to be updated at the same time or after the deactivation of the OEB Reminder function.

5 | OEB reminder function

Airline implementation

The OEB Reminder function was presented during the Operations Liaison Meeting 2006 and during the last 15th Performance & Operations Conference held in Puerto-Vallarta, Mexico, in April 2007.

These conferences, together with a survey that we conducted do confirm the following:

As indicated in chapter 4 above, **appropriate coordination** between the Flight Operations and Maintenance / Engineering departments within the airline is **key** to an efficient implementation and operation of the OEB reminder function.

Analysis of positive answers from airlines that use the function shows that an adequate implementation process is as follows:

Step 1:

Each OEB is validated by the Operational Engineering.

Step 2:

The documentation (FCOM and QRH) is updated and distributed.

Step 3:

If there is an OEB reminder code to be activated, the item is handed over to the Maintenance Engineering to activate the code on the Flight Warning Computer (FWC) of the aircraft.

Step 4:

During the retrofit of the correcting modification, the deletion of the OEB reminder code is integrated in the work order

Step 5:

Once the retrofit is completed for all aircraft of the fleet, the documentation is updated.

6 | Conclusion

The OEB reminder function provides help to the flight crew by enabling them to clearly / easily identify ECAM procedures overridden by OEBs. It is a very good tool to assure that the flight crew are made aware of the correct procedure when a Temporary Procedure overrides the ECAM.

Operators have to be aware that this device requires special attention and a specific management should be put in place. The Operational Engineering and the Aircraft Engineering, as well as the Maintenance Control Center, have to be involved in a common process to deal with the OEB reminder function.

For long-range aircraft, the OEB reminder function is optional, and is free-of-charge through RFC/RMO Service Bulletin (SB) 31-3020 for A330 aircraft, and SB 31-4032 for A340 aircraft.

For single-aisle aircraft, Airbus has launched a fleet-wide, free-of-charge, Airbus-monitored retrofit campaign (SB 31-1264) that consists of upgrading the FWC to the H2F2 Standard for all single-aisle family aircraft. This retrofit campaign also includes the optional activation of the OEB reminder function (for additional information, please refer to the Retrofit Information Letter (RIL), reference SER/916.0551/06, dated Nov. 15, 2006).

Note: This device does not exist on A300-600 / A310 Family.

Airbus flight operations support department remains available for any additional information or assistance :

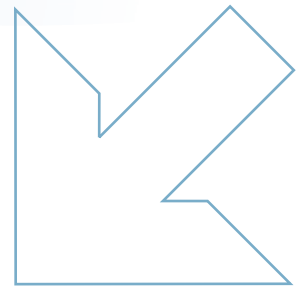
Email: ftops.flwstd@airbus.com



Avoiding high speed rejected takeoffs due to EGT limit exceedance



By: Arnaud BONNET
Engine Performance Manager



1 | Introduction

Unnecessary high speed rejected takeoffs are experienced from time to time due to high Exhaust Gas Temperature (EGT).

The goal of this article is to explain that a too high EGT overlimit must not lead to abort a takeoff at high speed.

The first part will provide some technical background on EGT and will outline the operational recommendations and Aircraft Maintenance Manual procedures in case of limit exceedance.

The second part will describe maintenance and operational procedures, which minimize EGT over limit occurrences.

2 | EGT is a good indicator of engine health

As engines accumulate cycles, their performance tend to deteriorate due to various reasons, e.g.:

- Dust/dirt ingestion and further accumulation on fan blades/compressor airfoils.
- Increasing tip clearances on compressor / turbine blades and seal clearances due to rub.

- Other mechanisms such as erosion of airfoils and seals, hot section oxidation and increased air gas path air seal wear.

The High Pressure (HP) compressor and the HP turbine are generally the main contributors to deterioration. On some higher bypass ratio engines, the low pressure (LP) compressor may also be a significant contributor.

The appropriate indicator of the overall performance of the engine (compressors and turbine) is based on the core flow temperature, which is measured at the turbine exit and is referred to either as EGT or TGT, for Turbine Gas Temperature on Rolls-Royce engines.

The above temperature is measured in the gas path, either at the Low Pressure (LP) turbine inlet (on CFM, EA, GE and RR engines) or at the LP turbine exit (on PW and IAE engines).

3 | Demonstration of EGT operational limit

To protect turbine hardware, an operational limit on EGT (called "EGT red line") is demonstrated during endurance tests required for FAR 33/JAR-E/EASA engine certification.

During such tests, the engine is run for 25 stages of 6 hours each. For each stage, the engine spends up to one hour cumulative time at max takeoff regime, with average EGT at redline conditions.

Moreover, FAR 33 engine certification requires the engine to run for 5 minutes with N1 and N2 at red line levels and with EGT at least 42°C above the red line. After the run, the engine is disassembled and the turbine assembly must be within serviceable limits.

4 | What is takeoff EGT margin and how is it calculated?

EGT Margin is an estimate of the difference between the certified EGT redline and a projection of engine EGT to full-rated takeoff at reference conditions.

The observed EGT is projected to a standard reference condition of takeoff full power, on a flat-rate temperature day at sea level, using characteristics derived from the Engine Manufacturer's thermodynamic model for the engine rating. This projected temperature level represents the expected EGT if the takeoff actually occurred with the reference conditions. The projected EGT level is then subtracted from the certified EGT redline for the particular engine rating in order to produce an estimated takeoff EGT margin.

Therefore the EGT margin is not just the difference between recorded EGT at takeoff and the EGT redline, since it is very unlikely that the takeoff data were recorded at the reference power level, temperature day, and bleed level.

5 | Use and limitations of EGT margin projections

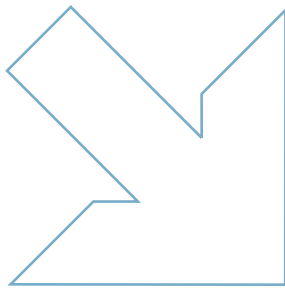
EGT margin is routinely used to monitor the health of installed engines through the ECM tool (Engine Condition Monitoring), together with cruise performance trends, takeoff EGT margin trends are used to detect shifts in performance for each engine, which can indicate the need for inspections and/or maintenance. The EGT margin trends are also used to forecast an average remaining time on-wing, if engine removal is due to takeoff EGT margin shortage.

However:

- Calculated EGT margin should not be used as sole criterion for engine removal. Apart from the Life Limited Parts constraints, it should be considered with other factors such as cruise trends, number of EGT over limit occurrences and the associated maintenance tasks requested by AMM prior to an engine removal decision.
- Takeoff EGT margin has a limited accuracy, driven by:
 - the accuracy of recorded flight conditions and engine parameters,
 - the fact that the performance model included in the ECM tool is representative of the average behaviour of production engines, but not of every single engine.

Further, recall that EGT margin is calculated for a reference condition, typically a full-power takeoff, on a flat-rate temperature day, at sea level. This condition is not necessarily the most severe condition; the worse condition can be different for different engine models. So, EGT margin is frequently not projected for the worst case. However, this representative





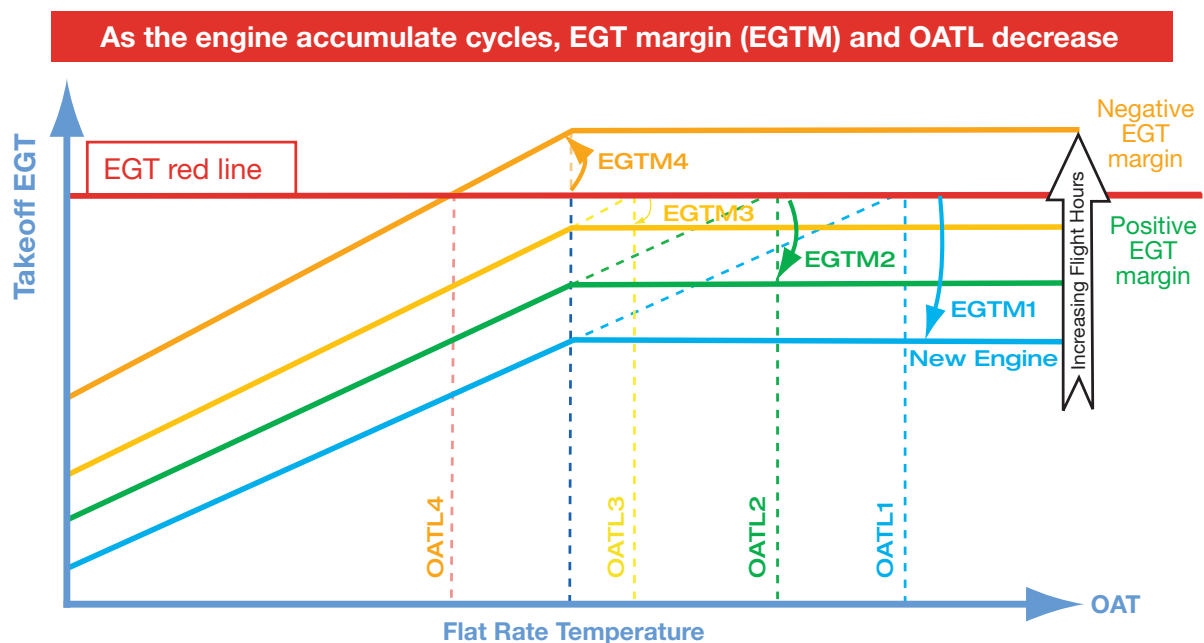
condition permits trending takeoff margin on a consistent basis. Factors such as ambient temperature, amount of derate, time since previous operation of the engine, altitude of the runway can impact the actual peak-EGT during any given takeoff. Therefore:

- An engine with a slightly positive takeoff EGT margin may experience EGT over limit at takeoff
- An engine with a slightly negative takeoff EGT margin may not necessarily experience EGT over limit at takeoff.

6 | What is OATL?

(Outside Air Temperature Limit)

For the engines whose takeoff EGT is nearly constant with increasing Outside Air Temperature (OAT) beyond Tref (flat rate temperature), OAT Limit (OATL) is another related indicator of engine health for takeoff. OATL is a projection of the highest ambient temperature at which an engine should be able to produce full flat-rated thrust without exceeding EGT redline. Thus, this parameter describes an engine's takeoff performance capability in operational terms that can be used directly by Flight Operations. Note that OATL and EGT margin are similar measures of performance based on takeoff data; these parameters are not independent assessments of the temperature limitations for an engine. For instance, when the OAT Limit equals the flat-rated temperature for an engine, the EGT margin is zero.



- OAT Limit (OATL) is a projection of the highest OAT at which an engine should be able to produce full flat-rated takeoff thrust without exceeding EGT redline.
- When OATL is below the Flat Rate Temperature (i.e. EGT margin is negative), EGT over limit may occur during a full rated takeoff.

Fig 1: Engine Deterioration Effect on EGT margin and OATL

7 | Operational recommendations:

An EGT over limit due to normal engine wear does not affect the engine thrust, safe continuation of the takeoff is therefore possible.

Below 80 knots, an ECAM caution will trigger and the takeoff may be aborted.

Above 80 knots, ECAM caution is inhibited, no crew action required.

During flight phase 4, from 80 knots to lift-off, the Flight Crew Operating Manual (FCOM) procedure in case of EGT over limit calls for continuation of the takeoff. On all fly by wire aircraft, EGT over limit ECAM cautions are inhibited during this flight phase whereas the EGT indication will become red as EGT goes beyond the red line. The intent is to avoid distracting the pilot during a critical flight phase with information that might cause inappropriate crew response.

After lift-off, the ECAM procedure should be applied when the appropriate flight path is established and the aircraft is at least 400 ft above the runway. Pending the magnitude of the EGT over limit, the ECAM will call for different procedures, as illustrated in the following figure.



8 | Aircraft Maintenance Manual procedures in case of EGT over limit:

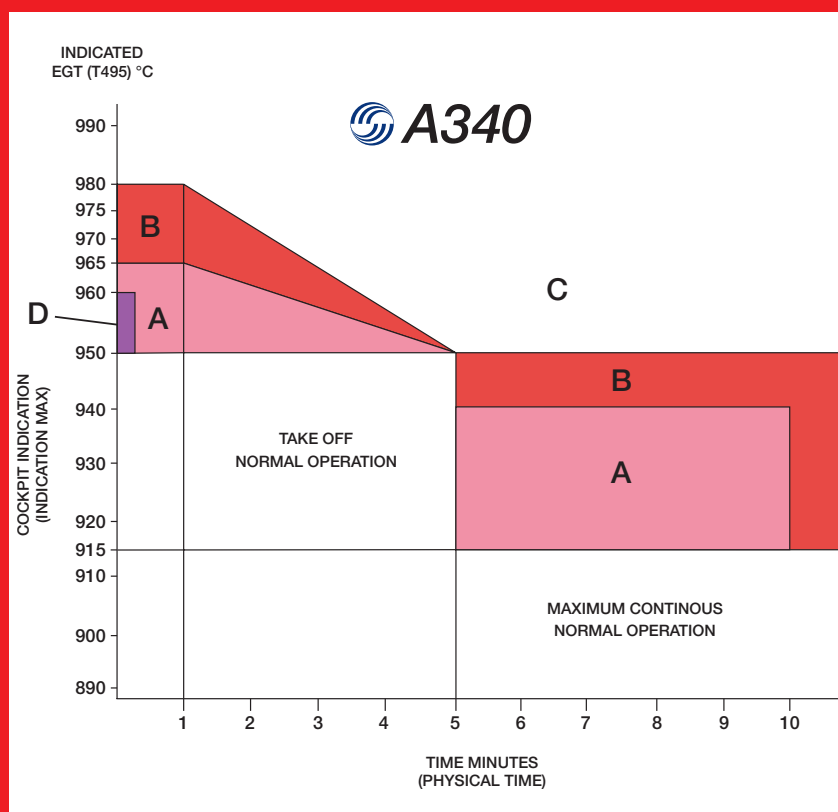
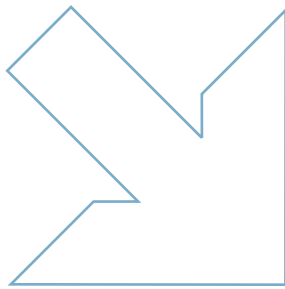
To increase the operator's flexibility for engine removal and allow the aircraft to fly back to its main base whenever possible, maintenance tasks have been defined according to the magnitude of the EGT over limit and its duration. Those tasks range from a visual inspection up to a required engine removal and overhaul. As a reminder, this latitude given to operators is not a means of extending on-wing life for EGT limited engines, but aims at offering flexibility, to avoid Aircraft On Ground (AOG) situations at other stations than the main base.

The chart below shows an example of AMM chart for the CFM56-5C:

In this particular example, three areas referred to as, A, B and C, were originally defined according to the magnitude of EGT over limit and the duration of the event. To each area corresponds a specific maintenance action.

At a later stage, it was decided that within A, occurrences implying EGT over limit of less than 10 degrees Celsius with a duration of less than 20 seconds did not call for any maintenance action. This particular area is referred to as D.





Allowance for CFM56-5C EGT over limits

In order of gravity:

- **Area D**
EGT over limit of less than 10°C and during less than 20 seconds are permitted, without any requested maintenance action
- **Area A**
Inspection and troubleshooting required.
Maximum of 20 over limit occurrences allowed before engine removal
- **Area B**
Inspection required.
If root cause not identified, borescope inspection required.
20 over limit occurrences in area A & B combined or 10 in area B allowed before engine removal
- **Area C**
Remove the engine and return to shop.
One non-revenue flight allowed if no damage beyond serviceable limits.

9 | Maintenance/Operational procedures to minimize EGT over limit occurrences:

Follow-up of engine performance with the Engine Condition Monitoring tool allows focussing attention and efforts on engines with limited takeoff EGT margin.

Within each operator's constraints, operations on most demanding routes of aircraft equipped with such EGT limited engines should be avoided.

The following recommendations should be applied in priority to those engines.

Engine wash:

Each engine manufacturer has issued recommendations on intervals between two washes. Each operator, based on their various constraints, e.g., environmental, may tailor those intervals. Average EGT margin recovery based on operators' feedback to engine manufacturers is around 7°C (up to 15°C).

Air conditioning selection:

- Full rated takeoff operations:

On twin engine Airbus aircraft, the EGT level is quite similar regardless of air conditioning selection (bleed ON or OFF). Power setting decrement associated to bleed selection is designed to achieve that result.

On quad engine Airbus aircraft, the power setting decrement is designed to reach the same EGT level with bleed ON as with bleed OFF, when one engine feeds one air conditioning pack (failure case). EGT levels at full rated takeoff are thus lower with bleed ON than with bleed OFF.

- **Flex takeoff operations:**
At constant takeoff weight, switching OFF the engine bleed allows operation of the engines at higher flex temperatures than with bleed ON. This leads to lower EGT level.

Example:

To illustrate this point, let us consider an A340-300 equipped with CFM56-5C4 engines, taking off from an airport at 8 600 feet altitude , with a 10°C OAT:

With air conditioning ON (on the engine) and Tflex = 17°C, aircraft TOW= 225 tons.

Same TOW with air conditioning OFF (or ON but from the APU) is achievable with Tflex = 23°C, leading to EGT 10°C lower than with bleed ON.

Engine warm-up time:

Cold engine takeoff can lead to higher peak EGT values than with warm power plants.

The FCOM recommends a minimum engine warm-up time to avoid engine damage.

Extending the engine warm-up time beyond this minimum recommended will lower peak EGT values at takeoff.

Example:

The A340/CFM56-5C FCOM quotes a 2-minute minimum engine warm-up time before takeoff.

Increasing this warm-up time to:

- 10 minutes provides an average 9°C lower peak EGT,
- 15 minutes provides an average 12°C lower peak EGT.

Note: Extending the warm-up time show more benefit on takeoff peak EGT for engines with single stage HP turbines than for those with two-stage HP turbines.

10 | Conclusion

- To minimize EGT over limit occurrences, use engine trend monitoring and consider the following actions for aircraft equipped with reduced EGT margins:
 - Avoid operations on demanding routes
 - Conduct regular water wash.
 - On quad engine aircraft, privilege bleed ON for full rated takeoff and bleed OFF for flex takeoff operations.
 - Consider longer warm-up time to reduce EGT peak level at takeoff.
- **Operations of engines with very low takeoff EGT margin may lead to a risk of unnecessary high speed rejected takeoff. This risk increases as ambient conditions and power setting get closer to the worst-case conditions (full power, day temperature at or above flat rate temperature).
If an EGT over limit occurs when the aircraft speed is above 80 knots, the pilot should continue the takeoff and wait for the flight path to be established, at an altitude of at least 400 feet above the runway; before applying the appropriate ECAM procedure.**



Do you know your ATC/TCAS panel ?



By: Bernard VIGNAULT

Flight Operations Safety Enhancement Engineer



1 | TCAS Fault leads to AIRPROX

Shortly after takeoff from London Heathrow, the ECAM alert TCAS FAULT was triggered in an Airbus A340-600. The ECAM procedure consists in setting the TCAS mode to standby. Unfortunately, the effects of the action were not the expected ones: the crew inadvertently switched off both transponder and TCAS instead of selecting the TCAS standby mode as per ECAM procedure. The Air Traffic Control secondary radar information was temporarily lost and prevented the automatic update of the flight data. In other words, the aircraft disappeared from the ATC radar screen and was not able to respond to other aircraft TCAS interrogation. During this time the Tower Traffic Controller tried to contact the approach centre. Although several attempts were made the calls were not answered. Unknown to the approach controller, the aircraft was climbing in conflict with another departing aircraft. As the aircraft transponder was not responding, no TCAS alerts nor Short Term Conflict Alert (in Air Traffic Control) triggered and the minimum separation reduced to 3.7 NM and 0 ft.

2 | TCAS controls

Let us have a closer look to the ECAM procedure and to the TCAS controls, to understand this scenario.

When the TCAS fails, the ECAM procedure indicates (on A340/330): TCAS MODE.....STBY (See fig 1).



Fig 1: CAS FAULT ECAM procedure on A330/340



Fig 2: Gables 40 ATC/TCAS control panel

The crew is expected to set the faulty system on standby.

In the above event, the airline had chosen for its fleet the TCAS panel, which is shown in figure 2.

On this panel, a single rotating selector enables the crew to switch between several modes, linked to ATC transponder and/or TCAS. When the selector is placed in **TA/RA** or **TA ONLY** positions, both TCAS and ATC

transponder operate. But if the selector is placed in one of the three other positions (**XPNDR**, **ALT RPTG OFF**, **STBY**), then the TCAS is on standby mode. In their intention to set the TCAS only on standby mode, as requested by the ECAM, the crew turned the selector until it reached the **STBY** position. **They did not immediately realize that this position set both the TCAS and the ATC transponder on standby mode.**



TCAS + Transponder in standby

TCAS standby / Transponder On

TCAS + Transponder ON

3 | Other TCAS Control Panels

Several types of panels are available to customers, and pilots have to pay attention to the switches layout when operating them, as functions may differ from a panel to another.

On Airbus basic TCAS panel, the controls are split into two parts:

- one side of the panel is dedicated to ATC transponder controls
- the other side is dedicated to TCAS control.

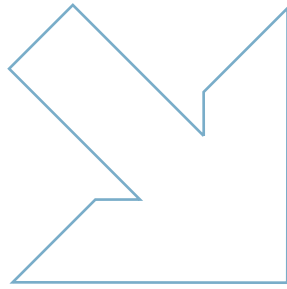


Fig 3: Basic ATC/TCAS control panel

Setting the TCAS mode to standby is done by setting the appropriate switch to the STBY position. The switch is easily identified, as it is located with other TCAS controls, and separated from ATC transponder controls (see fig 3).

When the TCAS switch is placed on the STBY position, the TCAS is electrically supplied but is inoperative, and the ATC transponder still operates normally. As a result, there will be no TCAS TA or RA on board the aircraft whose TCAS has been set to stand-by. However, the ATC transponder will be able to continue responding to potential intruder interrogation, and TA/RA information will continue to operate on-board the intruder.

Other designs exist for ATC/TCAS panel, on which TCAS setting on standby is achieved by setting the selector to XPNDR, STBY, ON or OFF, depending on which TCAS control panel is installed. On Gables 10 panel, for example, the selector should be turned from the normal TA/RA position to the ON position to set the TCAS on standby (see Figure 4). The ON legend is related to the ATC Transponder only. This is indicated by the fact that the ON legend is out of the settings related to the TCAS, that are gathered by a line associated to a TCAS label.

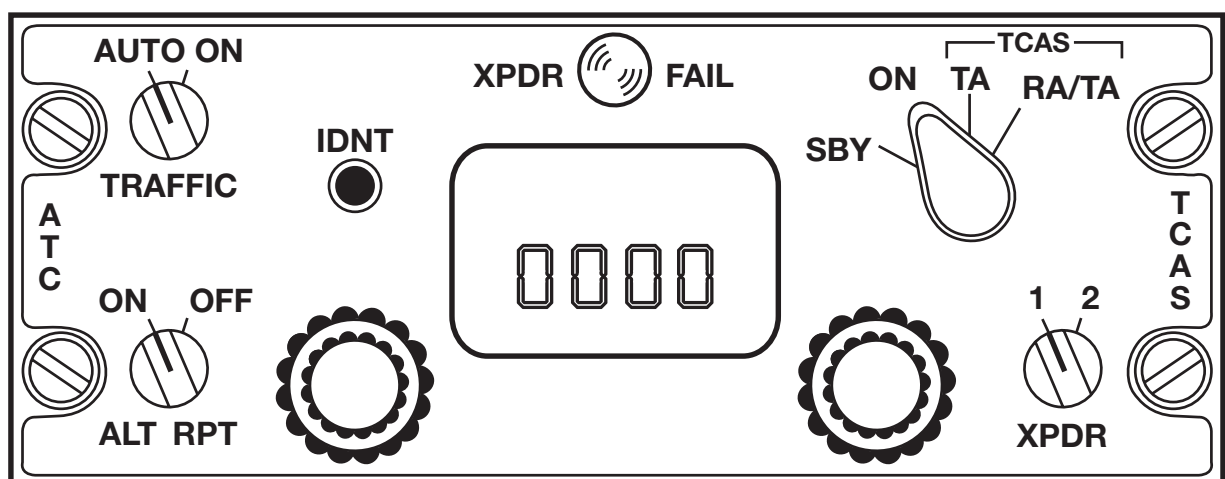


Fig 4: Gables 10 ATC/TCAS control panel – TCAS on standby

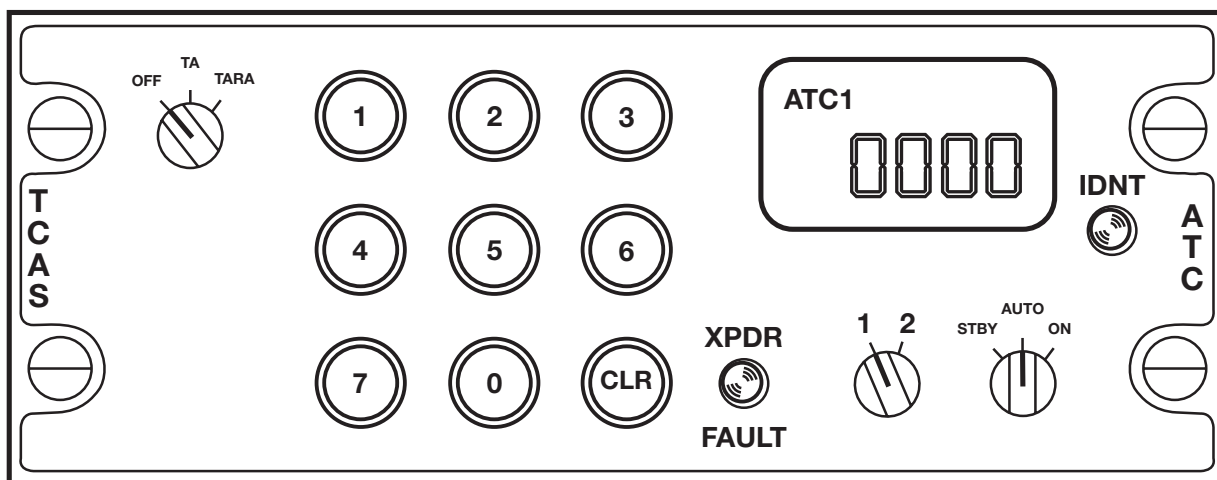


Fig 5: Gables 20 ATC/TCAS control panel – TCAS on standby

On Gables 20 panel, ATC transponder and TCAS have dedicated controls. TCAS is set on standby by placing the TCAS selector to the OFF position (see Figure 5).

4 | New ECAM procedure

Setting the TCAS to standby mode can be achieved by setting the selector to XPDR, STBY, ON or OFF, depending on which TCAS control panel is installed.

The Flight Warning Computer that generates the ECAM procedure in case of a TCAS fault has no means of determining what type of ATC/TCAS control panel is installed. It is therefore not possible to provide the crew with a customized ECAM procedure indicating the setting to be reached for each panel.

This is why the TCAS FAULT ECAM procedure is generic and provides the objective of the action to be performed: TCAS MODE.....STBY. It is then up to the crew to place the right selector in the right position.

ECAM Change

Setting the TCAS on stand-by when it is faulty enables to remove the TCAS FAULT flags on PFD and ND.

But the related in-service event highlighted the difficulty for the crew to use the right setting when the word “STBY” is displayed on the ECAM with a panel that differs from the AIRBUS standard one. Airbus then decided to remove the action line TCAS MODE.....STBY from the ECAM procedure and to accept the drawback of the flags remaining on PFD and ND after the failure. This modification will be effective upon fitting with new FWC standards. This modification is only applicable to Long Range aircraft, as the TCAS FAULT procedure is crew awareness only (no action line) on Single Aisle and A380 aircraft, and there is no ECAM warning for TCAS failure on A300/A310 family.

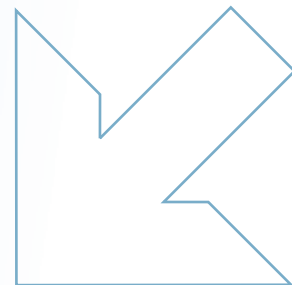
In the interim period before FWC standards are installed, AIRBUS published an OEB to inform crews not to apply the action line TCAS MODE.....STBY, in the case of a TCAS FAULT ECAM caution. The TCAS FAULT ECAM caution should be considered as a “crew awareness”.

This information was dispatched to airlines through FOT 999.0138/06 on 11th December 2006. The crews are informed of the deviation from ECAM procedure by:

- OEB **68/1** for **A330** aircraft (cancelled by FWC STD 2)
- OEB **82/1** for **A340** aircraft (cancelled by FWC STD L11 for A340-200/300 aircraft and FWC STD T2 for A340-500/600 aircraft)



Managing hailstorms



By: Albert URDIROZ
Flight Safety Manager

1 | Introduction

In the second issue of this magazine, dated September 2005, readers found information on turbulence encounter and avoidance in an article titled "Managing severe turbulence". Further to this, we will here discuss about the possible consequences of hailstorm encounter and the adequate prevention means.

No civil air transport aircraft structure is designed to absorb large hailstone impacts without damage. In conditions of extreme hailstorm encounter, consequences like destruction of the radome, loss of visibility through the two front windshields, unreliable air data or engine failure may turn out to jeopardize the safety of the flight.

Safe operations therefore consist in avoiding areas of hailstorms by relying, like the avoidance of turbulences, on the efficient use of weather radar. The effectiveness of the latter has been increased by the introduction of enhanced weather radars.

In order to illustrate this discussion, we will refer to in-service events that have been experienced by a few Airbus operators. Events with similar structural and operational consequences have been reported to occur with other aircraft type.

2 | Possible damages to the structure and engines

Windshields

Most of the civil air transport aircraft share the same design of windshields, made of two inner plies that ensure the structural strength, and of one outer ply. The structural plies will withstand impacts, but the outer ply may be damaged. Even if strength is not compromised, effects may be significant in terms of visibility, as shown by this picture taken after flight into a severe hailstorm.



Radome

In most of the severe hailstorm encounters, radomes suffer body damages but still fulfill their functions of fairing and protection for the radar and antenna. However, the air transport industry has recorded a few occurrences of radomes being destroyed.

Fuselage, wings, antenna, probes etc

Leading edges and protruding components may be damaged, or may brake when overstressed.

Engines

Even if Airbus has never received such report, the air transport industry has recorded some occurrences of engine(s) flame-out due to ingestion of hail.

3 | Possible subsequent consequences

All the communication and navigation aid systems may become inoperative when antennas are damaged (VHF, VOR, ADF etc..)

In addition, destruction of the radome may imply:

- Further structural damages upon impact with radome debris
- In isolated cases, engine flame-out upon ingestion of these debris
- Loss of the radar and attached wind shear prediction function
- Loss of ILS information
- Unreliable Air Data situation from disturbed airflow along the probes located downstream of the radome (Ref. sketch, probes location on A320 family).

Unreliable Air Data situation may also result from hail impacting the probes.

A fly-by-wire aircraft experienced such a situation recently. Because pitot probes were impacted by hail, airspeed information was affected.

Systems responded as follows:

- F/CTL NAV ADR DISAGREE was triggered;
- Electrical Flight Controls Systems reverted to alternate law;
- Autopilot and auto thrust disengaged;
- Flight directors were no longer available.

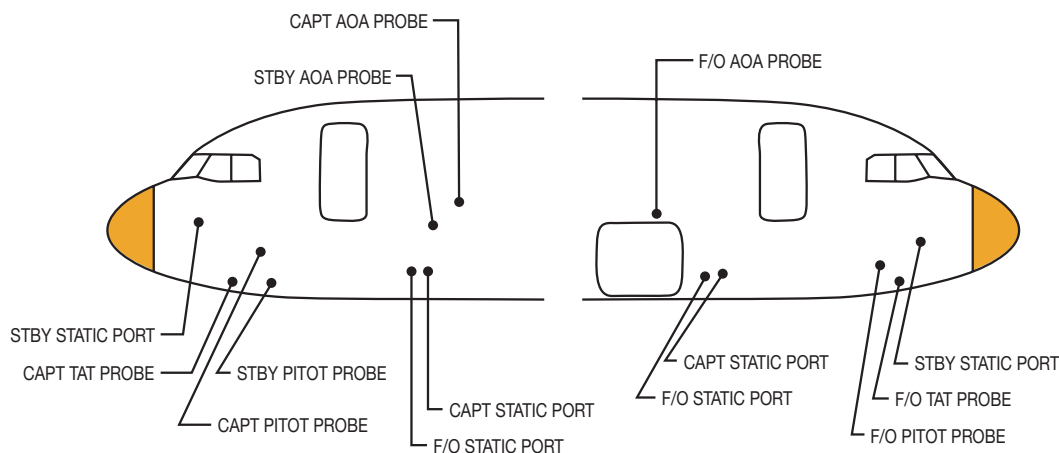
All these effects resulted from the unreliable airspeed flight conditions, which the crew had to manage as per ECAM.

During the same event, the windshield outer ply was damaged, as shown on the picture above. Autopilot, autothrust and flight directors were not recovered when the aircraft flew out of the hailstorm.

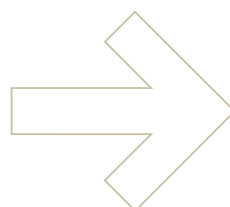
An emergency landing was performed, in the following adverse conditions:

- no autoland capability,
- no ILS guidance,
- no visibility through the front windshield.

The crew was able to land with the sole visual references obtained through the lateral cockpit windows.

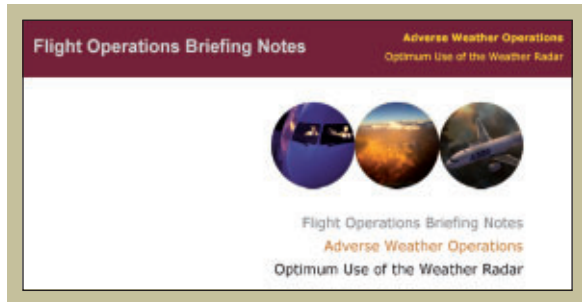


Probes location





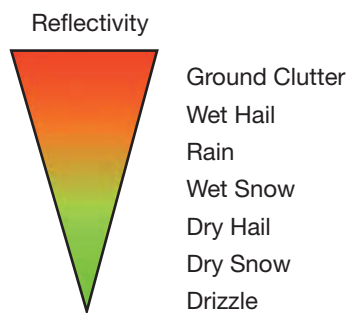
4 | Prevention means



The Flight Operation Briefing Note entitled "Optimum use of weather radar" explains how to tune weather radar in flight and to interpret the information displayed. It then considers the decisions to take in terms of adverse weather avoidance.

This document highlights that adverse weather management relies on:

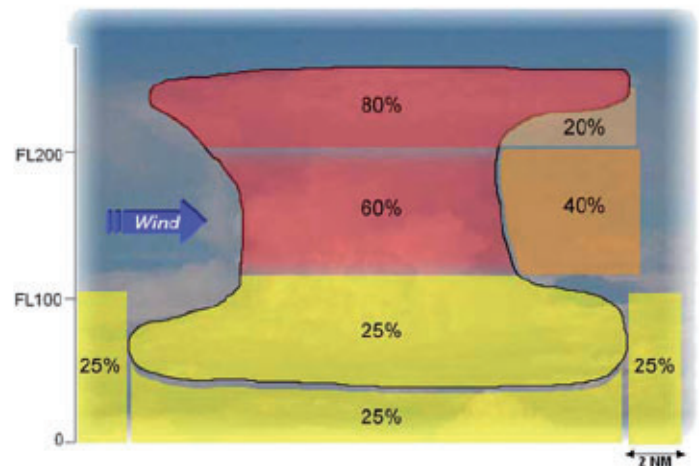
- Awareness of weather radar capabilities and limitations;
- Active and optimum use of radar, with crew tuning the range, gain and tilt;
- Flight crew's interpretation of the Navigation Display radar image;
- Relevancy of decisions taken.



Reflectivity According to Droplet Type

One of the radar limitations is that it indicates presence of liquid water. It does not identify the nature of returns, i.e. displays will not positively indicate presence of hail.

Consequently, avoiding hailstorm areas not only relies on the adequate use of the weather radar, but also on the good understanding of the structure of the cumulonimbus clouds that produce hailstorms.

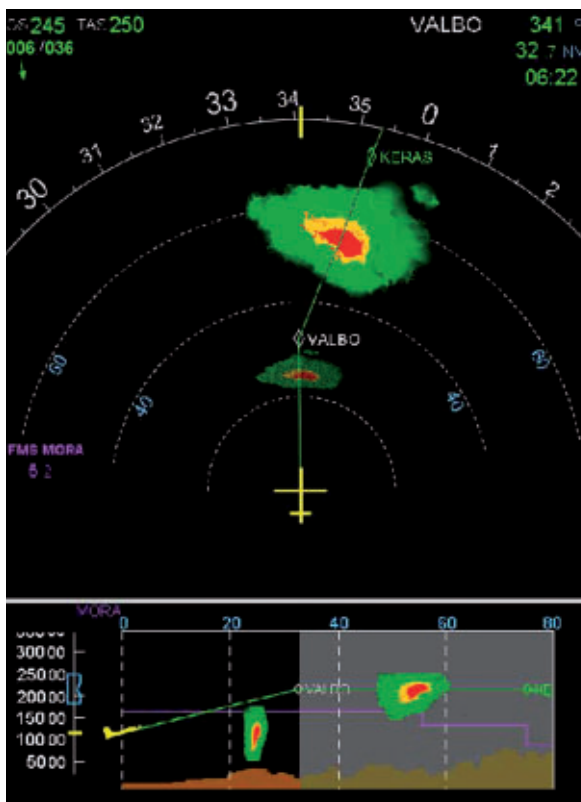


The Risk of Encountering Hail relative to Cb Cloud Position

Airbus recommends that this briefing note be used for training purposes and be made available to crews for developing and maintaining their radar usage knowledge.

5 | Adverse weather radar avoidance initiatives

Airbus and the weather radar manufacturers continuously cooperate in increasing radar performance and have introduced enhanced weather radars, which:



- Are more sensitive and accurate;
- Use pulse compression technology and algorithms;
- Scan airspace ahead of the aircraft out to 320NM and up to 60,000 feet;
- Feature 3D display of aircraft route (Ref. picture);
- Feature Auto-tilt.

These enhanced weather radars are proposed at entry into service for new programmes (A380, A350). Feasibility of introduction onto other programmes is under study.

6 | Conclusion

In extreme situations, hail encounter may result in:

- Severe damages to the structure,
 - Engine flame-out,
 - Major systems disruptions,
- and thus may jeopardize the safety of the flight.

Consequently all efforts should be made to avoid hailstorms areas. In that perspective, crews should optimally use the weather radar, i.e. adapt the tuning to the flight conditions and correctly interpret the information displayed, in order to take the appropriate decisions. Useful information is provided in the dedicated Flight Operation Briefing Note titled "Optimum use of weather radar".

Enhanced weather radars features, now implemented on new programmes, may be considered for introduction on in-service aircraft as available. For more information contact your Customer Support Manager or your dedicated Upgrade Services Manager.

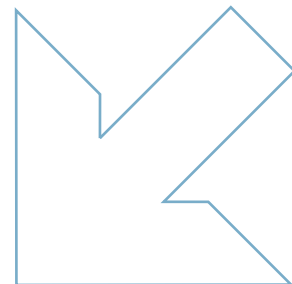
The briefing note dedicated to the optimum use of the weather radar can be downloaded from the Airbus Safety Library website:

http://www.airbus.com/en/corporate/ethics/safety_lib/





Introducing the Maintenance Briefing Notes



Uwe EGGERLING

*Deputy Vice President,
Maintenance Engineering
Services, Customer Services*

1 | Airbus Briefing Notes Concept Goes Global

Briefing Notes have been developed to constitute a safety-awareness reference for all aviation actors, regardless of their role, type of equipment and operation.

Briefing Notes provide an equal focus on Flight Operations, Cabin Operations and Maintenance.

The Issue # 01 - January 2005 - of the Safety First magazine introduced the Flight Operations Briefing Notes - A Tool for Flight Operations Safety Enhancement (see feature article on pages 23-25).

The Issue # 03 - December 2006 – introduced the Cabin Operations Briefing Notes – A Tool for Cabin Operations Safety Enhancement (see feature article on pages 27-29).

With this Issue # 04, Airbus is pleased to introduce the Maintenance Briefing Notes series.

2 | Introducing the Maintenance Briefing Notes

Statistics on the contribution of maintenance errors to incidents and accidents vary widely, from 5 % as a primary cause up to 30 % as a contributing factor. Maintenance errors also impact the profitability of operations, being responsible for 15 % of delays, 50 % of delays / cancellations due to an engine-related cause and 20 % of in-flight shutdowns.



Acknowledging that human errors can be reduced but not eliminated, error-management offers one of the promising avenue for safety enhancement.

The Maintenance Briefing Notes series was created to provide an eye-opening and self-correcting approach to human performance in maintenance. This publication will provide operators with lessons-learned derived from real-life case studies, highlighting :

- Statistics;
- Applicable procedures and best practices;
- Involved technical and human factors;
- Company prevention strategies / personal lines-of-defenses; and,
- Reference Airbus or regulatory material.

Maintenance Briefing Notes are developed by a panel of experts in engineering, human factors, scheduled and unscheduled maintenance, maintenance documentation and maintenance training.

3 | Scope of Maintenance Briefing Notes

The first Maintenance Briefing Note, issued in December 2006, is dedicated to Human Performance and Limitations, highlighting the challenges resulting from the traffic growth and increased demands upon aircraft utilization, the pressure of maintenance operations for on-time performance and the resulting growing need for an enhanced awareness of the importance of human factors issues in aircraft maintenance.

The upcoming Maintenance Briefing Notes will further explore subjects such as :

- Craftsmanship;
- Standard / best industry practices;
- Specific techniques; and,
- Trouble-shooting.

4 | Conclusion

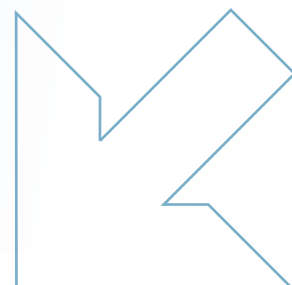
Flight safety enhancement has often focused on operational issues. The Airbus Maintenance Briefing Notes are intended to tackle maintenance issues, thereby contributing to the enhancement of maintenance.

The Flight Operations Briefing Notes, the Cabin Operations Briefing Notes and the Maintenance Briefing Notes constitute respectively the Volumes 1, 2 and 3 of the Airbus web Safety Library posted on the Airbus corporate website

http://www.airbus.com/en/corporate/ethics/safety_lib/



A320 - Dual hydraulic loss



By: Michel PALOMEQUE

Flight Safety Advisor

A318/A319/A320/A321 program

1 | Introduction

The A320 may experience a series of dual hydraulic loss when, at low altitude, a leak in the green hydraulic system causes the loss of the yellow circuit.

To understand how this may happen, this article will first describe the aircraft's hydraulic system and explain the respective roles of the Power Transfer Unit (PTU) and ECAM caution in case of pressure differential between the green and yellow systems.

The second part of the article will describe how the combination of a major leak in the green circuit and the ECAM inhibition below 1,500 feet may lead to the dual hydraulic loss.

The third and last part will develop on the corrective actions proposed to avoid this type of occurrences.

2 | General overview

The A320 hydraulic system is composed of three different and fully independent circuits: Green, Yellow & Blue. The users are shared between the systems in order to ensure the control of the aircraft, even when one system is inoperative.

On the blue hydraulic system, the normal source of pressure is the electrical pump, and the auxiliary source is the Ram Air Turbine (RAT). The Constant

Speed Motor/ Generator (CSM/G) is used to provide aircraft electrical power in case of emergency.

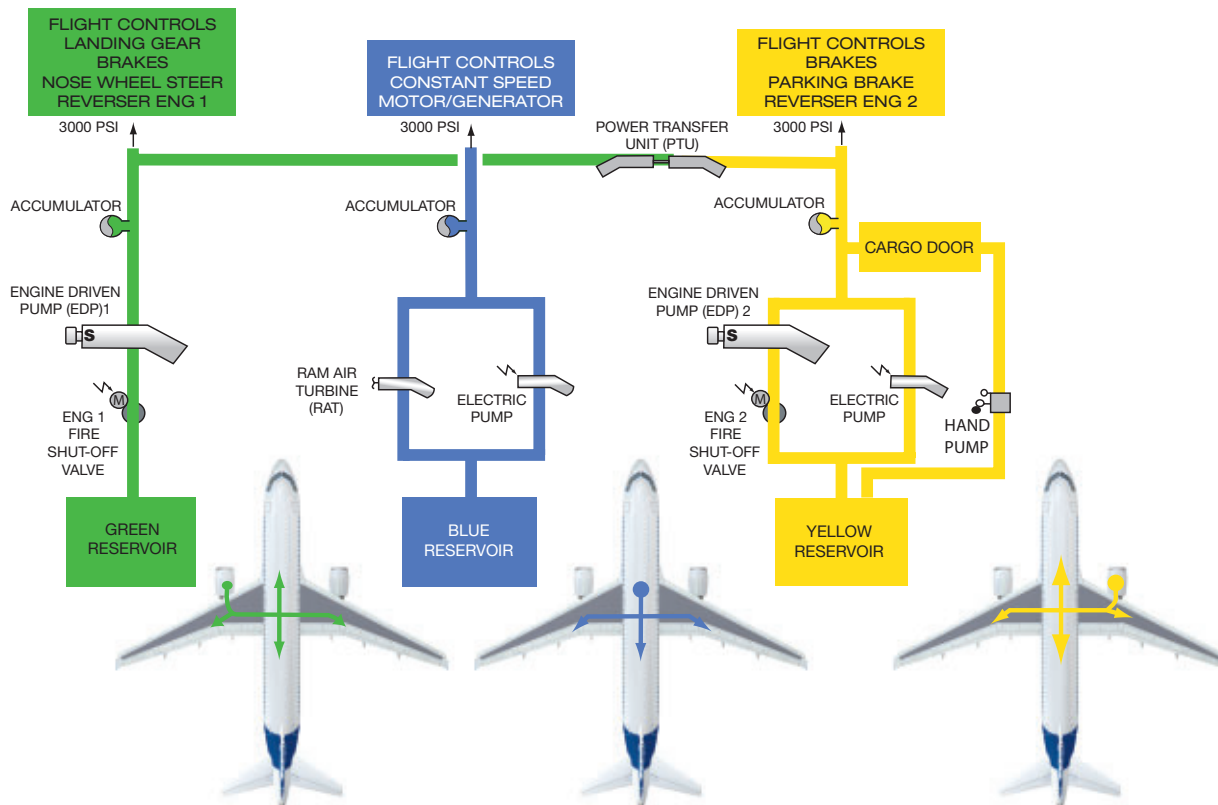
On the green & yellow systems, the normal source of pressure is the Engine Driven Pump (EDP) and the auxiliary source is the Power Transfer Unit (PTU). The PTU is a hydraulic motor pump which transfers hydraulic power between the green and yellow systems without transfer of fluid.

It operates automatically, whenever the pressure differential between the two systems reaches 500 PSI.

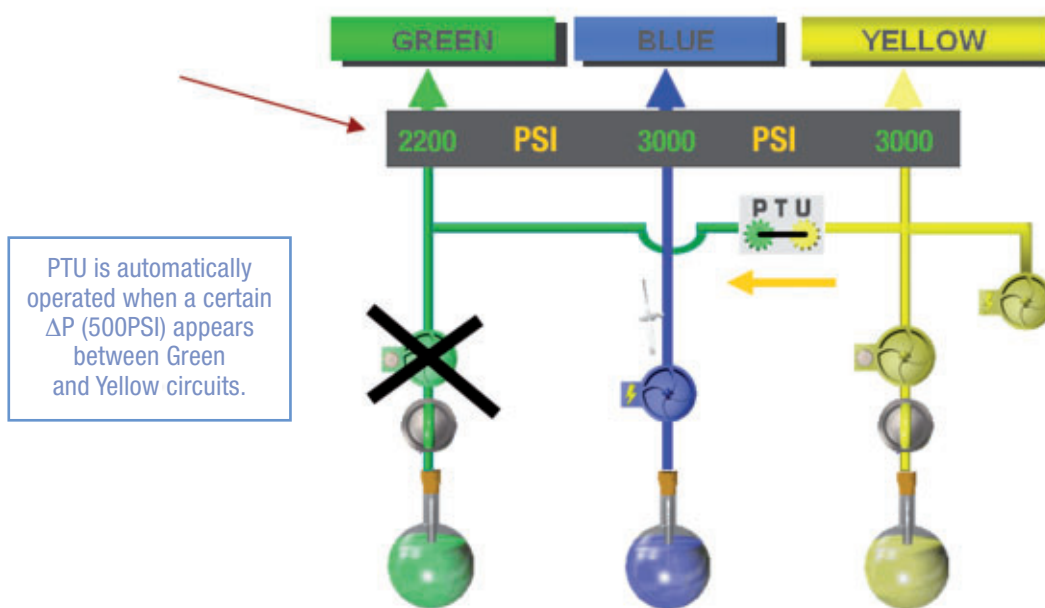
In case of low fluid level in either the green or yellow system, an amber caution is triggered on the ECAM, which requests the pilot to switch off the PTU as well as the EDP. This to avoid having the PTU running at maximum speed and causing the overheating and loss of the properly functioning hydraulic system.

According to the Airbus philosophy of not overloading the flight crew during the critical phases of flight, the above amber caution is inhibited below 1,500 feet.

The figure below shows all the systems, which are interconnected to the hydraulic systems:



SYSTEM OVERVIEW / RAT
Example of architecture.
Aircraft pre modification 26925.

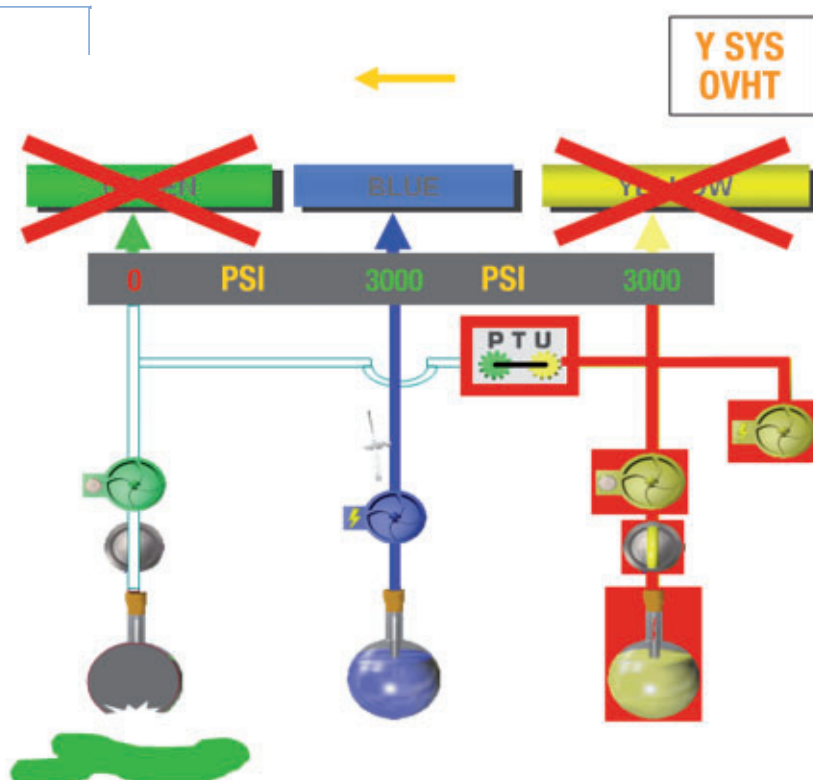




3 | Dual hydraulic loss scenario

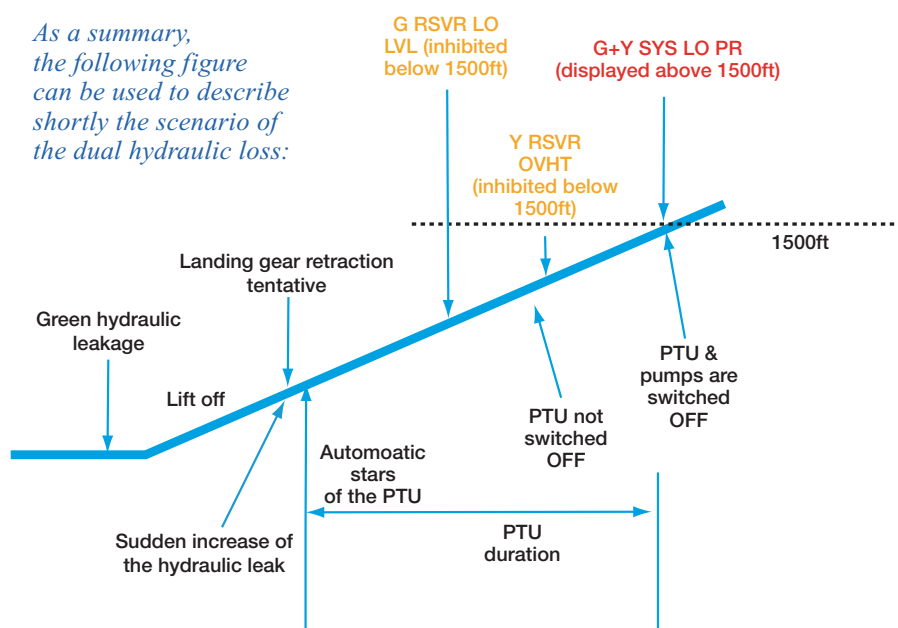
The scenario of the dual hydraulic loss is the following:

- 1) During takeoff, a leak in the gear retraction circuit leads to the loss of the green hydraulic system. This loss stops the retraction of the landing gear.
- 2) The 500 PSI pressure differential between the green and yellow hydraulic pressure is reached and the PTU automatically switches ON.
- 3) The loss of the green system normally triggers the corresponding ECAM caution, which requests the crew to switch off the PTU.
- 4) However, below 1,500 feet, the ECAM caution is inhibited.
- 5) The PTU therefore remains ON, and operates at its maximum speed.
- 6) As a consequence of the non retraction of the landing gear, the crew may be busy communicating with ATC and managing the situation, leaving the aircraft flying below 1,500 feet longer than usual, and thus keeping the ECAM caution inhibited.
- 7) Within less than two minutes, the PTU overheats the yellow hydraulic system and causes its loss.



- In case of green low level, if PTU is not switched off this will lead to
- A Yellow overheat (around 2 minutes later)
- Then to a double G+Y hydraulic failure

As a summary, the following figure can be used to describe shortly the scenario of the dual hydraulic loss:



4 | Corrective actions

This scenario already occurred in-service, leading to the following design change:

Below 1,500 feet the PTU is automatically switched to OFF.

This solution was preferred to the following alternatives:

- Upgrading the ECAM caution to a red warning.
- Cancelling the inhibition of the ECAM warning below 1,500 feet.

Indeed, red warnings require immediate action, which is not justified in this case, and cancelling the inhibition would only overload the crew during a busy flight phase.

The operational consequences of such change are described below:

In case of hyd leak in flight:

- No longer risk of dual hydraulic loss if no rapid crew action.
- Follow "G(Y) SYS LO PR" ECAM caution when triggered.

Note: the ECAM procedure requests a manual confirmation to switch off the PTU.

In case of hyd leak on ground:

- No PTU logic change:
Follow "G(Y) SYS LO PR" ECAM caution

In case of single engine taxi, or hydraulic pump failure or engine failure...:

- **No change : PTU runs** to recover the normal pressure in the affected system.

No ECAM change with new PTU logic:

- **ECAM still requests to switch OFF the PTU**
 - Only Pilot confirmation (in flight) with new logic
 - Common ECAM definition with old logic

5 | Conclusion

The scenario of dual hydraulic loss occurred in-service.

- The green hydraulic system was lost during gear retraction.
- The PTU automatically switched ON.
- The ECAM warning requesting to switch OFF the PTU remained inhibited below 1,500 feet.
- The aircraft remained below that altitude for more than two minutes after the start of the operation of the PTU, which led the yellow system to overheat and caused its loss.

A design change has been developed, which consists in the automatic switching of the PTU to OFF below 1,500 feet.

This change is covered by the following modifications.

MOD 34236 + 35879 / SB 29-1115:
Install provisions for new PTU inhibition logic

MOD 35938 / SB 29-1126:
Activate new PTU inhibition logic

Modifications 34236 & 35879
are now standard on production lines from MSN2740.

Modification 35938 is optional, and must be requested.

We therefore encourage airlines to retrofit these modifications.



Terrain Awareness and Warning Systems operations based on GPS data



Dimitri CARSTENSEN
*Surveillance Systems
Engineer*

1 | Introduction

The following article is giving comprehensive information on the Airbus policy promoting the use of GPS data for TAWS operations. This subject was introduced for the first time in Safety First #1 (January 2005) through the article titled “Go-Arounds at Addis Ababa due to VOR Reception Problems”.

The two TAWS systems proposed by Airbus, EGPWS and T²CAS, were originally coupled to the Flight Management computer to gather aircraft position and navigation data. The FM system is using data originating from multiple sources (GPS, IR from ADIRU, Nav aids such as VOR, DME, ...) to compute the aircraft position.

Experience has shown that FM and ADIRU data could be affected by improper IR alignments, erroneous Nav aids or improper ADR barometric settings. These could lead to TAWS spurious alerts and unnecessary go-around procedures during approach and landing phases.

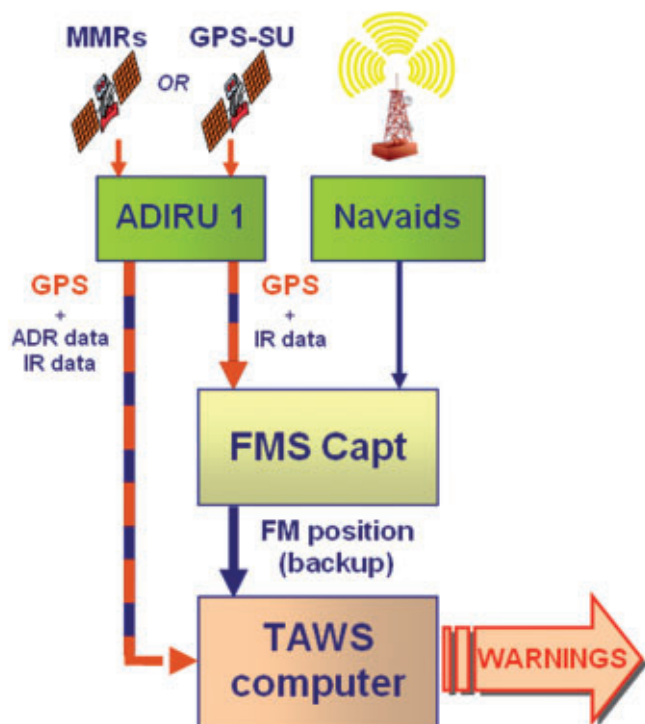
Consequently, Airbus developed new TAWS architectures where the TAWS computer takes the aircraft position data directly from the GPS sensor.

2 | Basic principles of the new TAWS + GPS architecture :

The new TAWS architecture is based on the use of a GPS sensor (Multi Mode Receiver or GPS Stand-alone Unit) linked to the TAWS computer.

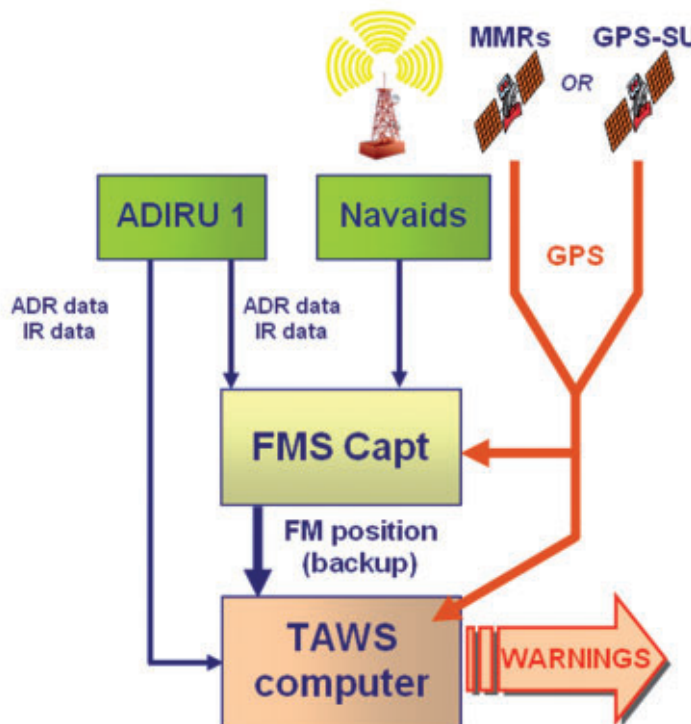
Indeed, with this GPS based architecture, TAWS performance is improved due to the better accuracy of GPS information compared to FM and ADIRU data. The segregation of the surveillance aircraft positioning data channel from the navigation channel ensures a full independence between these two major avionics functions.

The GPS is linked either directly (Autonomous configuration -) or through the ADIRU 1 (Hybrid configuration – most common on Airbus aircraft). In the latter configuration The ADIRU 1 is not interacting on the GPS data delivered to the TAWS computer, it is only used as a pass-through media.



Hybrid architecture

Most commonly used on Airbus (ADIRU 4MCU)



Autonomous Architecture

Previously used on Airbus (ADIRU 10MCU)

The TAWS computer uses the GPS data for positioning the aircraft in the three dimensions:

- The latitude and longitude data are used to position the aircraft relative to the TAWS Terrain Database (EGPWS and T²CAS). This can be easily implemented on the aircraft by activating the corresponding functions on the TAWS computers by simple pin programming. These functions are named "Use of GPS for Lateral positioning" on EGPWS, and "Alternate Lateral Position based on GPS" for T²CAS.
- The altitude data is used to compute a "Geometric Altitude" (EGPWS) also called "Alternate Vertical position based on GPS" (T²CAS), which is a blend of the Barometric altitude, Radio Altitude, terrain and runway elevation data to ensure optimal performance of the Basic and Terrain functions of the TAWS computer.

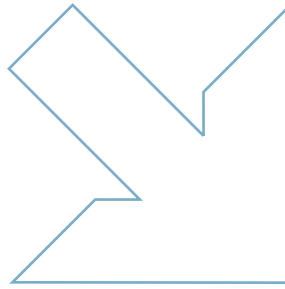
As above, these functions can be easily activated on aircraft by a simple pin programming of the TAWS computer.

In addition, when GPS data are used for latitude and longitude, the TAWS computer is modified by pin programming to perform an automatic management of the Terrain functions. This management is based on the availability and precision of the different position sources (by order of priority: GPS, IR from ADIRU, FM Computer).

When these position sources are neither available, nor precise enough, the TAWS computer automatically deactivates its Terrain functions. Previous deactivation had to be performed manually with the possible consequence, in case of omission, of potential spurious Terrain warnings during the approach and landing phases.

Note: In case of the Terrain function deactivation, basic TAWS Reactive Modes 1 to 5 remain fully operative.





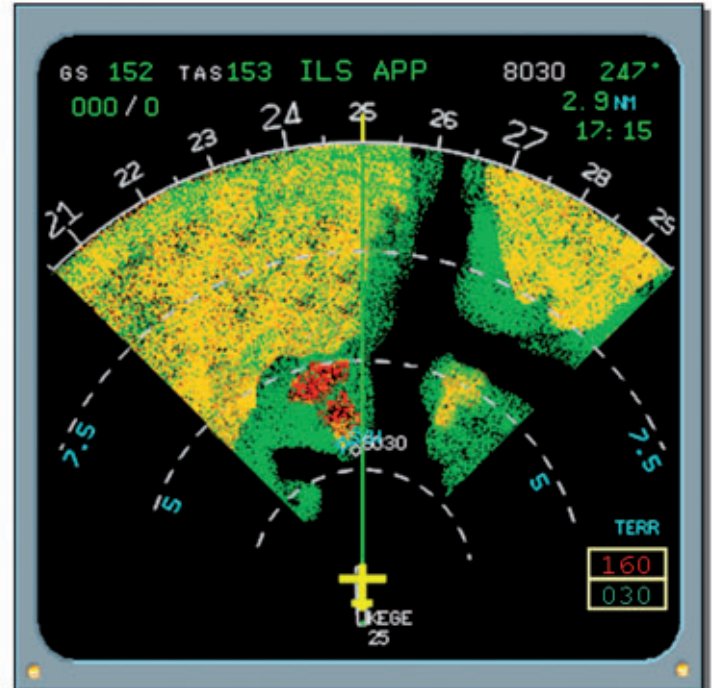
3 | Implementation for the EGPWS Computer (Honeywell) :

Airbus has certified the new Honeywell EGPWS P/N 965-1676-002 for the direct use of GPS data, either in Hybrid or Autonomous configuration. The EGPWS P/N 965-1676-002 can be installed in place of previous EGPWS versions, on all Airbus aircraft.

In addition to the use of GPS data for latitude/longitude positioning and activation of the geometric altitude, P/N 965-1676-002 also provides the availability of Peaks and Obstacles functions for all Airbus aircraft equipped whether with EIS1 (CRT) or EIS2 (LCD) display systems.

The Obstacles function enables the EGPWS to alert the crew of possible collision with man-made obstacles. The Peaks function enables the display of the terrain with the elevation being relative to the Mean Sea Level (MSL).

The green number in the lower right corner of the display features the lowest terrain altitude. The red number, just above, indicates the altitude of the highest obstacle.



Peaks & Obs display

This new EGPWS will enable a fleet wide Part Number commonality whatever the aircraft configuration, resulting in a noticeable operational benefit.

Airbus has developed a set of Standard Service Bulletins for installing EGPWS P/N 965-1676-002 and activating the GPS data based functions. These Standard Service Bulletins are covering every Airbus aircraft and have been sent to every operator having aircraft already equipped with EGPWS P/N 965-0976-003-206-206 or P/N 965-1676-001.

In production, the TAWS + GPS architecture on EGPWS equipped aircraft has been standardized since January 2006.

Please refer to OIT ref. SE 999.0050/06/VHR dated 18 April 2006.
Please refer to SIL 34-080 rev.06 (March 2007).

4 | Implementation for the T²CAS Computer (ACSS)

The “Alternate Lateral Position based on GPS” and “Alternate Vertical position based on GPS” functions can be easily activated through pin programming on T²CAS Standard 1 P/N 900000-10110 and future Standard 2 P/N 900000-11111 (certification obtained in April 07), on every Airbus aircraft.

Airbus has developed a set of Standard Service Bulletins for the activation of these GPS data based functions. These Standard Service Bulletins are covering all Airbus aircraft families and have been sent to all operators using aircraft already equipped with T²CAS Standard 1 P/N 900000-10110. In production, the TAWS + GPS architecture on T²CAS equipped aircraft has been standardized since May 2005.

Please refer to OIT ref. SE 999.0034/07/VHR
Dated 13 March 2007.
Please refer to SIL 34-080 rev.06 (March 2007).

5 | Regular update of the TAWS database

TAWS operations are based on the use of a terrain database. This database must be kept updated regularly to the latest version to obtain the full operational and safety benefits of TAWS operations.

Please refer to SIL 34-080 for more information
on the terrain Database and its associated
downloading procedure.

6 | Conclusion

Errors in the aircraft position provided by the Flight Management computer to the TAWS system may lead to spurious alerts and unnecessary go-arounds.

Airbus has therefore developed a new system architecture, which links the TAWS computer directly to the GPS. This solution is easy to retrofit and improves the performance of the system.

Please refer to SIL 34-080 rev. 06 (March 2007)
to find the applicable Standard Service Bulletins
for your aircraft fleet.

For more information about FM map shifts
scenarios and root causes analysis, please refer
to SIL 22-043.

The Airbus Policy promoting this new TAWS
system architecture based on GPS data is given
in OIT/FOT ref. SEE999.0015/04/VHR dated 05
Feb 2004.



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