The Airbus Safety Magazine
October 2015

Special Issue

Safety first

Functional Check Flights

AIRBUS

Safety first, Special Edition October, 2015.
Safety first is published by Airbus S.A.S. - 1, rond point Maurice Bellonte - 31707 Blagnac Cedex/France. Publisher: Yannick Malinge, Chief Product Safety Officer, Editor: Corinne Bieder, Director Product Safety Strategy & Communication.
Concept Design by Airbus Multi Media Support 20151711. Reference: D15030884.
Photos by Airbus, P. Masclet, Lindner Fotografie, S. Chobert, P. Pigeyre, C. Brinkmann.
Printed in France.

This brochure is printed on Stucco.
This paper is produced in factories that are accredited EMAS and certified ISO 9001-14001, PEFC and FSC CoC. It is produced using pulp that has been whitened without either chlorine or acid. The paper is entirely recyclable and is produced from trees grown in sustainable forest resources.
The printing inks use organic pigments or minerals. There is no use of basic dyes or dangerous metals from the cadmium, lead, mercury or hexavalent chromium group.

The printer, Art & Caractère (France 81500), is engaged in a waste management and recycling programme for all resulting by-products.

Safety first

The Airbus magazine contributing to the enhancement of the safety of aircraft operations by increasing knowledge and communication on safety related topics.

Safety first is published by the Product Safety department. 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, MMEL 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
safetycommunication@airbus.com
Fax: +33(0)5 61 93 44 29

editorial

YANNICK MALINGE
SVP & Chief
Product Safety Officer

Past experience has shown that conducting Functional Check Flights like "normal" commercial flights poses significant safety problems.

Indeed, even though they may be performed in an airline environment, used to managing the safety of commercial flights, they differ from these routine flights in many respects: their status of non-revenue flights, the required pilots' profile, the characteristics of suited operational environments, the guidance documentation or even the overall regulatory framework.

Functional Check Flights are peculiar flights requiring specific safety attention. As such, addressing them deserved a peculiar format. This special issue of the Safety first magazine will take you through the specific Functional Check Flights preparation journey.

This journey starts way before performing the flight itself, at much more remote and wider organizational levels as well. It involves a variety of aspects at a variety of time horizons that all contribute to Be Prepared for such flights.

To address all these aspects as a consistent whole, this special issue deserved a special structure as well. Not a set of articles, but a single text structured along the various organizational levels and time horizons illustrating what it takes to be prepared for safe Functional Check Flights.

Enjoy your reading!

Functional
Check Flights

HARRY NELSON
Experimental Test Pilot

SIMON PETERSON
Flight Test Engineer
Instructor

What does it take to be prepared?

Every flight is singular and needs to be prepared as such by flight crews, considering the state of the aircraft, the route, weather conditions, their own condition, the fuel quantity, the aircraft weight and balance… However, flights involving aircraft functional checks are flights with additional specific risks that deserve even more safety attention.

Indeed, these flights, when flown within an airline environment, differ significantly from “normal”, routine airline flights in many respects. They are sometimes called Technical Check Flights, Post Maintenance Check Flights, End of Lease Transfer Flights or Functional Check Flights. For the purposes of this magazine we shall use the abbreviation of Functional Check Flights, or put simply, FCFs.

Ensuring the safety of FCFs relies on various aspects and actors, at all organizational levels and phases. This special issue will provide you with an overview of what it takes to perform safe FCFs. It will address along a time / organizational unit line, the major aspects that, at each level, contribute to make FCFs safe. It is therefore arranged into the following sections:

1 **Special flights** requiring special treatment

2 **Airline preparedness** to perform Functional Check Flights

3 **Planning and preparing** a Functional Check Flight

4 **Executing** a Functional Check Flight

Special flights requiring special treatment

What is a Functional Check Flight?

Functional Check flights are non-revenue flights following maintenance actions or repairs that could affect the aircraft's inherent aerodynamic and/or system characteristics and operational performance or before a return to lessor of the aircraft. It is recommended that they are performed by three airline crew members, two pilots and an engineer.

Therefore, in the airline world, FCFs are flights that differ from routine activities in many respects.

To start with, FCFs are "non-revenue flights". As this activity is not the core business of airlines, it also disturbs to some extent the aircraft and crew availability schedules by mobilizing aircraft as well as crews and all the other needed operational personnel.
In addition, considering the objectives of a FCF, which is to get close to the limits and check the systems and the aircraft response, FCFs are unusual flights for airline crews.

"Non revenue"

"Technical check"

"Post maintenance check"

"End of lease"

A specific framework

Be it a matter of mind-set, of training, of documentation, of planning or all the other dimensions that contribute to making such flights safe, FCFs require specific preparation and conditions.

A preliminary condition to make such flights safe is to acknowledge this unique status and the need for special treatment of these flights at all levels.

From a regulation perspective, FCF specificities have been acknowledged and translated into the development of a dedicated regulation on Maintenance Check Flights that was issued in 2012 by EASA: Ref- EASA, NPA 2012-08. Maintenance Check Flights (MCF).

The regulatory requirements address a number of aspects contributing to the safety of FCF, namely:

- Flight crew requirements
- Additional crewmembers
- Training course
- Maintenance Check Flight Manual

In order to complete and reach beyond the regulatory material, the following sections provide some detailed and qualitative insights on key aspects that contribute to making FCF safe flights.

EASA REGULATION ON MAINTENANCE CHECK FLIGHTS AT A GLANCE

Figure 1: Summary of Functional Check Flights regulations

	Level A		**Level B**
Flight Definition	• Flights involving the use of Abnormal or Emergency Procedures or • when a "back-up" or safety level recovery system is to be checked. i.e. RAT		All other flights
Aircraft Definition	**Complex (motor powered aeroplanes)** • Above 5700 kg MTOW, or • Certificated for more than 19 seated pax, or • Certificated for operations with at least 2 pilots, or • Equipped with turbojet engine(s) or • More than one turboprop engine.	**Non-complex** • All other aeroplanes	
Flight Crew	• 1000 hrs total experience • 400 hrs as PIC on type • Completed Training Course to be PIC	• 500 hrs total experience • 200 hrs as PIC on any type	No specific requirement PIC and Co-pilot Type rating on type
Currency	• 1 check flight in last 36 months • If out of currency, 1 check flight as Co-pilot or observer to regain currency		
Training Course	• Includes: Ground and Simulator elements • Valid for all types • 1st flight must be as Co-pilot / Observer unless course included real aircraft training		
Maintenance Check Flight Manual	• Requirement for airlines to have one • Copy "lodged" with their authority • No "external" approval process		
Notes	1. Qualified test pilots automatically qualify, as having completed the Training Course 2. "Grandfather rights" apply w.r.t Training Course, but not the hours requirement 3. Additional crew member required in the cockpit 4. Possibility to add cabin "specialists" to crew 5. "Specialist crew" definition to be included in the Maintenance Check Flight Manual		

Airline **preparedness** to perform Functional Check Flights

Once it is acknowledged that FCF deserve special treatment, setting up all that is needed at the airline level to be prepared for performing such flights encompasses a number of aspects that are reviewed hereafter.

Selected and trained crews

There are certain characteristics of individuals' profiles that are more important in check flight work than in other tasks. In the airlines, most young pilots are selected against criteria with a different objective in mind. However, check flights are a fact of life for all airlines and often the task falls to the Chief Pilot or other senior personnel like the fleet captain, or the fleet technical pilot who may see such flights as a chance to get "out of the office". Not all these categories of people, important as they are, may necessarily be best suited for the task nor do they necessarily have the available time to prepare in the way they should and probably would wish to. So what should be looked for in a pilot or engineer who will be recruited into the "checking community"?

There are **4 pillars** on which a check crew member builds a successful career. These are **Knowledge, Skill, Aptitude and Experience**. "Not much difference there from my world" one may rightly say but let us look at some of these characteristics more closely in a "checking" sense.

KNOWLEDGE

A deep knowledge is clearly required of the aircraft, the theory behind the task and the role. A determined inquisitive mind is essential if one is to survive in the check flight world, and one would expect all check aircrew to be asking questions and then more questions until they receive an answer that is both "right" and makes sense. Questions coming from newcomers are especially welcome, as they keep the organisation true and sharp. Disinformation is generally easy to recognise and has no time in the checking world, so the answers had better be good.

An answer that was right 5 years ago may not be right today. Circumstances change and those changes sometimes demand a re-think. Equally, it is important to be self-reliant in this regard. Don't wait for the information to come to you, go looking for it and develop good contacts and sources of quality information.

> "A determined inquisitive mind is essential. Don't wait for the information to come to you, go looking for it."

SKILLS

> "Valued skills include Observation, Interpretation, Analysis and by no means least, Communication."

Valued skills include Observation, Interpretation, Analysis and by no means least, Communication. So called "motor function" flying skills for the pilots need to be pretty good too but it may be surprising to some that pure flying coordination and technique is not necessarily the top priority as long as this aspect is to an acceptable level for the task. However, flying ability does have an impact on the capacity of the pilot to handle high workload situations and therefore it will be referred to later in the section about Upsets.

Some of these skills do not come naturally to some. It is necessary to think through each check point or task and decide which parameters are important. Know also when and how often to read them and then when to record them. For the third crew member in this situation this recording task is always secondary to acting as the safety "observer", someone with an immediate oversight of the way each of the check points is being conducted and someone who can therefore issue timely warnings.

APTITUDE

> The right type of pilot or engineer should be naturally skilled at Crew Resource Management and be especially good at listening… the trick is to ensure on check flights that all those with knowledge and useful information are really heard, whatever their level, number of rings on their jacket, nationality, gender or salary grade.

Aptitude is a bit more complex. In this context, it refers to whether someone “thinks in the right way” and demonstrates the right judgement.

Firstly, check trainees need to be able to handle several apparent paradoxes. Let us take an example or two. Take the issue of when a check crew member has to stand their ground on a given topic versus when they can afford to be flexible. If we take a situation where an aircraft may need some re-work before or after a check flight but is due on the programme later in the day, you can immediately see the pressure that has to be handled in this fairly common situation and knowing when it is ok to be flexible or when a tougher stance has to be taken is part of the job.

Taking another example, in a typical group discussion about, for example, a specific systems check, certain people will inevitably have more knowledge than others, so the issue of when to speak from within your own knowledge and when to listen becomes a skill and a challenge. With the right level of sensitivity and awareness of each other, the team dynamic has to lead to the right answer.

Perhaps the most well-known is the issue of confidence. A check crew member has to have sufficient self-confidence to make decisions when necessary and to intervene in developing situations but not so much confidence that may lead to check points being flown in conditions outside the safe limits. There are many such paradoxical situations to be faced and correctly resolved in the world of check flights. Good team members get more of these situations right than wrong.

The right type of pilot or engineer should therefore be naturally skilled at Crew Resource Management and be especially good at listening. But check flight CRM is very different from the normal airline route situation. A ground engineer who is acting as a Functional Flight Check Engineer may well be the person with the best knowledge of a particular system. The second pilot likewise may be a specialist on a given area so the classic cockpit leadership balance may change during a check flight and should only tip with certainty towards the Captain when and if a final safety decision has to be made. Clearly, in the normal airline situation, the authority gradient is clearly defined. But each airline will need to decide how to handle the authority gradient issue in the context of their local and national culture. The trick is to ensure on check flights that all those with knowledge and useful information are really heard, whatever their level, number of rings on their jacket, nationality, gender or salary grade.

Check pilots in particular, also need to be able to achieve a good balance in their activities and maintain the necessary level of self-confidence without an over developed ego. Look for people who are not trying to prove how good they are but rather how good (or bad) the aircraft is. Interestingly, this trait is also critically important in the flight display world.

> Look for people who are not trying to prove how good they are but rather how good (or bad) the aircraft is.

In some respects this is the key difference between the checking world and the normal operational pilot world. Younger pilots spend their developing career improving their skills as a pilot and having to demonstrate those skills under test conditions. If the flight doesn’t go too well the normal reaction is, “it must be me”. “I am having an off day”. In other words they look inwards at their own performance. The checking world is different. It demands that they become “the standard” and that they use that standard to assess the aircraft they are flying. It is the aircraft that is under examination, not the pilot. They have to look outwards. If the same type of aircraft was flown yesterday and its response through a given manoeuvre was “normal” but today it is not or it feels different, then what has changed? Has something altered? Is the weight and Centre of Gravity (CG) the same, or is it potentially something even more serious like a degraded flight control system due to something like trim damage?

> It is the aircraft that is under examination, not the pilot.

Finally, and highest on the list of desirable characteristics, is personal integrity which is valued above everything else. The check flight specialists need to be people mentally strong enough to take responsibility for their decisions (good and bad) and then be able to live with their mistakes, learn from them and communicate them to others. Hours can be wasted chasing a non-snag or flight characteristic when in fact the culprit was the pilot who had selected the wrong configuration or moved the wrong switch at the wrong time. In the development test world there is no hiding place as everything done is filmed, instrumented, telemetered and examined by teams of specialists but this is not true of the airline check flight situation where good old fashioned integrity is vital. There is no more important characteristic in this activity.

> Highest on the list of desirable characteristics, is personal integrity.

EXPERIENCE

“Look beyond the hours…”

Experience (of the right kind) is extremely valuable in terms of improving judgement, prioritisation of task and risk evaluation but experience can also be a great deceiver. There are many 35,000 hr airline guys, in some parts of the world, who are totally unsuited to check flight tasks. Such people have much experience of doing repetitive and similar tasks rather than a range of different experiences against which to make good informed check flight judgements. So look beyond the hours and find out what relevant checking experience lies within the log book and how many non-routine operations have been successfully carried out by an individual.

SPECIFIC TRAINING

Identifying these main characteristics during an interview and selecting the “right” kind of person for this kind of work will buy you many dividends in the check flight scenario. Indeed, if you get the people wrong, no matter how good the process, it will still be at risk. Yet, training these people to further develop the knowledge, skills and attitudes to perform check flights is an additional asset.

It is quite possible to train check flight pilots inside an airline when the right expertise exists and is supported fully by management who recognise the need to get their people “up to speed” in a check flight sense. Some of the airlines with very large fleets, have a dedicated professional department whose role is to carry out the checks on all their fleet aircraft.

Equally, a manufacturers’ Functional Check Flight course has been developed by Airbus and has demonstrated very positive results. It is not designed to generate full test qualified crews but rather to give an initial immersion into the right type of thinking and to help airline check personnel get some way up the learning ladder and so prevent some basic errors. The course uses one of the Airbus aircraft types as a vehicle on which to hang the “generic” teaching elements and Airbus also uses this type to demonstrate the level of knowledge and skills that are needed to safely carry out FCFs.

Other aeronautical training agencies also do the same sort of thing but in a much more general way. The choice is with the airline.

THE AIRBUS TECHNICAL FLIGHT FAMILIARISATION COURSE

The analysis of actual Functional Check Flights that involved safety concerns allowed for highlighting some key aspects contributing to the safety of such flights:

- an aircraft checking mindset
- appropriate crew expectations
- specific skills to perform manoeuvres different from line operations
- recognition of the threat of differing objectives of crew members especially in an end of lease situation
- keeping away from a “tick the box” approach
- an awareness of performance and handling differences associated with unfamiliar airplane weights and CG
- new crew member skill sets and new knowledge
- a positive ATC interface

Based on this feedback from experience, Airbus developed in 2009 a Technical Familiarization Flight course with the objective to provide flight crew with Knowledge, Skills and Attitude to improve safety, quality and efficiency for conducting:

- **Technical flights or Functional Check Flights** (i.e. post maintenance, painting, etc.)
- **Acceptance flights** (i.e. handover between operators)

This course is designed for a crew of 3, 2 pilots and 1 engineer and is delivered by 2 instructors, 1 flight test pilot and 1 flight test engineer.
It combines a ground phase (2 days), a Full Flight Simulator phase (2 days) and a flight to cover all the aforementioned aspects to make FCF as safe as possible.

Want to know more about Airbus Technical Flight Familiarization course? **Contact or website**

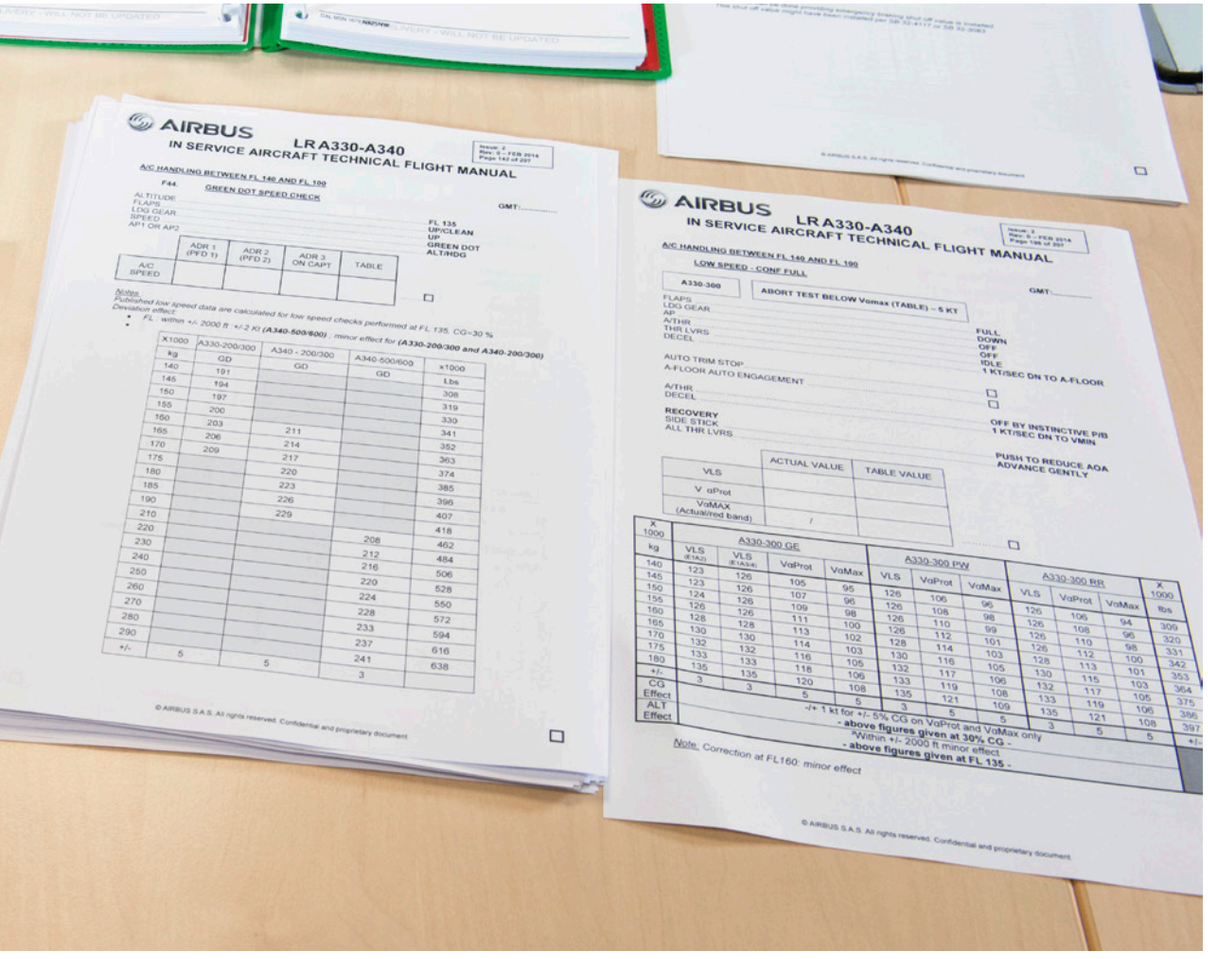
> The only manual that is to be used to perform Functional Check Flights is the ISATFM. Do NOT use the CAM.

Guidance documentation

Beyond having the right people, being prepared for performing functional check flights also relies on an understanding of what these checks are, what they are for and how to perform them.

There has been a certain amount of confusion over the years about which document an airline should use if it is intending to carry out its own post maintenance FCFs.

Mistaking one manual for another could induce hidden risks that have no place in the world of Functional Check Flights. So which one should be used?



A MANUAL FOR EACH CIRCUMSTANCE

A number of manuals have been developed by Airbus to perform “check” flights. Specifically, the ISATFM (In-Service Aircraft Technical Flight Manual), the PATM (Production Aircraft Test Manual) and the CAM (Customer Acceptance Manual).
There has been a certain amount of confusion over the years about which document an airline should use if it is intending to carry out its own post maintenance flight check.

The easiest, and incorrect, solution seems to be to use the one that is most likely in hand….the Customer Acceptance Manual, which has been received by all Customers during the acceptance flight of a newly delivered aircraft. However, this “solution” carries with it several hidden risks that have no place in the world of Technical Flight Checks. So which one should be used?

Although all the flights covered by these three manuals are meant to perform checks, each manual has a specific scope in terms of:

- The status of the aircraft (from straight off the production line to already in-service).
- The background of the pilots and the organization they belong to.

In a nutshell, these documents could be characterized as follows:

Status of the aircraft / Flight crews	Brand new, straight off the production line	Just passed through the stringent testing process of the Production Flight Test Department	In-service, following maintenance actions on items that cannot be properly ground tested
Manufacturer test pilots	PATM Objective: Fully check the operation of the aircraft to the limits of the certified flight envelope. More than checks, the PATM is used to perform tests as it is the first time the aircraft will have been tested in flight. Serves as evidence to the Authorities that the aircraft meets the standard required for the granting of a Certificate of Airworthiness.		
Mixed manufacturer/airline crew		CAM Objective: Demonstrate that the technical operational standard against a commercial contract has been met i.e. the aircraft flies correctly with no abnormal handling or system failure.	
Airline crew, specifically trained for Functional Check Flights			ISATFM Objective: Verify that the aircraft’s operational characteristics have not been adversely affected following the maintenance actions on items that cannot be properly ground tested.

In other words, the only manual that is to be used to perform Functional Check Flights is the ISATFM. Do NOT use the CAM.

THE ISATFM (IN-SERVICE AIRCRAFT TECHNICAL FLIGHT MANUAL)

As just mentioned, this is THE manual which must be used for In-Service aircraft. There is an ISATFM for each family of Airbus Aircraft: Wide Body for A300 family, Single Aisle for A320 family, Long Range for A330/A340 family, and Double Deck for the A380.

Each manual is divided into 3 parts:

Part 1 is the Ground Check phase
Part 2 is the Basic Flight Phase and
Part 3 is the Flight Phase with additional checks for Trained Crews.

These phases should be carried out in the logical and numbered sequence.

Here, we will deal only with the flight phases. (Parts 2 and 3)

In 2014, the ISATFM flight phase was divided into 2 parts after requests coming from the aircraft leasing community. It was recognised that the older generation of ISATFM manuals was quite complicated to fly for pilots who had no flight checking experience. The manual was therefore divided so that “Part 2”, became the basic function checks of the aircraft within the normal envelope, and “Part 3” the advanced checks to be performed by crews who had been suitably trained and therefore allowed a deeper technical check of the aircraft and its systems.

In fact, Part 2 is intended to be used for aircraft already in service, with no significant maintenance actions prior to flight, allowing a handover phase between operators. It could be flown by regular line pilots.

These are the primary reasons why Part 2 should not be used as a manual for carrying out Technical Flights within airlines.

The Part 3 flight profile is very similar to a production first flight, but without the checks for performance or degraded modes. At the end of the flight, the crew have a very good picture of the technical state of the aircraft.

In order to fly the “Part 3” flight profile, it is recommended that the crew should be correctly trained.

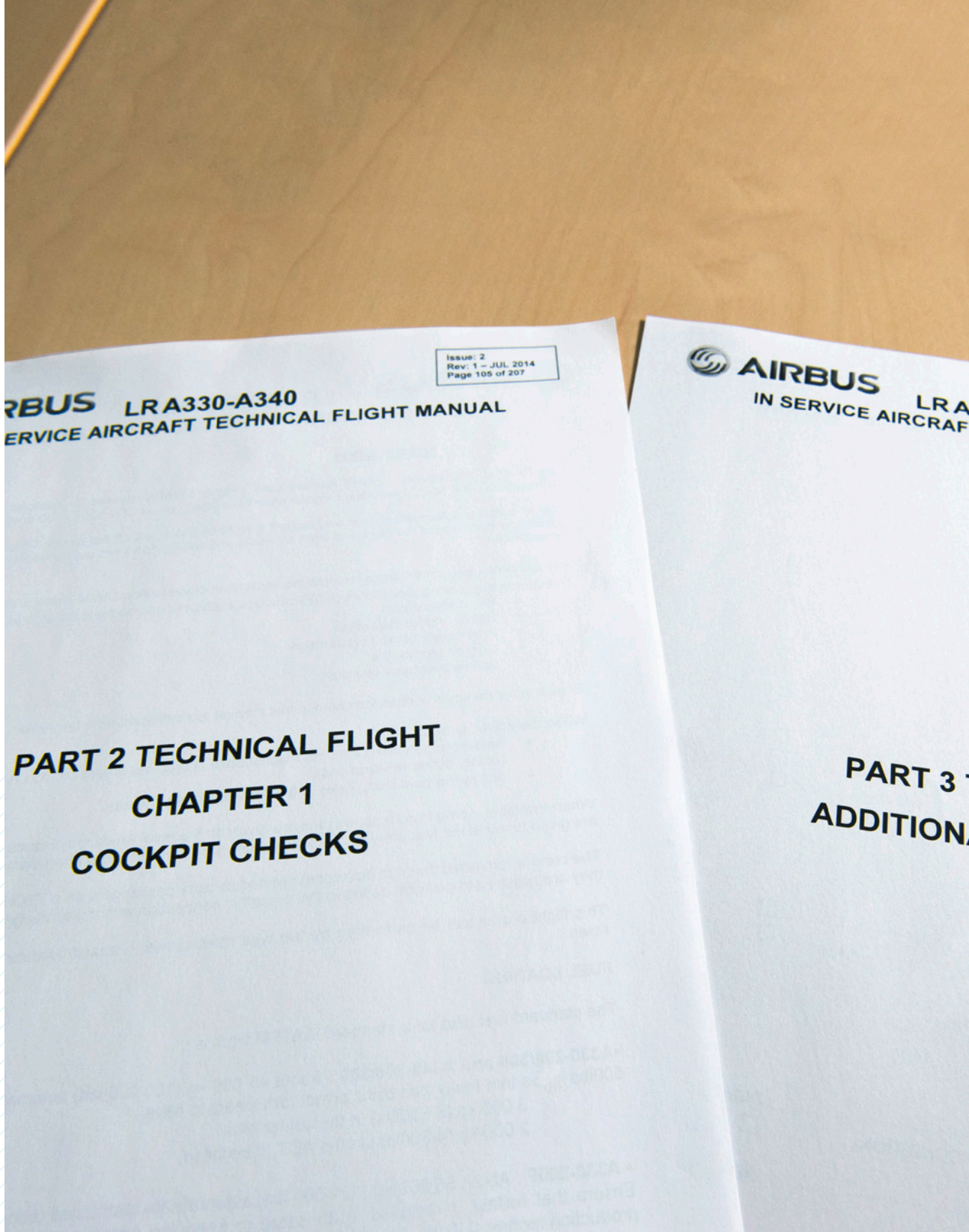
HOW TO GET THE ISATFM MANUAL AND USE IT?

The philosophy of use of the ISATFM document developed by Airbus is to support airlines in the development of their own FCF manual, adapted and customized to their own context of operation (airfields, checks, pilots profile…). In other words, the ISATFM has been designed as an “a la carte” menu, and is a guideline recommended by Airbus based on its expertise. But in order to support the safety of FCFs, each airline needs to go through its own thinking process and design its own manual based on this reference. This reflection may lead an airline to remove some checks if it does not feel confident about performing them or add some specific information considering its environment...

In order to make sure all airlines are aware of and acknowledge this required step, the ISATFM is supplied by Airbus upon request, after signature and reception of a legal waiver stating how to use this document. The legal waiver states that the airline should take control of its own document using the guidelines of the supplied ISATFM and that the reference to the document being an Airbus document should be removed and the Airline headings applied. Logically, it also states that the ISATFM document with Airbus headings should not be forwarded to third parties nor copied or stored, but this is only with the Airbus headings.

To receive the Waiver, airlines need to write (e-mail) to the secretariat of EVRT (evrt.control-room@airbus.com)

In turn, the airline will be supplied with the legal waiver which must be signed, and returned, in order to receive the document for their type of aircraft. The airline will then receive a pdf version of the document.



A FLAVOUR OF THE ISATFM... OR THE CHECKS TO BE PERFORMED IN FLIGHT

The first major actions on the aircraft in flight are the flight control check. After ensuring that all loose objects are secured and the weather radar is switched off, the pilot will pitch and roll the aircraft towards, but not exceeding, its protection limits – that is +30 to -15 degrees pitch with a pull of up to +2.0g and push to no less than +0.5g, and just over 45 degrees LH and RH. The objective is to ensure that the aircraft response and the "feel" of the aircraft is "normal" and that the envelope protections function as per design.

Following this, the autoflight systems will be checked with normal and stick over-ride disconnections, followed by a check of global speed protection that is carried out to monitor the control law reversions.

During the climb, the 3rd crew member monitors, and records, the systems parameters, whilst checking for abnormal values. The pilots keep busy performing Radio and Navigation qualitative checks. On arriving at FL310, the crew perform a series of checks for the engines, lateral trim (to check that the aircraft flies wings level) and anemometry checks of the altimeters, and angle of attack probes. Once happy, the crew will proceed with pressure checks. The first check is to inflate the cabin up to its maximum pressure limit in order to check the correct functioning of the cabin pressure safety valves. This check is critical as the crew must monitor very carefully that the valves open within the correct limits. Leak rate and depressurisation checks follow, which may take the cabin up to 14000ft cabin altitude, whilst checking the cabin leak rate (caused by passenger and cargo door seals), pack valve sealing, cabin altitude warnings and finally the dropping of the oxygen masks. This later check involves good communication and coordination with any cabin engineers on board. If there are "non-crew members" working in the cabin, a depressurisation to a lower cabin altitude may be advisable – in which case stopping the depress at the Hi Altitude warning (9550 or 11300 feet cabin altitude) then using Mask Man On, is a more prudent option.

After this, the crew will fly towards the operational ceiling of the aircraft, performing more anemometry checks to complete RVSM checks. At the ceiling, the APU will be started, and when stabilised, each engine generator will be selected OFF then ON, in turn, in order to check the correct transfer of electrical power to the APU generator.

The descent is relatively fast, with overspeed checks at MMO and VMO, plus speed brake deployments to check for any abnormal lateral behaviour. Wing and engine anti-ice are also checked in the descent, as is APU bleed at lower flight levels.

The descent is into an airspace known as "the block". This is an altitude "block" agreed with Air Traffic Control normally FL100 to FL140 – but significantly depends on the geographical terrain where the aircraft is flying. If the terrain is high then a higher block altitude will be necessary! Here, the low speed checks are carried out provided that the aircraft has not acquired any ice in the descent. Prior to commencing any low speed checks, the Green Dot speed and AOA values are confirmed. If problems are found at this stage, then the remaining low speed checks may be abandoned. When the relevant values have been assessed and agreed, the aircraft will be decelerated in the clean configuration until it is stable at "alpha-max". This condition is the stabilised minimum speed with full back stick using "normal law". When the 3rd crew member has recorded the values, the pilot will perform the low speed recovery procedure and, immediately, the aircraft is set up for the alpha-lock test. This check is to confirm that, with a low speed / high angle of attack, if the slats are set from 1 to 0, they will not retract.

The aircraft will then be configured into the landing configuration and decelerated again to alpha max. It may be surprising to know that for A320s, A330s and A380s, the stabilised minimum speed will be roughly the same, in the region of 100 knots! Whilst both of these checks must be approached with caution and due care in terms of rate of speed reduction and gentle control use, provided the aircraft systems are working normally, they are relatively easy check points to fly.

The final checks in the low speed block, are to ensure that various systems are functioning correctly – Automatic Go-Around, Hydraulic locking of the spoilers (when hydraulic systems are degraded), emergency electric and Ram Air Turbine, and flap relief and audio warnings with various speeds and flap configurations.

The final check – depending on airfield capability – is an autoland. However this check needs to be carefully considered. Before checking the autoland system, the characteristics of any non Cat III ILS facility need to be assessed beforehand, preferably on another serviceable aircraft. (The readers may interpret that as meaning they need to fly another aircraft before they fly the check aircraft). The intended autoland also needs to be discussed with the local ATC as Cat 3 protection may need to be organised in advance.

It is important to note that the sequence of tests above has been carefully considered, is important and should be adhered to.

Why is it advisable to fly such a profile? The answer is that, while the ground checks performed by the hanger staff are very good and thorough, there may be still some aspects which the airline management feels cannot be adequately checked on the ground. The airline decision will be – "do we need to do a dedicated technical flight?"

Such decisions must be based on the local engineering and operational judgement on, the level and depth of overall maintenance that has taken place, the number of systems that have been disturbed, the applied modifications, the maintenance "history" of a given unserviceability and the significance or all these issues with regard to the flight control system, the engines, the aerodynamics and the sensors of the aircraft. The Aircraft Maintenance Manual reads as follows:

AIRCRAFT MAINTENANCE MANUAL

NON-REVENUE FLIGHT - REQUIREMENTS FOLLOWING MAINTENANCE ACTIONS
DESCRIPTION AND OPERATION

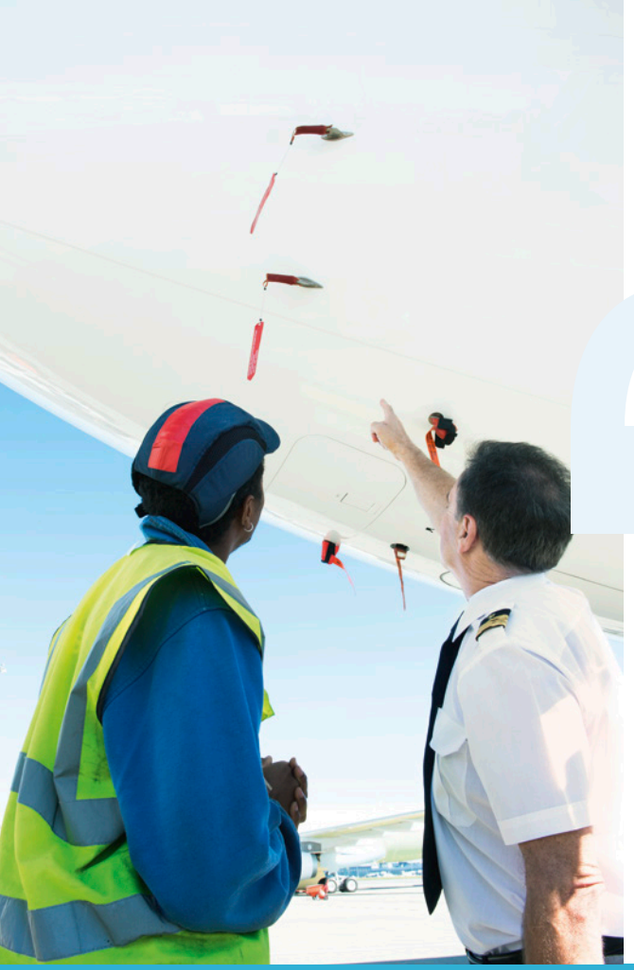
1. General
Non-revenue flight following maintenance actions are not required by **AIRBUS** except for actions involving items that cannot be properly ground tested to verify that the aircraft's operational characteristics have not been adversly affected. Service experience has shown that a non-revenue flight is good practice following actions or repairs which could affect the aircraft's inherent aerodynamic characteristics.

NOTE : Operators Regulatory Authority may require non-revenue flights following certain maintenance actions.

2. Engine Replacement Replacement or reinstallation of both engines does not require a non-revenue flight providing the engines have been successfully shop tested prior to installation, properly installed and successfully ground tested in accordance with all applicable maintenance instructions. However, owing to the number of different interfaces concerned, **AIRBUS** recommends that a non-revenue flight be carried out after changing or installing both engines to check that no double maintenance induced faults have been introduced.

NOTE : It is recommended that operators avoid performing maintenance on multiple engines installed on the same aircraft at the same time if at all possible.
If it is not possible to avoid maintenance on more than one engine at the same time, it is recommended that different maintenance teams service each engine.

Planning and preparing a Functional Check Flight



> ONLY those checks that cannot be performed on the ground should be performed in the air.

Let us now move to the planning and preparation aspects. Many questions need to be asked and answered before the check flight takes off, starting with the need to understand the task. What exactly is the objective of the flight? Can the objective be met on the ground? What state is the aircraft in? Who will be doing it? When has it got to be done? Where is it to be done? And finally, with all that information, what are the risks and what will we do if it goes wrong? Some things seem to be common to most tasks. Let us try to capture those which come up most often.

The first rule is to be able to justify why a flight check is being done in the first place. Many checks can be performed successfully on the test bench. Despite pilots' love of flying, ONLY those checks that cannot be performed on the ground should be performed in the air. GPWS is a good case in point. The "box" has all the logic fixed and it can be bench tested. The software will have been correctly tested and certificated. What is then needed of a possible check flight? In reality, the "aircraft connections" only need to be verified in terms of flap signal, gear signal and radio altimeter. Such a check does not require all the modes to be flown.

The Aircraft

Let's deal with the aircraft first. The check flight crew will need to know exactly what servicing has been carried out and which systems have been disturbed. They will also need to know if repairs, modifications and upgrades have been applied and if so, what impact they may have on the intended flight. Some notice of the flight is therefore required because a visit to the hangar is essential to get to the bottom of most of these aircraft questions. Talk to the servicing manager and look at the log books in depth. Take care with the "can you just come down this afternoon and carry out a quick check flight" type of request. More has often been disturbed or worked on than at first appears.

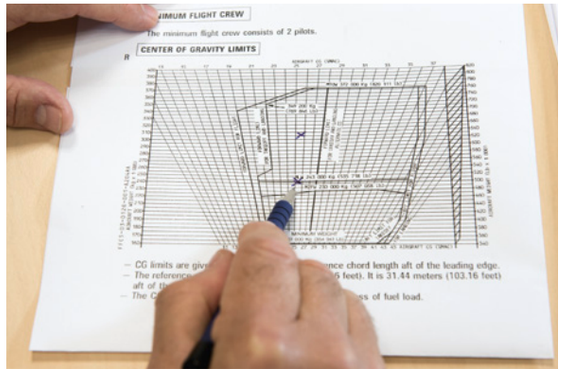
In the longer term develop a trustful working relationship with the mechanics in the hangar. It is amazing what they will tell you once that trust is established. Humour between people who know each other tends to help a lot here. If the situation does not encourage that, due to the use of an outstation or remote facility for instance,

> Apply the principle that if it can happen, it will happen.

try to gauge the quality of the hangar guys (and their management) and the level of pressure they have all been working under.

If the aircraft has been cleaned or painted, pay careful attention as these activities can give rise to numerous "knock on" technical issues such as pitot or AOA sensor damage. Always do a detailed walk around before such a check flight and take time over it. There have been many examples of jacking pads left on aircraft, masking tape covering elevator hinges and over spring tabs, not to mention paint on static plates and vents being blocked by FOD following deep servicing or painting.

Remember also all those systems that may have been required to be put into the Ground Test position to allow certain ground checks to be completed prior to flight clearance. Know what they are and make sure that they



are all correctly re-positioned to the flight position prior to flight. Apply the principle that if it can happen, it will happen. Your job as checker is to ensure that there is no adverse effect on the flight.

You will also need to think carefully about the weight and Centre of Gravity (CG) for the check flight. Loading ballast in an airline is not always the easy thing it is in the manufacturers test world and unusual CGs are not so common for the loads specialists. Even so, ask anyone who has been around a while in the test world and they will all have accrued a few mis-loading incidents in their life time. An advice would be to try to put the aircraft into a weight and loading situation with which you feel comfortable and use it as a standard for all subsequent similar flights.

Set up a mid CG if possible, avoid being on the limits and do consider the effect of the weight and CG on the expected "feel" of the controls. Expect that the aircraft will inevitably be much lighter than the aircraft on the line. No big problem there, but think about it and consider the speeds to be used in relation to stall speed and Minimum Control Speed. It may be that whilst you would normally be stall speed limited, you may now be on or near the Minimum Control Speed in the Air (Vmca) limits. It may also be that to fully test the fuel system a specific fuel load is needed and this may drive the CG.

> Think carefully about the weight and Centre of Gravity (CG).

Crewing

> The primary role of management, with regards to check flight personnel, is to select the right people, then to let them do the job and finally be supportive in a safety sense, of their sometimes difficult decisions.

As previously said, often FCFs are seen by airline flight operations management personnel as a “chance to do some flying”. Understandable and tempting as this may be, they may well be the least able in terms of their ability to spend time researching and understanding the issues, keeping their flying skills at the right level and at being able to focus completely on the task and make the right technical judgments whilst handling the “pressure” to get the aircraft back on the line. Clearly, there are some management pilots who are “right” for the task but before selecting themselves, a totally honest review of their workload, experience and technical type knowledge needs to be carried out. The primary role of management, with regards to check flight personnel, is to select the right people, then to let them do the job and finally be supportive in a safety sense, of their sometimes difficult decisions. Checkers need to know that they will be supported by their operational boss in this regard and yes they will sometimes make mistakes too.

Having a small team of hand selected crew members who are properly prepared for the task is a better approach than trying to “be fair” and rotating the checking flights amongst all to give everyone the experience. A minimum group needs to be defined consisting of sufficient support or check engineers and pilots to manage the checking workload of the airline. They should have a nominated head who, through regular meetings with the team, reviews the schedules to be used, and ensures learning from the experience gained from each flight. He / she can also recommend to senior management how aircraft to be checked should be presented. Such a person can also act as the liaison with the aircraft manufacturers to pick their brains and ensure that the airline receives the best advice possible from the manufacturers test specialists.

We recommend a crew of three wherever possible, so perhaps one of the major challenges for many airlines is to be able to integrate a ground operations engineer, a licenced quality engineer or specialist check engineer into the «test» crew environment in such a way that his voice is «heard» and his opinion weighed and valued alongside the pilot’s. No easy task in some cultures. Some airlines use a third pilot in this role but it must be clear that the primary role of this third crew member is not to be a third pilot but is to record data, maintain an over view of the checks to be carried out and most importantly to act as a safety back stop.

> Having a small team of hand selected crew members who are properly prepared for the task is a better approach than trying to “be fair” and rotating the checking flights amongst all to give everyone the experience.

The checks to be undertaken will determine the number of check personnel in the full checking crew. With increasingly complex cabins and cabin systems, several Cabin Engineers are used by the manufacturers in a test capacity. The basic flight deck checking group should consist of the pilots and the senior Functional Check Engineer, who may also be cabin qualified. If needed, specialist Cabin Engineers can also be included. Take care during depressurisation checks, when using such a small team as there is a risk of one crew member being isolated in the cabin. The size of the cabin and the complexity of the systems checks in it, will generally dictate the overall size of the team in the back of the aircraft.

Airfield

The airfield to be used is rarely a choice matter but it is wise to consider any implications stemming from the airfield itself. The runway capability, the height above sea level and its effect on performance, high ground and obstacles, the available navigation aids, and the active NOTAMs, all need to be considered as well as the general operational situation. For example before doing a rejected take-off or braking check, ask the question “is the operational runway the only runway in use?” and consider at what time of day the RTO will be carried out in respect to scheduled traffic. Burst a tyre at a busy time and you will not be too popular. At the bigger and busier central hubs, a short flight to another quieter airfield will probably be the answer.

> Pre-flight ATC briefings, directly between the pilots and the controller who will look after them, are very valuable and tend to act as a positive “bond” between pilot and controller. Wherever possible a quiet ATC environment is helpful.

Air Traffic and Airspace

ATC can be your best friend or your worst enemy in a check flight sense. The check crew have got to ensure that they are a friend. Pre-flight ATC briefings, directly between the pilots and the controller who will look after them, are very valuable and tend to act as a positive “bond” between pilot and controller. The controller will then tend to move other traffic rather than the check aircraft. No briefing and the opposite happens. The controller may become irritated by the continual and seemingly illogical demands for turns and odd levels and can then add to the workload of the check crew by making things a lot more difficult.

It is also useful to annotate the flight plan in Section 18 with the words “This flight is a check flight””. The implication to a briefed ATC controller is that it will therefore be subject to many changes of height, heading and configuration and the crew workload may be high at times.

Wherever possible a quiet ATC environment is helpful and if the ATC agency has such a quiet frequency channel, it should be used. In the pure manufacturers test environment we have dedicated controllers to ensure efficient flight separation and conflict avoidance but normally an airline does not have this privilege. However, a careful look pre- flight at the airspace and the prevailing weather can often lead to selecting a good quiet, out of the way, corner of airspace like an inactive danger area which will serve the check aircraft flight profile well. If in doubt, ask the controller for his advice and through this advice he again tacitly binds himself to the success of the mission.

> It is recommended that a daylight flight is better. If there are any serious weather concerns, a day only flight is the logical decision.

The day / night question

Each organization will need to make a decision on the question of whether to carry out check flights by day only or by day and night. In principle, there is no major issue with carrying routine checks at night provided the meteorological conditions are VFR. However, there are nights when you can see for miles and there are other nights when it is inky black out there with no moon to assist. The combination of night and IFR should start to ring a warning bell or two and certainly will increase the workload on the crew a lot. So, it is recommended that a daylight flight is better, particularly for smaller airlines where these types of flight are flown less often and the crew currency may be lower. Also, after a significant deep service, the flight should commence in daylight if at all possible. In Airbus production testing, the last possible take off time for a first flight is related to the time of useful daylight so that at least the first slow speed handling checks can be carried out in daylight and VFR. If there are any serious weather concerns, a day only flight is the logical decision.

> Ask the controller for his advice and through this advice he again tacitly binds himself to the success of the mission.

Weather

During certification development flight testing, the weather criteria often drive the ability to carry out a given test. However, in the check flight world it is rare to have the privilege of waiting for perfect weather. That said, it is certainly wise to know what the bottom line is for the checks to be undertaken. It may not be wise to carry out a check of the brakes in a 30 kt crosswind for example.

In Airbus, the minimum weather for a first flight of a new build aircraft is defined. If full authority flight control checks or envelope protection checks are to be done then some clear vertical airspace between clouds is needed. Autoland systems are checked out in Cat I conditions before they are used for real and a lot of attention is paid to avoid icing layers in the descent for the low speeds handling. Even small amounts of icing can significantly change the onset of buffet speeds and the schedule speeds at which warnings operate.

So as part of the flight preparation and in the cool of the office it is best to define the rules of the game that will be applied from a meteorological point of view. Apply as few rules as possible as this will allow the greatest flexibility for the check crews. Apply only as many rules as may be needed to ensure safety. But then they must be respected - always.

> Regarding weather, apply only as many rules as may be needed to ensure safety. But then they must be respected - always.

> Checklists should still be used but they should be used for guidance and not treated as if they are the holy grail. No checklist can cover all check situations.

Checklists

Bearing in mind the more normal airline “standards driven” operational situation, the check crew will need to be able to think and work «outside» the standard checklist (whilst still understanding and recognising its importance) and be comfortable doing so. Checklists should still be used but they should be used for guidance and not treated as if they are the Law. No checklist can cover all check situations.

> Check flights should not be used to carry any form of passengers or people “along for the ride” or just for “the experience”

Test schedules

In the airline world, Functional Check Flights are often looked at as not being necessary at all or at best a necessary irritation that interrupts the smooth aircraft allocation and planning process. It means that they are often conducted under great pressure from both operations and technical management who, of course want to see their costly asset getting back into the schedule where it is earning money for the airline as soon as possible. Whilst this is absolutely understandable, especially in the smaller airlines, management have a vital role to play in the check flight process, which is to shield their selected check personnel from such unhelpful pressures, whilst they in turn must do their job as safely and professionally as possible.

Therefore, planning for success means ensuring that the time element is considered. Ideally check flights should be flown in daylight and without the immediate pressure of a “back in line service” time. With smaller airlines sometimes this is simply not possible. However, the planning must allow time for a full briefing opportunity prior to flight and the opportunity to fully de-brief the technical staff.

Likewise, check flights should not be used to carry any form of passengers or people “along for the ride” or just for “the experience”. Whilst appearing to be tempting for various reasons, passengers in the checking situation often lead to adding complexity, health issues and pressure to an already complex exercise. If there is a requirement to move people from A to B then carry out the check flight first, land and then pick up the passengers for the subsequent transit.

Different approaches to check schedules are used. A different check schedule can be developed for each type of check flight to be carried out or a master reference check schedule can be created where certain checks are crossed through if they are not applicable. The document should not only have the item to be checked but also any associated safety warnings written before the check together with the success criteria and the maximum tolerances allowed. Where a check demands the approach towards a hard limit like a VFE limit, then the NOT BEYOND figures need to be clearly written as this will form part of the mini item briefing later in the execution phase. Avoid writing a check over two pages if possible and certainly avoid having the safety warning detached from the check to be done. Better to have gaps on the pages. Also as check flights rarely work out as planned, format the schedule to make it easy to handle and use in a different order but take care with this. Certain checks should be carried out before others i.e. low speed handling before approaches.

The Airbus In Service Aircraft Flight Test Manual (ISAFTM) can be used as a reference by Customer airlines to create their own check schedules. Along with the data provided, the other factors mentioned above should all be taken into account in the final airline version. The process, of generating one’s own check schedules, forces the discipline of thinking about all the factors mentioned and ensures a better pre-flight preparation.

4

Executing a Functional Check Flight

Ok, so now the right people have been selected and as much preparation as possible has been done. It is time to fly, but in this paper there is no intention of going through a test schedule check by check. This is well covered in Airbus Technical Flight Familiarization Course. The emphasis has deliberately been put on preparation. However, some of the good things to do and some good general practices that should be followed will be mentioned.

Let us start with the briefing. No matter what the level of advance preparation certain things will change just before the flight and they need to be covered at a pre-flight briefing.

Briefing

Some guidelines on the briefing are useful here.

1. All involved parties need to be present and listening. Let us remember that this is a pre-flight briefing, not a long maintenance diatribe on what has been done item by item to the aircraft. Such data should already have been reviewed and frankly anyone can only remember a certain amount of detailed information at a time. The briefing is run by the Captain or the Check Engineer and needs to stay relevant to the flight. By all means have background technical people there to answer any questions that may arise.
2. Everyone must understand the task, their role in that task, the planned check sequence and the way in which the flight will be conducted. Any limits and key words should be agreed.
3. The weather needs to be specifically briefed with regards to any impact on any of the abovementioned aspect of the task.
4. Likewise the airfield and ATC and airspace situation must be reviewed.
5. A brief flight risk assessment should be made. This deals with the practical “what will we do if this or that happens?” question. It is not a deep engineering risk assessment but rather a review of the sequence assuming that things may not always go exactly as planned. It should include the things most likely to cause a problem and the fall back plan should they happen.

> “Always have one person flying.”

The sections of the flight that are primarily a pure flying activity (like flight control checks or low speed handling) will be identified as will those which are essentially systems related (like a de-pressurization check) and it will be decided who is flying and who is monitoring. Always have one person flying. An observed tendency is that the whole crew gets “involved” in the detail of the check sequence. There is absolutely nothing wrong in having one crew member quietly listening but focused on the basic flying.

This pre-flight briefing will be later supported by mini “in flight briefings” that will be made before certain phases of the check flight to “remind” everyone what is coming next, what the limits are and what action needs to be taken by whom “in the event of” certain situations arising.

Getting airborne

The pre-flight preparation should consider any need for FMS programming regarding fuel transfer and also back up flight plans in case the maneuvers flown early in the plan erase waypoints. Also electrical checks can sometimes cause some interesting computer responses on modern aircraft.

As stated, it is expected that most airlines would use the standard checklists in the run up to getting airborne in their normal way. The difference is that a third crew member will probably be present in the jump seat. His or her role is to record data and to monitor the work of the pilots in a non-intrusive way but with a “right of intervention” should something occur that he doesn’t understand or that he thinks may be incorrect.

Irrespective of the good use of checklists, along with most of the test fraternity, always carrying out a quiet final configuration check just before take-off and also just before landing seems a useful safety habit to develop.

Take-off

In the manufacturers test world, some specialist Flight Test Engineers are included in the take-off brief, so as to allow them the right to call STOP, as a key word command. The circumstances under which they would exercise this right are discussed and carefully considered and if in doubt they say nothing. In the airline world such a protocol probably would not be appropriate (subject to the experience and training) and we would recommend staying as close to the local standard practice as possible. In general, the flight deck should be quiet and free of unnecessary “chat” and certainly so below FL100. Careless words can be mis-interpreted and sometimes create a dangerous response.

Switching

Switching and system selection needs to be thought about. Who switches and how? In general a two man principle on all switching actions should be used, with one person pointing at the switch and then after verification that it is indeed the right switch, the selection is made. Some may consider this as overkill but there have been cases where due to poor switching discipline, engines have been “accidentally” shut down and also hydraulic and electric systems lost when APUs have been inadvertently switched off during acceptance flights. Under stress bad things can happen and it is best to develop good practices right from the start.

Actually, in the manufacturer’s world, the principle is carried a bit deeper than this and it is normal to have two members of the three man check team always “in the loop”. Normally the flying pilot is allowed to concentrate on that task whilst the non-flying pilot and the “engineer” focus on system switching safety. It is also easy for one person to get “buried”, for example whilst carrying out radio checks (normally the non-flying pilot) but under those situations it is essential that the non-flying third member be in the loop with the person on the controls and aware of what is happening in a general flying sense. “Switching” confusion should be avoided by carrying out only one check at a time.

> “Switching” confusion should be avoided by carrying out only one check at a time.

Communication

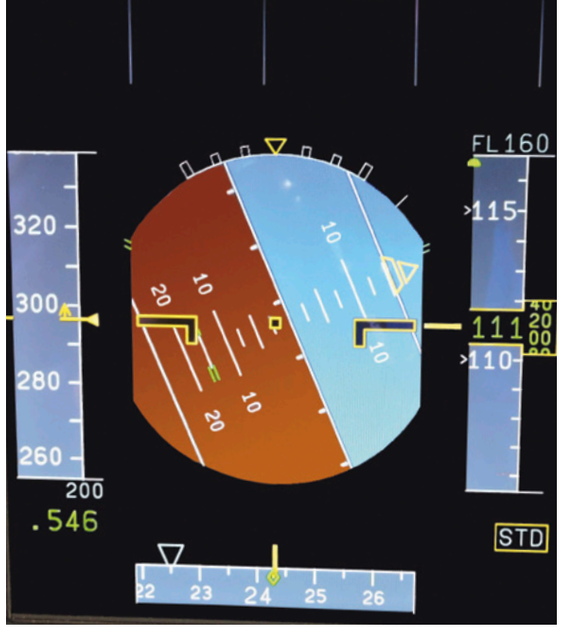
Really good crew communication throughout the check flight is required. Key words are sometimes useful. These can include commands such as STOP or GO AROUND but there are also some unwritten but absolutely clear rules for events such as one crew member not being comfortable with the test progression.

> Really good crew communication throughout the check flight is required.

If any test / check crew member says “I am not happy” the active pilot recovers immediately and the crew reviews the situation. Likewise if someone declares themselves as being “out of it” through workload or whatever, again, a recovery is carried out and then a re-brief to ensure all crew members are mentally on the same test point with the same level of understanding of the plan. Even silences need to be “listened to” as they can tell you that another crew member may be concerned about something. After a while it is possible to develop a “nose” for when it is not going according to plan and that is the time to slow it down and think about what is happening and whether the plan still makes sense. The pacing has to be led by the slowest crew member but of course there are situations where ATC has no choice but to dictate the check pace such as when you are in the pattern or on the approach. Often the aircraft may be carrying a snag or two by this stage and the impact has to be continually re-assessed against the “remain to do” checks. This is where good check crews work together to continually formulate a new and safe plan of action.

As regards external communication, if there are significant radio problems, then the safe continuation of a check flight quickly becomes very challenging and it may well be wiser to concentrate on getting on the ground safely to get the radios fixed before continuing with other checks.

> If there are significant radio problems, then the safe continuation of a check flight quickly becomes very challenging.



Workload

> Enter a hold or ask for a vector away from the airfield, to give thinking time.

Workload also has to be continually assessed on an individual and group basis. One person may become overloaded for a short while but if two out of the three reach this state then the situation can become very critical very quickly. The whole crew must never be allowed to reach this state, so if the test crew is only a two person crew the increased threat is obvious. A third, check qualified, crew member for this type of work is therefore strongly recommended.

One of the problems with workload is that it can rise very quickly and in such a way that the individual concerned, although aware that he or she is working too hard, is unable to take the decisions that will reduce that potentially dangerous situation. The person involved may even be unable to "see" the problem, never mind the solution.

As the workload increases the crew has to prioritize the tasks. The first priority is always securing the safety of the aircraft. Easy to say, but often this requires some tough decisions to be made and sometimes ones that local management may not be too happy with. Someone, normally the Captain, has to make it clear that until the technical systems issues are resolved or their implications fully understood, no more check points will be carried out. Enter a hold or ask for a vector away from the airfield, to give thinking time, are useful workload reducing techniques. If the crew has a problem that they do not understand they should put the aircraft back on the ground while they think about it. There is no room for "pressing on" when a situation is not understood and may be potentially dangerous or worse, catastrophic.

Secondly, the objective is to secure good quality check or test data. There is no point in being there to gather poor data that the engineers cannot use. And finally the whole process should be carried out as expeditiously as possible. It is not a pleasure flight, although when done well, it's extremely enjoyable. The objective is to re-clear the aircraft so that it can get back into the air quickly and re-start earning revenue with passengers on board.

> The first priority is always securing the safety of the aircraft… Secondly, the objective is to secure good quality check or test data…

Snag resolution

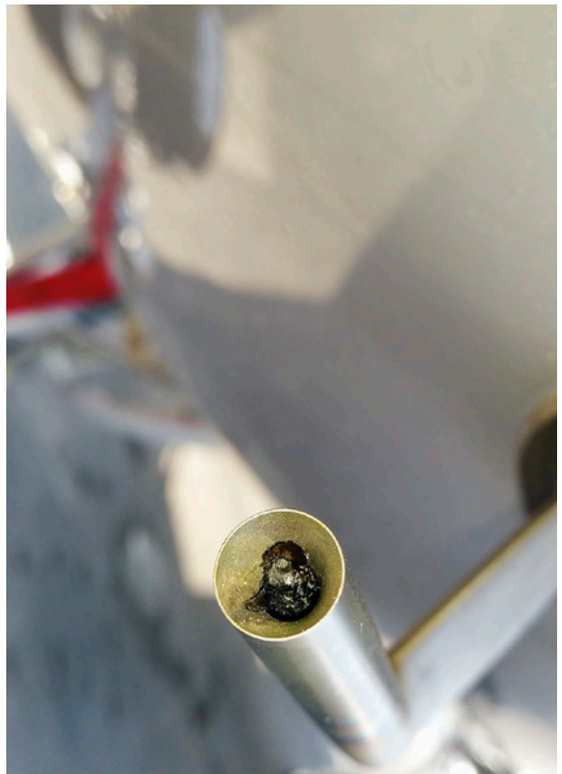
The whole purpose of a check flight is be able to give an aircraft a clean bill of health, so it is not surprising that if a snag is found there is a desire to find out as much as possible about that snag to help the mechanics. Laudable as this may sound, it can lead quickly to some very unhealthy situations. Great care needs to be taken when "snag chasing". The implications of one failure needs to be understood across all the systems affected, as do the implications of selecting certain associated systems into a degraded mode so as to "isolate" a snag. Remember too, that there may be another dormant but un-reported snag in the system already, which when coupled with the original snag and the crew switching may put the aircraft into a serious risk area. We tend to think, with modern aircraft, that everything is captured by the BITE system or is presented to us through the Flight Warning Computers but this is not so. This brings us back to the issue of integrity and if the crew do not know all the ramifications of complex and multiple switching actions then they simply should not do it. Put the aircraft on the ground, examine the situation very carefully, call the manufacturer if in doubt and only then proceed after having tried to fix the problem.

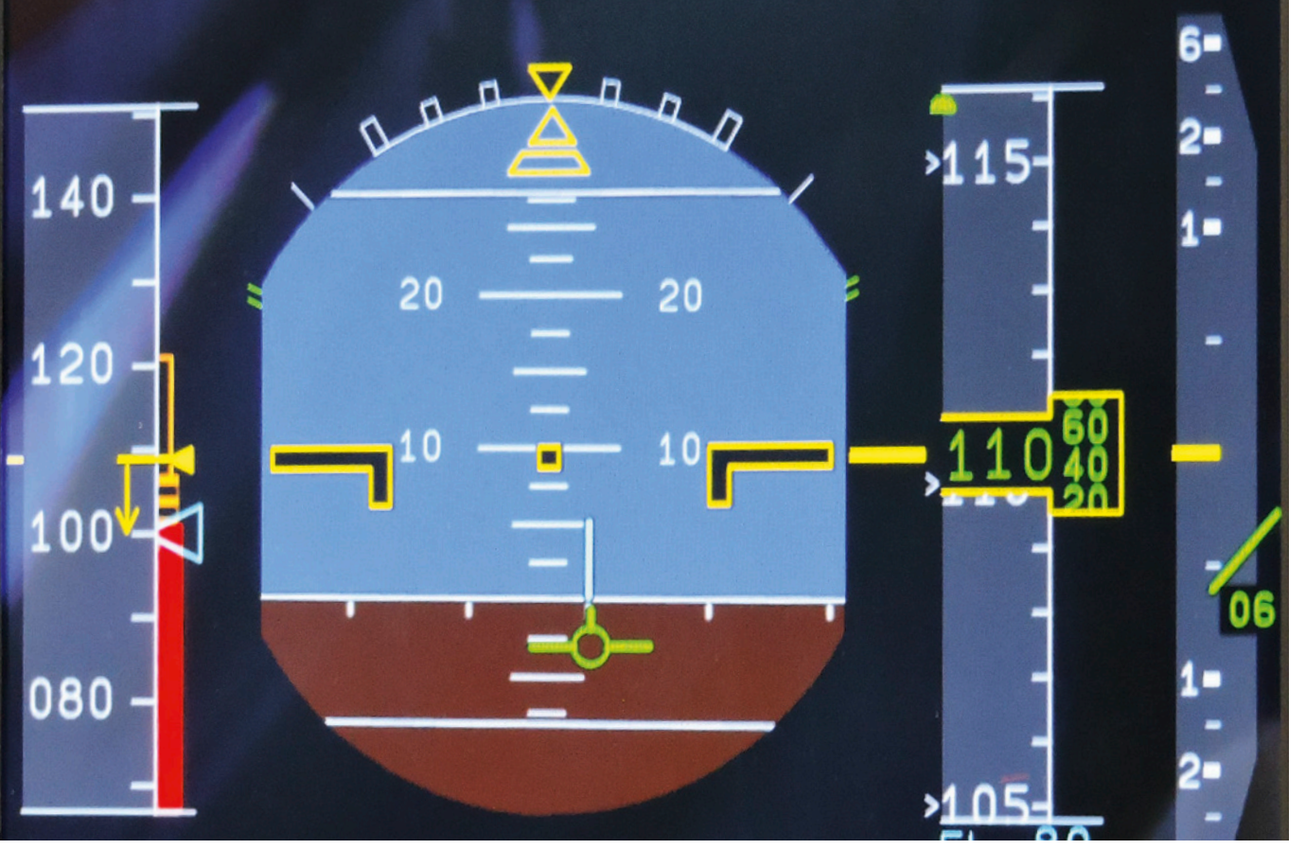
No anomalous indication on an aircraft appears for no reason. Some are small, some have little operational significance, some are intermittent (the worst kind) but there is always a reason. It is no good just hoping a snag has somehow just "gone away". It may indeed not be easy to reproduce the symptoms or it may be limited to certain very precise flight or meteorological conditions but it will still be there and if left, these types of snag have a habit of returning at the worst possible moment. Sometimes the smallest of apparent issues can lead to failure scenarios with some very serious consequences. Watch out particularly for snags associated with "enabling" functions like weight on wheels switches and sensors. Their impact can be seen over several systems. Pressure controllers are another area where a snag can turn from fairly benign to very serious pretty quickly.

> Watch out particularly for snags associated with "enabling" functions like weight on wheels switches and sensors.

> No anomalous indication on an aircraft appears for no reason.

Note: In case the crew also needs to perform a Certificate of Airworthiness renewal which also includes checks, the crew must mentally separate these two demands and if possible clear the aircraft of snags first prior to completing the C of A renewal check points. If that is not possible (sometimes it is not) then crew awareness and good communication is essential.





Tricky test points

> Think about tricky test points on the ground carefully and decide how they should be flown and what the “break off” point is.

Some checks are certainly more difficult to fly than others or some may have a more immediate impact if they go wrong. The failure of a generator to come back on line does not have the same immediately damaging effect as allowing the speed to exceed Vmo by too much. So it is sensible to treat the “tricky test points” with the care they demand and not to rush them. Think about them on the ground carefully and decide how they should be flown and what the “break off” point is. These tricky tests can include speed limit checks, envelope boundary checks, depressurizations, initial handling checks, low speed checks and of course some engine checks.

It is also important not to become tempted to “take a look at” some of the certification test points. There are many “interesting” experiences in this category that could have developed into sad stories. Taking one example like Vmca definition, fuel starvation on some types of aircraft has occurred in the past on this test (which is done at very low altitude) causing the remaining engine to stop. The job of the checker is not to try to re-define the basic certification criteria of the aircraft. Those criteria have been flown and examined by experts under strict weather conditions and rigorously controlled conditions. The checkers job is to check “this” line aircraft against a pre-defined and approved Airworthiness standard or to clear a reported squawk or snag.

> It is also important not to become tempted to “take a look at” some of the certification test points.

Different flight plans

With a modern aircraft check flight there are several “plans” being conducted at the same time. You have the desired planned check schedule. You have the approved Air Traffic Flight Plan which may involve some “on airways” flying and will often start with some sort of procedural departure. The FMS may have to be set up to a slightly different plan to ensure some functions work as they should like fuel transfer logics. There is also the Flight Warning Computer flight phase plan which may throw “stored” snags at you at pre-determined times and you also have an Air Traffic Control handover plan which drives the communication world and to some extent the workload. Finally, remember that you have no control over the most important “plan” and it’s called “the weather”.

The crews’ job is to safely carry out the check points whilst also conducting this “orchestra” of differing plans not all of which are in sequence and not all want to align conveniently. It’s not unusual to have a check point set up and ready, only to be asked to change frequency, squawk and then head straight towards a Cb.!! Or you may require an altitude or a block of altitudes only to run out of the ideal bit of airspace in which to do the next point. Patience is required and it is this aspect that benefits most from pre-planning, a good weather examination and pre-consultation with the ATC guys. It may be that on some days it simply becomes impossible and the sensible conclusion is to keep it safe and call it a day. Such judgments are not easy as they often have a considerable cost implication.

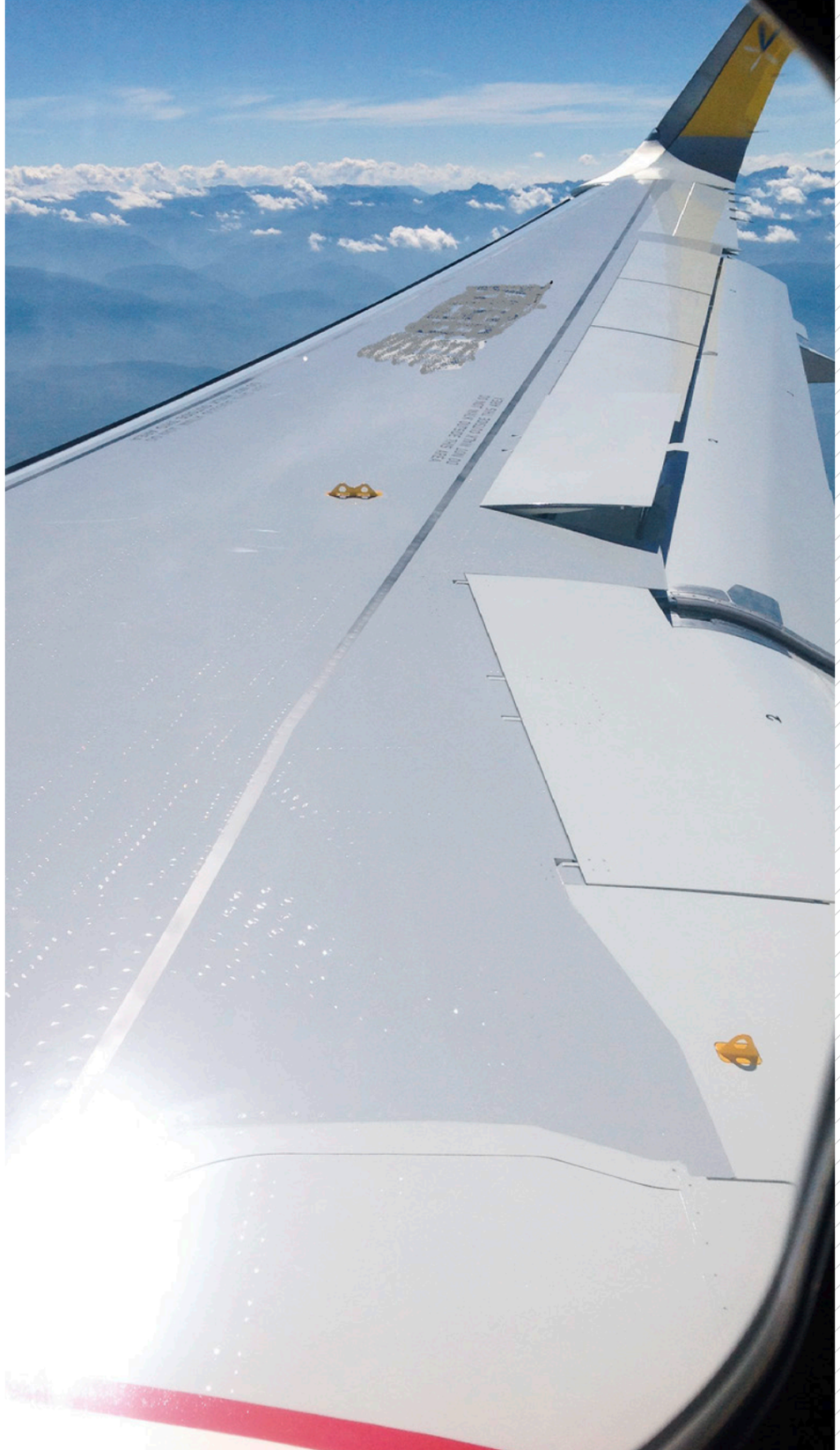
> The crews’ job is to safely carry out the check points whilst also conducting this orchestra of differing plans not all of which are in sequence and not all want to align conveniently.

Cabin systems

Increasingly the area of cabin testing, as said before, is becoming more and more important. Complex seat systems and entertainment systems prevail and it is worth getting to know basically how they work. With the new larger aircraft, there is much closer integration between cabin systems and the flight deck, so cabin systems are no longer “something back there”. They are “passenger important” check areas that have to be thought about quite hard.

This whole paper could have dealt with pressurization issues that have occurred during testing but in order to be brief it is worth thinking about emergency oxygen if a depressurization is planned. Plan which oxygen sets the crew will use. The typical therapeutic oxygen bottles may be “a bridge too far” for someone working in the back of the aircraft to get to. Try getting one out of its stowage and in use in 20 secs and remember that if you are in the cabin checking something you may have to walk some distance to get to the bottle. A better idea is to select and allow a few well-placed oxygen masks to drop in the event of a full de-pressurization, so that the cabin checker can immediately take a seat and then breathe oxygen with the nearest passenger system.

Think also about communication with the guys in the back and ensure the ability to inform them of what is going on and when to be strapped in. Likewise, there are many tasks they can help with like wing inspections and they will need to be able to communicate with the flight deck.



Conclusion

The key to a successful FCF is to prepare thoroughly on the ground and to ensure the best information and knowledge is available to the well selected and correctly trained crew. Once airborne, the most common weakness in the overall checking “system”, of aircraft and crew, will probably be the active pilot as he is the most likely to become over loaded in a workload sense. Therefore, well communicated and timely support from the rest of the check crew is essential in ensuring the success of the check mission. It is the role of the Captain to encourage such communication. It is the duty of all check flight crew members to be active in a communication sense. The challenge for the crew is to avoid critical crew workload levels by excellent preparation, by regular mini briefings and by being ready for the unexpected as they conduct each test. Solid flying skills help as they allow a greater concentration on the communication aspects of the whole operation.

Always remember: Select the crews well, train them properly, brief carefully including the ATC and airspace agencies, plan the flight carefully and then fly the plan “defensively” with “escape routes” in mind and being failure minded. Never assume “it” will work perfectly. Finally, communicate well and no matter what the pressures are, always default to the safest decision.

We wish you good, safe check flights and remember always that preparation is the key.

Articles published in previous ‘Safety first’ issues

Issue 20

July 2015

- Control your speed... during climb
- Lateral runway excursions upon landing
- Fuel monitoring on A320 Family aircraft
- High-altitude manual flying

Issue 19

January 2015

- Tidy cockpit for safe flight
- Landing on contaminated runways
- Understanding weight & balance
- Wind shear: an invisible enemy to pilots?

Issue 18

July 2014

- Control your speed... at take-off
- Safe operations with composite aircraft
- Learning from the evidence
- A320 Family cargo Containers/ pallets movement
- Parts Departing from Aircraft (PDA)

Issue 17

January 2014

- Airbus Brake Testing
- Hard Landing, a Case Study for Crews and Maintenance Personnel
- Aircraft Protection during Washing and Painting
- Flight Data Analysis (FDA), a Predictive Tool for Safety Management System (SMS)
- Flying a Go-Around, Managing Energy

Issue 16

July 2013

- **Performance Based Navigation:** RNP and RNP AR Approaches
- **Atlantic Airways:** Introduction of RNP AR 0.1 Operations
- Flight Crews and De-Icing Personnel – Working together in Temporary Teamwork for safe Skies
- Low Speed Rejected Take-Off upon Engine Failure
- Late Changes before Departure

Issue 15

January 2013

- The Golden Rules for Pilots moving from PNF to PM
- Airbus Crosswind Development and Certification
- The SMOKE/FUMES/AVNCS SMOKE Procedure
- Post-Maintenance Foreign Objects Damage (FOD) Prevention
- **Corrosion:** A Potential Safety Issue

Issue 14

July 2012

- Thrust Reverser Selection means Full-Stop
- Transient Loss of Communication due to Jammed Push-To-Talk A320 and A330/A340 Families
- **A380:** Development of the Flight Controls - Part 2
- Preventing Fan Cowl Door Loss
- Do not forget that you are not alone in Maintenance

Issue 13

January 2012

- A320 Family / A330 Prevention and Handling of Dual Bleed Loss
- The Fuel Penalty Factor
- The Airbus TCAS Alert Prevention (TCAP)
- **A380:** Development of the Flight Controls - Part 1
- Facing the Reality of everyday Maintenance Operations

Issue 12

July 2011

- Airbus New Operational Landing Distances
- The Go Around Procedure
- The Circling Approach
- VMU Tests on A380
- Automatic Landings in Daily Operation

Issue 11

January 2011

- What is Stall? How a Pilot Should React in Front of a Stall Situation
- Minimum Control Speed Tests on A380
- Radio Altimeter Erroneous Values
- Automatic NAV Engagement at Go Around

Issue 10

August 2010

- **A380:** Flutter Tests
- **Operational Landing Distances:** A New Standard for In-flight Landing Distance Assessment
- Go Around Handling
- **A320:** Landing Gear Downlock
- Situation Awareness and Decision Making

Issue 9

February 2010

- **A320 Family:** Evolution of Ground Spoiler Logic
- Incorrect Pitch Trim Setting at Take-Off
- Technical Flight Familiarization
- Oxygen Safety

Issue 8

July 2009

- The Runway Overrun Prevention System
- The Take-Off Securing Function
- **Computer Mixability:** An Important Function
- Fuel Spills During Refueling Operations

Issue 7

February 2009

- **Airbus AP/FD TCAS Mode:** A New Step Towards Safety Improvement
- Braking System Cross Connections
- Upset Recovery Training Aid, Revision 2
- Fuel Pumps Left in OFF Position
- **A320:** Avoiding Dual Bleed Loss

Issue 6

July 2008

- **A320:** Runway Overrun
- FCTL Check after EFCS Reset on Ground
- **A320:** Possible Consequence of VMO/MMO Exceedance
- **A320:** Prevention of Tailstrikes
- Low Fuel Situation Awareness
- Rudder Pedal Jam
- Why do Certain AMM Tasks Require Equipment Resets?
- Slide/raft Improvement
- Cabin Attendant Falling through the Avionics Bay Access Panel in Cockpit

Issue 5

December 2007

- New CFIT Event During Non Precision Approach
- **A320:** Tail Strike at Take-Off?
- Unreliable Speed
- Compliance to Operational Procedures
- The Future Air Navigation System FANS B

Issue 4

June 2007

- Operations Engineering Bulletin Reminder Function
- Avoiding High Speed Rejected Take-Offs Due to EGT Limit Exceedance
- Do you Know your ATC/TCAS Panel?
- Managing Hailstorms
- Introducing the Maintenance Briefing Notes
- **A320:** Dual hydraulic Loss
- Terrain Awareness and Warning Systems Operations Based on GPS Data

Issue 3

December 2006

- Dual Side Stick Inputs
- Trimmable Horizontal Stabilizer Damage
- Pitot Probes Obstruction on Ground
- **A340:** Thrust Reverser Unlocked
- Residual Cabin Pressure
- Cabin Operations Briefing Notes
- **Hypoxia:** An Invisible Enemy

Issue 2

September 2005

- Tailpipe or Engine Fire
- Managing Severe Turbulence
- Airbus Pilot Transition (ATP)
- Runway Excursions at Take-Off

Issue 1

January 2005

- Go Arounds in Addis-Ababa due to VOR Reception Problems
- The Importance of the Pre-flight Flight Control Check
- **A320:** In-flight Thrust Reverser Deployment
- Airbus Flight Safety Manager Handbook
- Flight Operations Briefing Notes