AIRBUS Generic Flight Test Installation

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ABSTRACT

This paper describes new concepts of test mean and processes to perform flight test for all Airbus aircraft family. The FTI (Flight Test Installation) designed for A320, A340, A380 and A350 programs include acquisition system, recorder, data processing, visualisation, Flight Test Engineer Station and optional functionalities (video acquisition, DGPS, telemetry ...)

In the past, these test means were specific for each test aircraft. Due to the large number of Aircraft development in parallel Airbus has designed and standardized new tests means for development and production aircraft. The first goal is to generate significant benefits regarding time and costs savings by simplifying installation and reusing all the test installations components.

This paper shows the opportunities and challenges of these new concepts.

KEYWORDS

GENETI(Generic Flight test installation), Aircraft deliveries, PATM (Production Aircraft Test Manual), CAM (Customer Acceptance Manual), FTI (Flight Test Installation), PATS(Production Aircraft Test System), DATS (Development Aircraft Test System), SA (Single Aisle), LR (Long Range), DD (Double Deck), FTE(Flight Test Engineer), FTES (Flight Test Engineer Station)

INTRODUCTION

The current objectives of Airbus are to prepare and achieve deliveries ramp-up by reducing lead time production with a good level of quality.

In addition, Airbus has to develop new programs (A400M, A350, Sharklet version, NEO,...) and ensure their airworthiness certification within the constraints of time and cost.

This is why, Airbus launched three projects in line with this new context to standardise the flight test installation:

- GENETI and DATS Test mean for medium and light FTI for development aircraft
- PATS, Tools and processes for production aircraft
CONTEXT

Development aircraft (GENETI and DATS)
Airbus has to manage more and more development aircraft with flight test installations due to a large number of simultaneous aircraft programs. For example, we will have up to six aircraft in parallel for the A350-900 version. We want to certify aircraft more quickly, and achieve full reliability at the entry into service, so we need to perform a lot of flight tests at the same time.

Production aircraft (PATS)
Airbus is delivering more than 500 aircraft per year and this figure increases each year. Three years ago, there were no tools and automated processes to support acceptance flight tests. For all these reasons, it became obvious to Airbus to change concepts, to improve its overall efficiency and to reduce the increasing workload.

TARGETS

Development aircraft (GENETI and DATS)
The target is to save time and money by reducing the workload of the FTI development.

Production aircraft (PATS)
The target is to optimize the turnaround time of aircraft in the process of acceptance test and to find in flight all non-compliances. In this case, the goal is to avoid the reflight and to install all test means in less than twenty minutes.

CHALLENGES

The main challenge was to isolate actors, needs, conditions of use and the environment:
- The actors, to optimize work sharing
- Needs, to define the number of parameters and measurements types
- The use conditions, to define new ergonomics and installation occurrences
- Environment, to design the mechanical and electrical interfaces

After studying the various requirements we decided to define three families of products.
**Development aircraft challenge**  
The main challenge for this project is the cost reduction.  
One key to achieve that objective is to use COTS equipments giving opportunity to a global work package call for tender.  
Another key is to define modular architecture with all components removable and reusable.  
The last key is to be able to easy transportation and storage.

**Production aircraft challenge**  
The first challenge is to improve data capturing, test analysis during flight according to PATM (Production Aircraft Test Manual) / CAM (Customer Acceptance Manual). The second one is to perform on-board troubleshooting activities.

**ARCHITECTURES and DEVELOPMENT**

**Main principle**  
The drivers of architecture are mainly based on:  
- Reusable equipment and installation  
- Easy to install and easy to use  
- Standardized wiring and connections with aircraft  
- Environmental compliance

The architecture applied is strongly linked with the size of FTI we need to install.
General description
Development aircraft (GENETI)
All elements involved in this FTI are connected together with specific harnesses which are reusable endlessly.
GENETI includes acquisition systems, recorder, data processing, visualisation, Flight Test Engineer Station (FTES), and optional functionalities. (Video, DGPS, Telemetry, VHF mix box, Intercom, CDS pack, calculators and e-brush)
The architecture of GENETI FTI is based on Airbus standard architecture with a time base reference, a set of Ethernet switches to connect various FTI systems together, a recorder for processing in differed time and a set of computers to perform real time monitoring. The complete installation is powered by dedicated power supplies which are a big part of GENETI component. The cables involved in power distribution are completely generic and easily identifiable by different colors. It is the main key to achieving the performance related to quick installation with minimal external documentation.
The flight test engineer station allows test specialist to monitor the flight test in connection with the pilots. This station is connected to the acquisition modules of GENETI by a single 1Gb Ethernet link. It is fitted on the aircraft close to the set of equipments involved in parameter acquisition.

Mechanical interface
Development aircraft (GENETI)
One standard mechanical interface is design to secure the modules on the floor of the aircraft. This interface is compatible with any standard SA, LR, DD, A350 and NEO. For these various mounting, holes are available based on widths of the rails in the cabin.
Modules including equipment are stacked on the interface with snaps and latches for holding the stress constraints of the aircraft in extreme conditions. The acceleration level of 9g is the most binding constraint for the design.

Modules
Development aircraft (GENETI)
The module functions are designed to ensure transport and storage with good mechanical strength and a low weight. The resin that composed the module must be free of toxicity in case of fire.
The module is composed by one box made of resin and two metallic structures to ensure the mechanical stress.

**Flight test engineer station**  
**Development aircraft (GENETI)**  
The FTES is designed to be installed and removed without tools or screws. The result is that GENETI can be installed in less than three hours for each type of aircraft. Strong involvement at all stages of development of flight test engineers gave good ergonomic to the final product.

**Wiring and harness**  
**Development aircraft (GENETI)**  
The study and manufacture of cables and harnesses follow the same rules as for the plane. For examples, segregation route rules or protection against lightning indirect effect. To ensure the protection, EMI and mechanical protection sleeves are widely used. All inter-module cables are standard whatever type of aircraft. They are also reusable and marked with colors for easy mounting. The color of the cable is painted on the back of each module and is different for each element.
The electrical interfaces with the aircraft are connected with one harness test plugs in the electronic bay and another harness to the power supply network. They are different harnesses for each type of aircraft family but all of them are reusable. The effect of this standardization is less implication of our design office and our manufacturer. The result is a big benefit in workload saving and in installation duration.

Checking process  
Development aircraft (GENETI)  
The phase of checking is operated on the ground before installation on aircraft. This lowers the immobilization of the aircraft during test period.

General description  
Production aircraft (PATS)  
PATS acquisition is installed in the electronic bay close to aircraft systems. This equipment is based on ARINC 600 standard. It take a significant benefit in collecting a big number of ARINC busses in a set of two test plugs available on each production aircraft. By this way, it is possible to define generic harnesses usable to acquire all parameters from main ARINC busses.

PATS includes acquisition systems (bus Arinc429, noise, vibration, and temperature), recorder, data processing and visualisation.
To fulfill the needs of real time monitoring, a laptop is installed in the cockpit with a support installed behind pilot seat. This laptop is connected to the acquisition system in electronic bay.

Pocket tools
Production aircraft (PATS)
The pocket is developed for the reception step (acceptance test before delivery to customer) to measure the quality of cabin comfort and perform troubleshooting if necessary. This tool measures acoustic, vibration, humidity and temperature. This system is portable with battery and transmits the measurement results by wireless. It does not require any mechanical interface or wiring. The flight test engineer uses this tool to perform the 'fleet monitoring' of all aircraft in reception in order to know very quickly if the measurements are inside the specification. It gives a mapping of the cabin in term of noise temperature, hygrometry and vibration if necessary. These measurements are displayed on the laptop at the end of the test. This tool includes a troubleshooting function to perform in flight diagnosis (noise & vibration) and avoid a new flight test.
Electrical and mechanical interfaces
Production aircraft (PATS)
To save cost and time and avoid unnecessary design and manufacturing a standard harness has been developed. The harness is connected directly to the test plugs in the electronic bay of the aircraft.
The acquisition system is directly installed into one Arinc 600 spare slot of the aircraft.
In the same time, in the cockpit a support with laptop is directly installed behind the copilot seat.
By this way the global installation doesn’t exceed twenty minutes.

Checking process
Production aircraft (PATS)
To achieve the checking, a software function able to check automatically the instrumentation and the harness has been developed.
The operator during installation launches this application. In case of defect the kit (system and harness) are replaced.
The main principle of this test is to control on each Arinc429 buses one specific refresh data.

Ergonomy
Production aircraft (PATS)
During the test, the flight test engineer sits between the pilot and copilot in the third man position.
This allows to look at the same time information on the screens of aircraft and to compare it with the displayed data on the laptop next to him.
APPLICATIONS

GENETI : Concept Operational since 2009 (successful Flight Tests)
⇒ Serial A/C SA, LR
DATS : Operational since 2011 (successful Flight Tests)
⇒ Serial A/C SA, LR
PATS : Operational since 2008 (successful Flight Tests)
⇒ All flight delivery A/C SA & LR

CONCLUSION

Standardization, generic products are the key words to define our policy for flight test installation in the coming years.

PATS DATS and GENETI are the first concept of this strategy.

Those products fulfil the initial targets: cost and time saving, better customer satisfaction.

We need now to prepare the next generation by using smaller size equipment, new technologies available on the market (wireless, optical fiber,...) and cost efficient solution.
REFERENCE

None