

DECEMBER 2005

FLIGHT

AIRWORTHINESS

SUPPORT

TECHNOLOGY

# FAST 37

A I R B U S T E C H N I C A L M A G A Z I N E



The Airport Managers. Fraport. The Airport Managers.



**AIRBUS**

F A S T 3 7

# Customer Services events

## Just happened

### **HUMAN FACTORS SYMPOSIUM IN MADRID, SPAIN, 28-30 NOVEMBER**

Airbus continued the dialogue with its operators at this forum, discussing human factors aspects with practical and operational perspectives on:

- Flight operations (environmental, safety, pure ops e.g. procedures, philosophy, systems)
- Maintenance (safety, CRM, organization, procedures, manuals)
- Cabin operations (safety, CRM, organization, procedures, mass travel, medical aspects)
- Training (to flight operations, maintenance, cabin operations, to human factors)
- ATC (environmental, safety, pure operations e.g. procedures, philosophy, systems)

### **A300/A310 FAMILY TECHNICAL SYMPOSIUM IN LISBON, PORTUGAL, 14-18 NOVEMBER**

A landmark event occurred at this symposium, with the first formal presentation to operators of the Airbus initiatives to ensure Long Term Support of the A300/A310 Family. The objective of this initiative is to ensure equivalent levels of operator satisfaction for A300/A310 operators as for any other Airbus programme through to the last aircraft being in-service (up to year 2050). Clearly the enhanced support foreseen for the A380 will set the satisfaction benchmark, and for the A300/A310 Family other considerations that affect the level of service include the low rate of production (can affect spares availability) and the eventual closure of the final assembly line, which must be anticipated. The operators at the symposium expressed their view that their expectations for the future had been met (61%) or exceeded (39%) in this respect.

The symposium discussion otherwise covered various technical, maintenance and support issues and 100 participants from 36 operators were present, including all of the largest A300/A310 operators. 67% of the operator respondents considered the event very useful and 33% useful.

## Coming soon

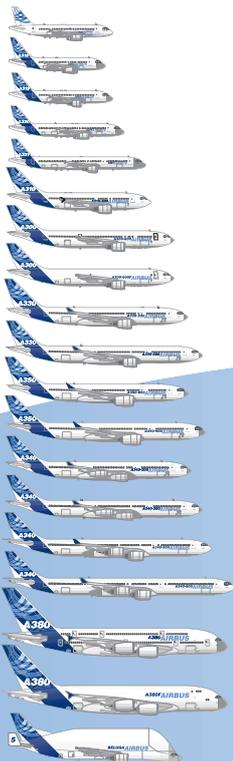
### **SPARES, SUPPLIERS & WARRANTY REGIONAL SYMPOSIUM IN ATHENS, 13-16 FEBRUARY 2006**

Following the Airbus Spares, Suppliers and Warranty symposium in Puerto Vallarta, Mexico for operators in the Americas, and in Sanya, China, for Chinese operators, it is now the turn of Europe and Africa. A Spares, Suppliers & Warranty regional symposium will be held in Athens, Greece, from the 13th to the 16th of February 2006 bringing together Airbus customers, operators and suppliers. Its objective is to review together strategic directions, operational support issues and current spares and warranty services. Operators will be given the opportunity to express their requirements and share their experience. Major suppliers will also have the opportunity to present their support and services strategy.

### **A330/A340 FAMILY TECHNICAL SYMPOSIUM IN SUN CITY, SOUTH AFRICA, 28 MAY-2 JUNE 2006**

Airbus is pleased to announce the date and location of the next A330/A340 Technical Symposium. The Symposium is the opportunity to review actual in-service experience with the A330/A340 Family of aircraft as well as to discuss subjects of more general technical interest.

A provisional agenda will be sent in February 2006.



# FAST

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# 37



FLIGHT  
AIRWORTHINESS  
SUPPORT  
TECHNOLOGY

Cover: A380 MSN004 at Frankfurt airport during its check exercise, see article on page 23.

**Publisher:** Bruno Piquet  
**Editor:** Kenneth Johnson  
**Graphic Designer:** Agnès Massol-Lacombe

Authorization for reprint of FAST articles should be requested from the editor at the FAST e-mail address given below

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Printer Escourbiac

FAST may be read on Internet  
[http://www.content.airbusworld.com/SITES/Customer\\_services/index.html](http://www.content.airbusworld.com/SITES/Customer_services/index.html)  
under Customer Services/Publications

ISSN 1293-5476

**Airbus Customer Services**

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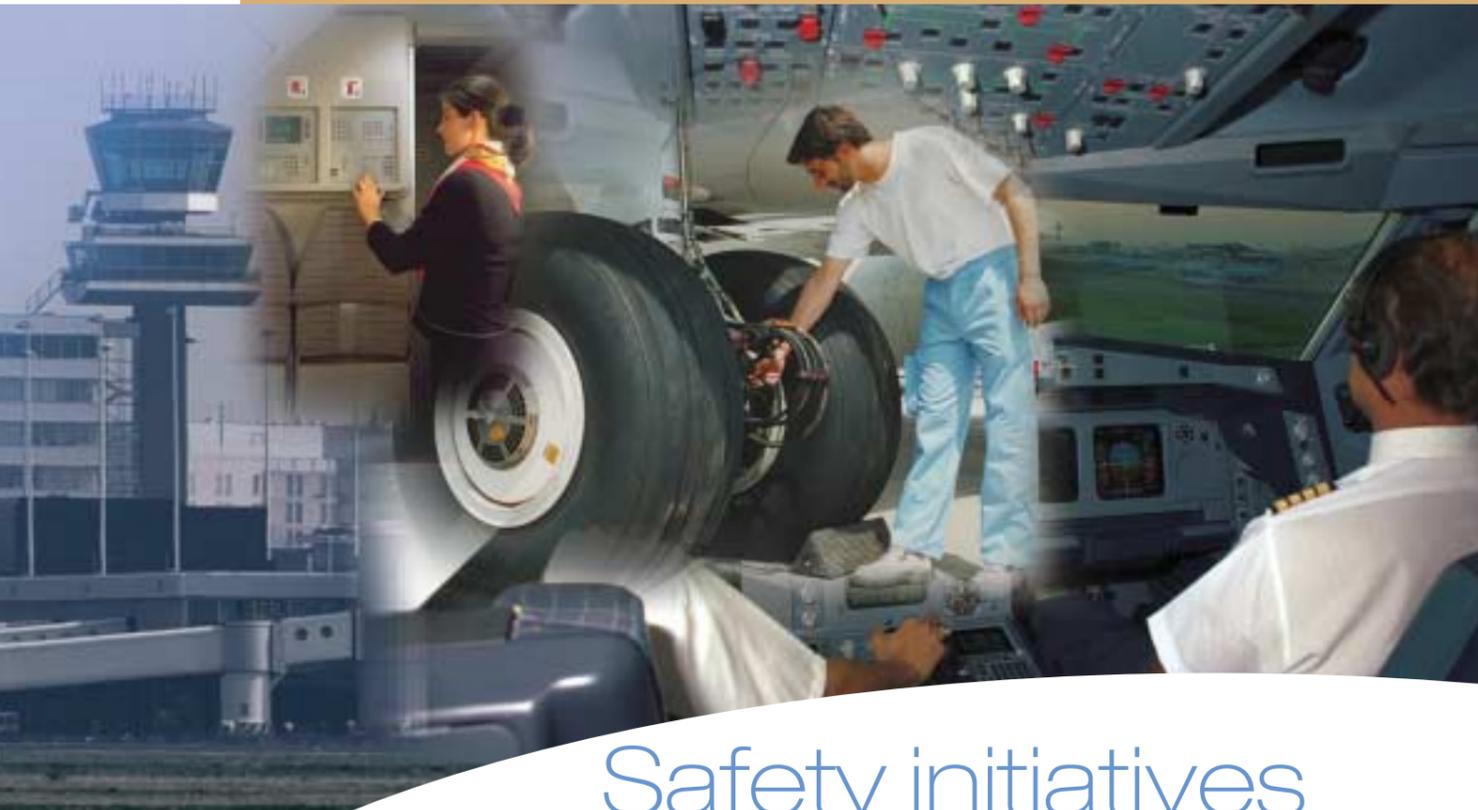
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Airbus France: Julie Pomery  
Cover page: Julie Pomery

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This issue of FAST has been printed on paper produced without using chlorine, to reduce waste and help conserve natural resources.  
**Every little helps!**



# Safety initiatives in Customer Services

## An overview of Airbus safety initiatives

As an aircraft manufacturer, the prime duty of Airbus in terms of safety is two-fold:

- Ensure the continued airworthiness and operational safety of the Airbus fleet,
- Support Airbus operators in attaining and maintaining a safe and profitable operation.

The former represents the manufacturer's regulatory obligation, as Airbus is the holder of a design and production operational approval. The latter reflects Airbus's commitment, as a customer services organization, to operators of Airbus aircraft.

Since 2003, Airbus Customer Services has deployed a yearly portfolio of safety initiatives that address all aspects of Airbus's internal core activities and all domains of an airline's operation.

This article provides an overview of this portfolio of safety initiatives to encourage operators and other actors to take full advantage of these safety enhancement opportunities.



**Michel Trémaud**  
Senior Director  
Airbus Customer Services  
Head of Safety Management

### Continued airworthiness and operational safety

Operators and Maintenance, Repair and Overhaul (MRO) organizations are required to report to their national authorities in-service occurrences defined by their country's mandatory occurrence reporting (MOR) scheme. It is essential that such in-service occurrences are also reported to Airbus, documented, analysed and understood in order to prevent the **reoccurrence of known types of events** and **the occurrence of potential events**. Indeed, this prevention process includes both a **reactive part** and a **proactive part**.

For effective identification of **events precursors** (also referred to as **weak signals**), the proactive part also includes the analysis of observations made by operators in the frame of their flight operations monitoring programme (i.e. incidents and human factors reports, flight data analysis and line observations).

The operational, technical and human factors analysis of in-service experience feedback enables Airbus to continuously identify lessons-learned and

implement safety enhancements in terms of **Design**, **Operations** (i.e. procedures) and **Training**.

Safety enhancement efforts address equally flight operations, cabin operations and maintenance. The lessons-learned derived from this process are blended with the conclusions and recommendations from industry working groups in order to develop and publish **safety-awareness information** in various media.

### Attaining and maintaining safe and profitable operations

Support to operators in attaining and maintaining safe and profitable operations has been the charter of Airbus Customer Services since the entry-into-service of the first A300 aircraft back in 1975. However, the industry has greatly evolved and Airbus' initial operators base of flag carriers has been enriched with charter operators and, more recently, low-cost carriers and corporate flight departments.

The leased-aircraft concept has been an enabler in this market evolution and has created a new



Airbus Flight Operations Briefing Notes, an example of Airbus safety-awareness publications

framework of relationships between Airbus, its customers (i.e. the leasing companies) and the aircraft operators. The traffic growth in fast-developing geo-economic regions has been an additional driver in the evolution of Airbus support to its aircraft operators.

Today, Airbus Customer Services offers a wide range of support and services to further enhance operating safety. This support is both direct (i.e., working with operators) and indirect (i.e., working with national civil aviation authorities, training organizations, MRO centres, international safety organizations...) and spans the following basic elements of a safe operation:

- Regulations,
- Regulatory oversight by national authorities,
- Operator's regulatory compliance and best practices:
  - . General organization,
  - . Flight operations organization (including flight operations monitoring process),
  - . Maintenance/engineering organization including maintenance best practices, spares provisioning and ground support equipment/tools,

- . Company safety management system (SMS),
- . Fleet upgrade and standardization,
- . English proficiency training.

## Safety awareness

Safety management is a mindset; safety *readiness* is a matter of *awareness*... being aware to be mentally prepared. Over the past years, Airbus Customer Services has developed a wide array of safety awareness publications on various media:

- 'Getting to Grips with' brochures that today cover 19 flight operations themes, including cabin safety,
- *Flight Operations Briefing Notes*, published on a monthly basis in the Airbus Safety Library, ([http://www.airbus.com/en/corporate/ethics/safety\\_lib/](http://www.airbus.com/en/corporate/ethics/safety_lib/)) and in a yearly collector box
- *E-Briefings*, available on the Flight Operations Community of the new [airbusworld.com](http://www.airbusworld.com) customer portal, (<http://www.airbusworld.com/>)
- Videos and CDs.

Flight Operations Briefing Notes collector box, brochure 'Getting to Grips' in Chinese and Russian languages, safety-awareness tutorials and courseware on CDs.



To further ease the dissemination and understanding of complex subjects by all stakeholders, some of the above safety awareness publications have been translated into the Chinese and Russian languages.

## Training and education

Maintaining the link with operators after their type qualification, in one of the Airbus Training centres, is an important element of Airbus' safety awareness strategy. In 2004, Airbus created the concept of regional Airline Instructors Seminars to promote the continued exchange of teaching and safety information between Airbus instructors and airline instructors. The following is the regional coverage achieved by these seminars in 2004 and 2005, and planned for 2006:

- 2004: Taipei, Mumbai, Beijing,
- 2005: Miami, Moscow, Hanoi,
- 2006: Bangalore, Tunis, Beijing, plus locations to be selected in the Middle East, Asia and South America.

Acknowledging the requests of operators, the initial concept that focused on flight operations has been extended to maintenance from the last seminar in Hanoi.

Airbus Safety Library home page hosted on the Airbus corporate website



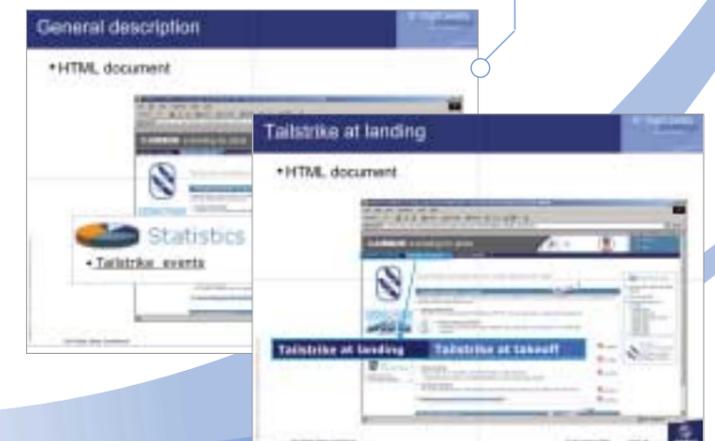
The above set of safety initiatives are intended for the various users of Airbus products and their instructors, but would not be complete if Airbus were not involved upstream in the basic education and training of future Airbus pilots, flight attendants and maintenance mechanics. Therefore, cooperation programmes with state technical universities, flight academies and flying colleges have been developed in China and North America, while similar programmes are currently being developed in Russia, Ukraine, India, South Africa and Australia.

The objective of these programmes is to provide students and cadets with early exposure to modern technology systems and flight decks, by providing education and training organizations with:

- Technical documentation and safety awareness publications,
- Courseware,
- Training devices.

## International safety cooperation

Airbus Customer Services is also further involved in the development of workshops and seminars that are deployed in the context of regional safety cooperation programmes funded or led by the European Union, the International Civil Aviation Organization (ICAO) and Airbus.



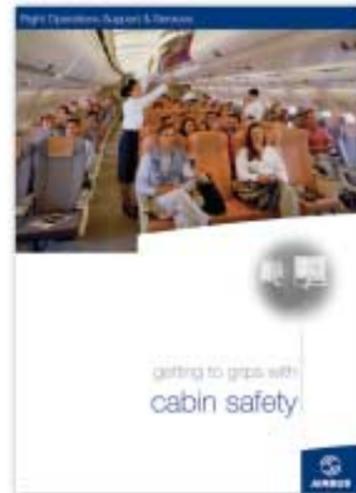
Airbus Training centres in  
1. Beijing  
2. Hamburg  
3. Miami  
4. Toulouse

E-Briefings, a new interactive safety-awareness publication

The scope of these workshops and seminars are defined to respond to regional needs and priorities. As described below, they address a large cross-section of themes identified as causal or contributing factors in incidents and accidents:

- **Company safety management**
  - . Incident/accident prevention,
  - . Safety Management System (SMS).
- **Flight operations**
  - . Preventing Controlled Flight Into Terrain (CFIT),
  - . Approach and Landing Accident Reduction (ALAR),
  - . Flight operations safety awareness (CFIT, ALAR, runway incursions, altitude deviations/level busts, fire/smoke/fumes in cockpit/cabin, weather avoidance, ...),
  - . Flight Operations Monitoring (FOM),
  - . Understanding and use of the Minimum Equipment List (MEL).

- **Cabin operations**
  - . Cabin safety (see brochure 'getting to grips with Cabin Safety' below).



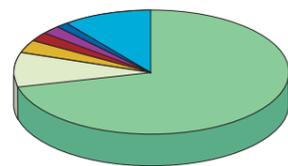
- **Maintenance/Engineering**
  - . Structural integrity/maintenance of aging aircraft structures,
  - . Maintenance of electrical, wiring and interconnections,
  - . Maintenance human factors.



# Airbus cabin air quality Still the best!



- Installation 72%
- Servicing 9%
- Job set-up preparation 3%
- Test 2%
- Human movement 2%
- Removal 1%
- Others 11%



Maintenance human factors: understanding and managing human errors

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Frequent flyers experience it regularly, flight attendants and cockpit crew complain about it, but up until now nothing was done about it - that smell coming from the exhausts of aircraft in front of you in the taxi queue waiting to take off. The major odour causing compounds in exhaust gases and fuels are from the family of compounds known as VOCs (volatile organic compounds) and they can really spoil that holiday feeling.

After carrying out air quality analyses (see FAST 20 December 1996 'Airbus Cabin Air Quality - Only the Best!') and discovering that air quality was worst during ground phases due to the influence of external pollution, Airbus decided to concentrate on finding an answer to these complaints.

## Conclusion

An accident investigator once said, '**Safety is leaving no stone unturned**' to identify threats that may lie hidden on the path to safety. Safety enhancement initiatives must involve a mosaic of efforts and cooperation programmes. None of us will ever be able to measure

his/her own contribution to aviation safety, but aviation safety has been built from, and is continuously enhanced by, successive building blocks. All of them - small or large - contribute to making our safe aviation transportation system even safer.



**Claire NURCOMBE**  
ECS Engineer  
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## Current standards

Ozone Converters (OZC) have been standard equipment for aircraft for over 10 years and optional equipment for 20 since it was found necessary to introduce ozone removal capability after the first trans-Pacific flights in the mid-70's. The OZC is installed as standard equipment on A330/A340 Family aircraft and the A380, and is increasingly being chosen as an option for the A320 Family. It was therefore decided to investigate the possibility of developing a new catalyst to remove both ozone and VOCs. Airbus suppliers rose to the challenge and developed a new catalyst to remove these odours, which could be combined with the existing ozone removing catalyst to minimize installation costs and weight impact.

with small amounts of other compounds, such as sulphur. Hydrocarbons are a class of compounds made up of hydrogen and carbon combined in molecular chains. These compounds are present in very small amounts, but due to the sensitivity of the human nose the cabin occupants can smell them, even down to levels of a couple of parts per trillion of the compound.

The catalyst coating is applied to a core within the converter's body and oxidizes these odorous compounds, resulting in the formation of odourless water (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>) as reaction products (see figures below). Since VOCs are present in very low concentrations the amount of water and carbon dioxide created by the conversion process is small.

## The conversion principle

The VOCs entering the bleed air supply via the engines may come from ground service vehicle exhausts or engine exhausts of other aircraft and mostly consist of hydrocarbons (HC) mixed

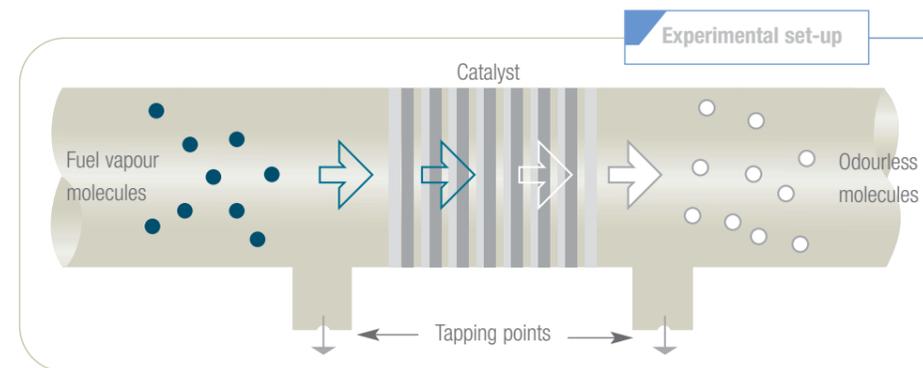
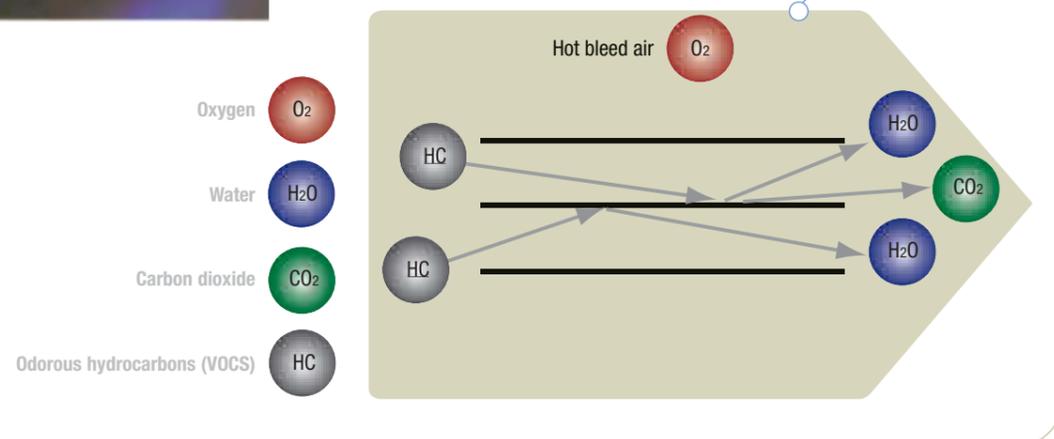
## Test methods

To investigate the performance of the catalyst the VOC containing vapours from an aircraft fuel sample was passed over the catalyst. VOCs may come from many sources, however fuel vapour was selected to provide a realistic mix of contaminants that may be present in contaminated airport air.

Catalyst and core structure



Catalytic reaction



Tapping points were installed upstream and downstream of the catalyst where air samples could be taken (see figure above).

In a quantitative analysis the iso-alkanes (a specialist term for compounds consisting of chains of carbon molecules) were measured and it could be clearly seen that the longer carbon chains present upstream of the catalyst were being broken down (see figure below). This proved that the catalyst was having an effect on the compounds within the vapour, however this type of analysis does not show whether the catalyst was effectively reducing odour.

While the chemistry may seem simple, the human nose is not and it was necessary to pursue some additional testing to make sure that the converter was not leading to more odorous by-products being produced. To do this human noses were used, as well as electronic analysers, in panel tests, and GC-O (gas chromatography - olfactometry) tests.

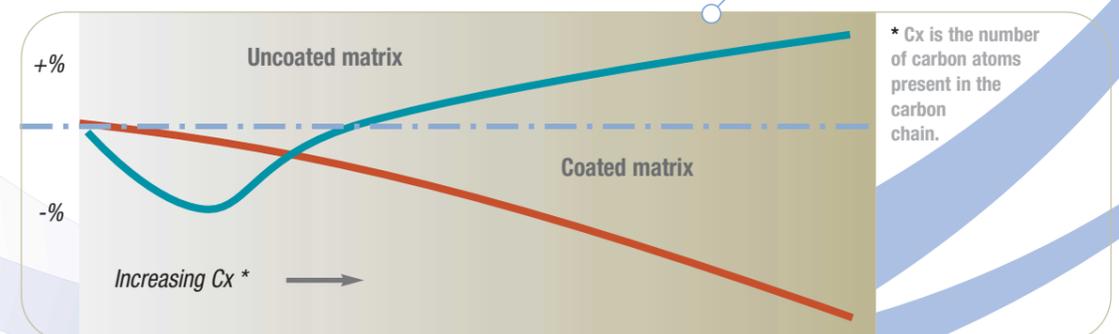
In order to test the odour intensity and hedonic tone (the tone describes how pleasant the odour is), as well as the overall perceived air quality, test panels made up of members of the public were given questionnaires to rate how the air smelt upstream and downstream of the catalyst. The panellists had to rate how strong the odour was at different concentrations and temperatures, and also whether it smelt pleasant or not. After the overall air quality was judged by the panellists they were asked to judge whether they could smell fuel odours in the air sample.

In addition to this human 'sniff' testing, samples were taken for the GC-O analysis. For this the air sample is analysed by a GC-MS (gas chromatography - mass spectrometry) analyser with a modified off-take. A GC-MS analysis presents the full chemical spectrum of a sample, allowing the chemist to see which individual compounds are present. The GC-O analyser additionally allows the flavour chemist doing the analysis to



Nose testing and electronic analysis. With thanks to the Fraunhofer Institute for Building Physics

Percentage difference for iso-alkanes up/down-stream of the catalyst





# The European Aviation Safety Agency

## A new regulatory authority for European aviation

The formation of the European Aviation Safety Agency (EASA) was the result of a longstanding request from European industry, going back to 1969. EASA has now been in operation since October 2003, so this is an appropriate time to take both a global and a closer look at this new institution, see how it is established and understand its role and actions in relation to Airbus products.

It all started in 1969, when aerospace industry leaders, conscious of the importance of international co-operation for future aeronautical programmes, prompted AECMA, their European trade association\*, to submit a request to the main European aviation certification authorities, asking them to cooperate and adopt common airworthiness certification requirements.

\* The AECMA association has now merged with European trade associations of space and defence industries to form the Aerospace and Defence Industries Association of Europe (ASD).



**Claude Schmitt**  
Senior Director Strategies & Policies  
Engineering-Product Integrity

identify the type of odour of the individual odorous compounds. The flavour chemist uses his or her trained nose to identify each odorous compound and give a description, such as 'green', 'citrus', or 'roasty' to it. These descriptions can then be compared to the known odorous characteristics of chemicals and the compounds that are causing the odour can be identified. A perceived air quality improvement of 80% and a significant reduction in the odour intensity was confirmed during the testing.

ozone converter equipment, meaning minimal weight and maintenance impact for operators.

The combined converter has the same maintenance requirements as for the ozone converter and the two converters are fully interchangeable (although of course the odour removing function is lost if exchanged for a standard ozone converter).

The modification is optional for A320, A330/A340 families and the A380, although introduction as standard equipment for the A380 is planned. The combined Ozone/VOC Converter (VOZC) will also be standard equipment for future Airbus programmes.

### Entry into service

The new odour removing function is integrated into the existing

Combined VOC/Ozone Converter (VOZC) for A320



OZC and VOZC data for aircraft programmes

Programme	OZC P/N	VOZC P/N	Mod Number
A320 Family	20499004 (A319-A320-A321)	44018003	34448
	20499005 (A318)	44018004	
A330/A340 Family	40997002	44142002	49110
A380	2341798-1/-2	2341798-3	TBC

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## Conclusion

### Still the best!

Airbus is the first aircraft manufacturer to integrate this technology into their aircraft. The installation of the combined VOZC is available as an option for the A320 and A330/A340 families and the A380.

This technology will become standard equipment for future aircraft programmes. With the VOZC installed, and improved cabin air quality on ground for crew and passengers, airlines will soon be 'smelling' the benefits of Airbus' dedication to innovation.





General scheme

<b>Basic Regulation</b> • No. 1592/2002 of 15 July 2002 → Basic principles, EASA creation, Essential Requirements	<b>Adoption by European Parliament and Council (co-decision)</b>
<b>Implementing Rules</b> • No. 1702/2003 of 24 September 2003 on Certification → Part 21 • No. 2042/2003 of 20 November 2003 on Maintenance → Parts M, 145, 66, 147	<b>Adoption by Commission of the European Communities (Comitology process)</b>
<b>Acceptable Means of Compliance &amp; Guidance Material</b> • Related to Implementing Rules	<b>Adoption by EASA Agency</b>
<b>Certification Specifications</b> • Airworthiness Codes (Book 1) • Acceptable Means of Compliance (Book 2)	<b>Adoption by EASA Agency</b>

The authorities responded very positively and created in 1970 what would subsequently be called the Joint Aviation Authorities (JAA), developing harmonized technical requirements (the Joint Aviation Requirements - 'JARs') with the support and contribution of industry expertise.

European aviation safety requirements (no national differences or variants), and for a single process to obtain, from one authority only, certificates and approvals having full validity throughout Europe.

A number of solutions were explored and many milestones passed before the governments of the European Union (EU), in March 2000, finally instructed the European Commission to negotiate the establishment of a new EU agency that could provide the effective, recognized, single authority requested by the various stakeholders concerned with aviation safety regulation.

This process was finally completed with the adoption, on 15 July 2002, of the regulation 'on common rules in the field of civil aviation and establishing a European Aviation Safety Agency' (referred to as the 'Basic Regulation' in the following) by the EU Council and Parliament.\*

However, despite the successive scope extensions (maintenance, operations, licences) and procedural improvements brought into the JAA system, it could not be legally empowered to fulfil the requests for a single set of binding

### The Basic Regulation and the European institutional context

Within the framework of existing EU treaties and institutions, the Basic Regulation is setting up the organization of Community competence for aviation safety. It constitutes a 'European Aviation Safety Act', which sets fundamental objectives, establishes and organizes the exercise (and, if necessary, the transfer) of legal competence and regulatory powers on aviation safety matters in the EU. Finally, it establishes the European

Aviation Safety Agency (EASA) and defines the agency's general organization and tasks.

#### THE OBJECTIVES

The main objective of the Basic Regulation is to ensure a high, uniform, level of safety of civil aviation in Europe. Additional objectives, in line with general EU objectives and principles, have also been added, concerning environment protection, free circulation of products, services and persons, improved cost-efficiency, assistance to member states and promotion of European positions concerning aviation safety rules and standards.

#### LEGAL COMPETENCE AND REGULATORY POWER

The legislative level (EU Council and Parliament), through the Basic Regulation, defines the scope of powers being transferred to the Community, adopts the essential requirements specifying the objectives to be met, allocates the executive tasks among the executive actors, and establishes the means of judicial control. At the executive level, standards necessary for the implementation of the Basic Regulation may be adopted by either the European Commission (implementing rules) or by EASA (certification specifications, acceptable means of compliance). See 'General scheme'.

#### THE TRANSFER OF LEGAL COMPETENCE

Since 28 September 2003, legal competence and power have been transferred from member states to the EU for:

- Rules governing the airworthiness of aircraft and related products (type design, continued airworthiness, maintenance organizations and personnel)
- Compliance determination for aircraft product designs and issuance of relevant type certificates

#### What will EASA do

- Aviation safety regulations**
- **Draft all regulations (including formal public, transparent, consultation process):** aircraft airworthiness (including design, production, continued airworthiness, maintenance), operations, organization approvals (DOA, POA, MOA), qualification of personnel (licenses) Subsequently: ATC and airports
  - **Submit to European Commission for adoption:**
    - Amendments to EU Regulation 1592/2002 and associated Essential Requirements (for adoption by legislator through EU Council Parliament co-decision process)
    - Implementing Rules (for adoption by EC through 'comitology' process)
  - **Adopt Certification Specifications** (including Airworthiness Codes, acceptable means of compliance, guidance material)

- Verification of correct and uniform implementation of Basic Regulation and common rules by member states

The decision and plan to transfer the responsibility on rules governing aircraft operations and qualification of relevant personnel is already stipulated in the Basic Regulation, while provision is made for the subsequent transfer of rules concerning safety of air traffic control and airports (a new EU Parliament and Council decision is necessary in this case).

#### EASA functions

EASA is in charge of drafting all future regulations relative to aviation safety (for adoption by EASA itself or for submission to European Commission or Parliament/Council) and is responsible for compliance verification tasks associated with some of these regulations.

The agency is also responsible for the coordination of research on aviation safety and assists the European Commission on a number of aspects, including the

#### Implementation of aviation safety regulations

- **Aircraft Type Certification:** determination and notification of TC basis (inc. special conditions, equivalent safety findings,...) for airworthiness and environment, evaluation of product for compliance finding\*, issuance of TCs, monitoring of continued airworthiness\* (ADs, design change approvals)
- **Organisation approvals\*:** design, production and maintenance (foreign organizations)\*\*
- **Coordination of research on aviation safety aspects**
- **Assistance to EU and member State:**
  - Inspections by EU to monitor uniform implementation
  - EU and member States relations with third countries
  - Cooperation with foreign authorities and international institutions (ICAO,...)
  - Fulfilment of their international obligations by member States

#### What will EASA not do

##### Functions remaining with National Aviation Administrations

- **Activities submitted to EASA standardization:**
  - Issuance of individual certificates of airworthiness
  - Approval of minor mods
  - Issuance of approvals for European production, maintenance and training organizations (flight, maintenance)
  - Issuance of air operator certificates (AOC) and crew licenses
- **Activities remaining entirely under national responsibility:**
  - Aircraft not covered by EU Regulation 1592/2002: aircraft of historical relevance, experimental, amateur built, ex-military, ultralight and unmanned aircraft
  - Operations and licenses not covered by EASA regulation

\* By EASA itself or by sub-contracted NAA or 'qualified entities'

\*\* And, upon request, also for European organisations

#### Responsibility splitting between EASA and NAAs

	Rulemaking (drafting, consultation)	Adoption of applicable rules	Implementation, monitoring of compliance
Before EASA	JAA	NAAs (possible national variants, JAR not necessarily single code)	TCs, STCs, J-TSOs issuance: NAAs, further to JAA evaluation and recommendation (possibility of ANDRs) Continued Airworthiness, ADs: NAAs DOA, POA, MOA approvals for EU organizations: NAAs Non-EU MOAs: JAA (or bilateral with foreign NAA) Individual C of As: NAAs AOC issuance for EU operators: NAAs EU Crew Licences issuance: NAAs
With EASA	EASA	EASA or European Commission (EASA regulations directly applicable in all members states, no national variants allowed)	TCs, STCs, J-TSOs issuance: EASA Continued Airworthiness, ADs: EASA DOAs, non-EU MOAs: EASA (or bilateral with foreign NAA) POA, MOA for EU organizations, Part 147 & 66 approvals & licenses: NAAs Individual C of As and Environment Cert.: NAAs AOC issuance for EU operators: NAAs EU Crew Licences issuance: NAAs

inspections to be conducted in the member states to check the uniform implementation of the regulations in Europe. Some of the tasks related to the implementation of regulations remain with National Aviation Administrations (NAAs), which requires a sharing of responsibilities between the agency and these administrations. A summary of what the agency will or will not do and the sharing of responsibilities is provided on pages 12 and 13.

### The structure and organization of EASA

EASA is controlled by a management board, which comprises representatives from each of the 25 EU member states, from the European Commission and from observers (non EU member states having negotiated agreements with the EU). See EASA membership figure.

In accordance with the Basic Regulation, a consultative body

composed of all professions concerned - the advisory board, has been established and is being consulted regularly by the management board prior to decisions affecting interested parties. The advisory board may also formulate positions, requests or proposals on its own initiative.

While recourse to the EU Court of Justice always remains possible in case of disagreement with an EASA decision, a board of appeal is established as a built-in appeal process, which provides for a faster resolution of disputes by independent experts.

The EASA executive director was recruited in September 2003 by the management board, which also endorsed the nominations of the four directors heading the agency's main functions (certification, rule-making, quality & standardization and administrative) on his proposal. EASA is currently pursuing a recruitment and staffing campaign for its four directorates, and it is expected that, after having reached a level of around 100 staff at the end of 2004, the agency will expand its resources to around 200 staff by the end of 2005. The agency's final level of staffing should be reached at the end of 2006 (assumed to be approximately 300 persons).

The EASA headquarters moved to Köln in Germany in November 2004 and the agency's organization and structure are summarized in the figure on the right.

### Transition and relations between former JAA/NAAs system and EASA

EASA has taken over member States responsibility for issuing certificates for aeronautical products and organizations. This means that since 28 September 2003, any product design, any modification or repair to a product,

any airworthiness directive affecting a product and any design organization approval or change thereof are now approved under the direct responsibility of the agency.

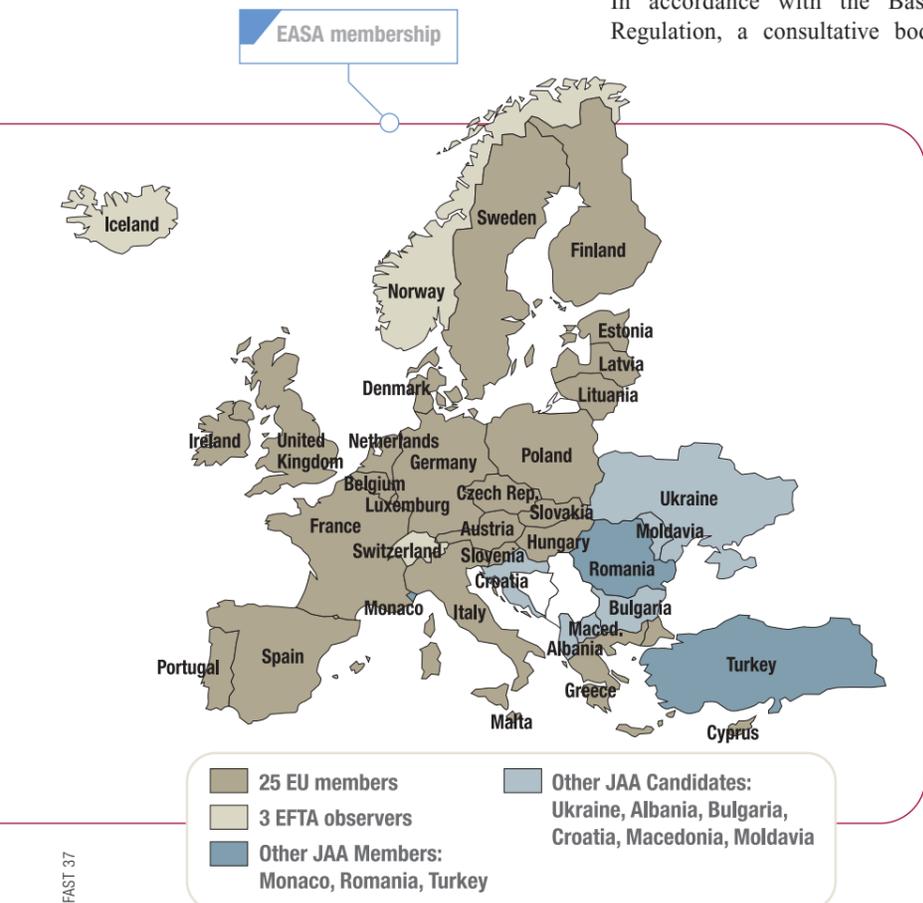
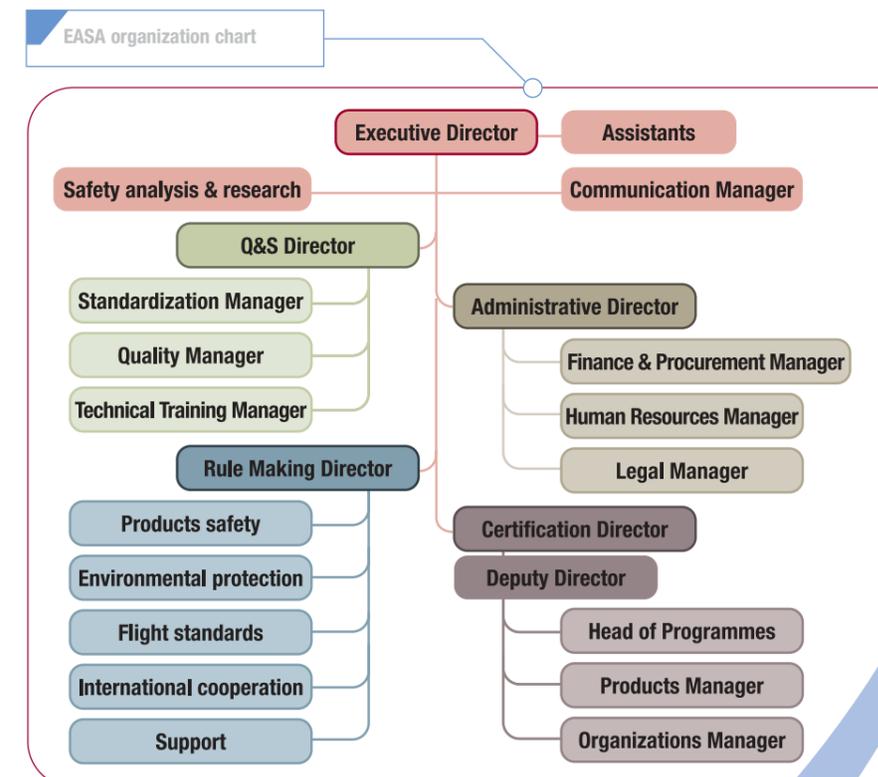
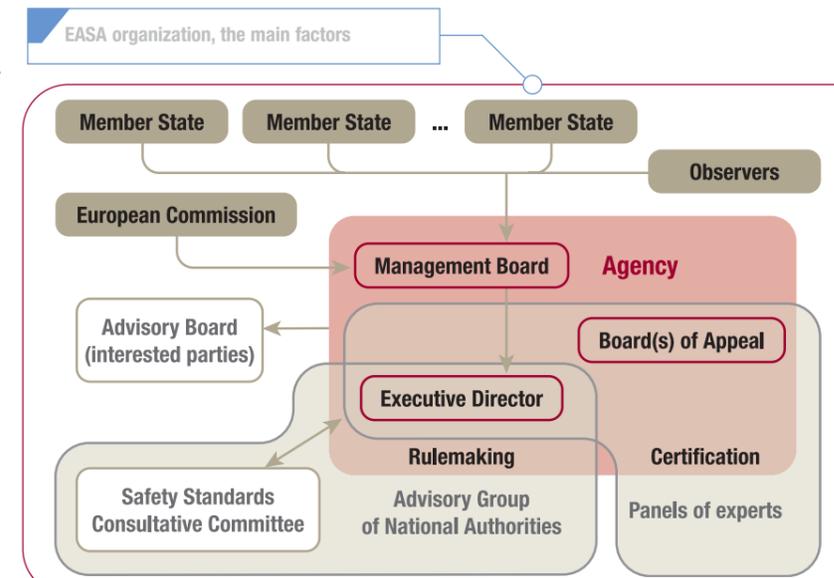
During the transition phase, until the agency has built up sufficient in-house resources and expertise to carry out these tasks entirely on its own, EASA will rely on the NAAs which will provide assistance to ensure the continuity of certification tasks during the establishment phase of EASA. EASA and the NAAs are accordingly negotiating contractual outsourcing arrangements for this purpose.

EASA has joined the JAA organization as a member and will represent EU member states in the JAA system, which is still developing operations and crew licensing rules (pending taking over of these aspects by EASA). JAA member states will accept EASA certifications and adopt the same requirements, to avoid any duplication or divergence. A contract between the two organizations also allows EASA to rely on the expertise and experience of the JAA central office for a number of regulatory tasks.

### The funding of EASA

The Basic Regulation stipulates that EASA's budget will be funded by resources provided by a contribution from the EU and by charges levied from applicants to cover the costs related to its certification and oversight tasks.

The EASA fees and charges system is the subject of a specific regulation, which has been adopted by the European Commission. In doing so, the Commission has been faced with the difficulty of evaluating the future workload involved for a number of tasks, and with the impossibility of making credible comparisons with the previous situation characterized by completely different cost recovery and



revenues, confirm or correct assumptions made, and adjust the level of charges for the following year.

The EASA fees and charges regulation entered into force on 1 June 2005 and transitional arrangements should be such that any double charging of applicants is avoided as EASA moves to the new charging system.

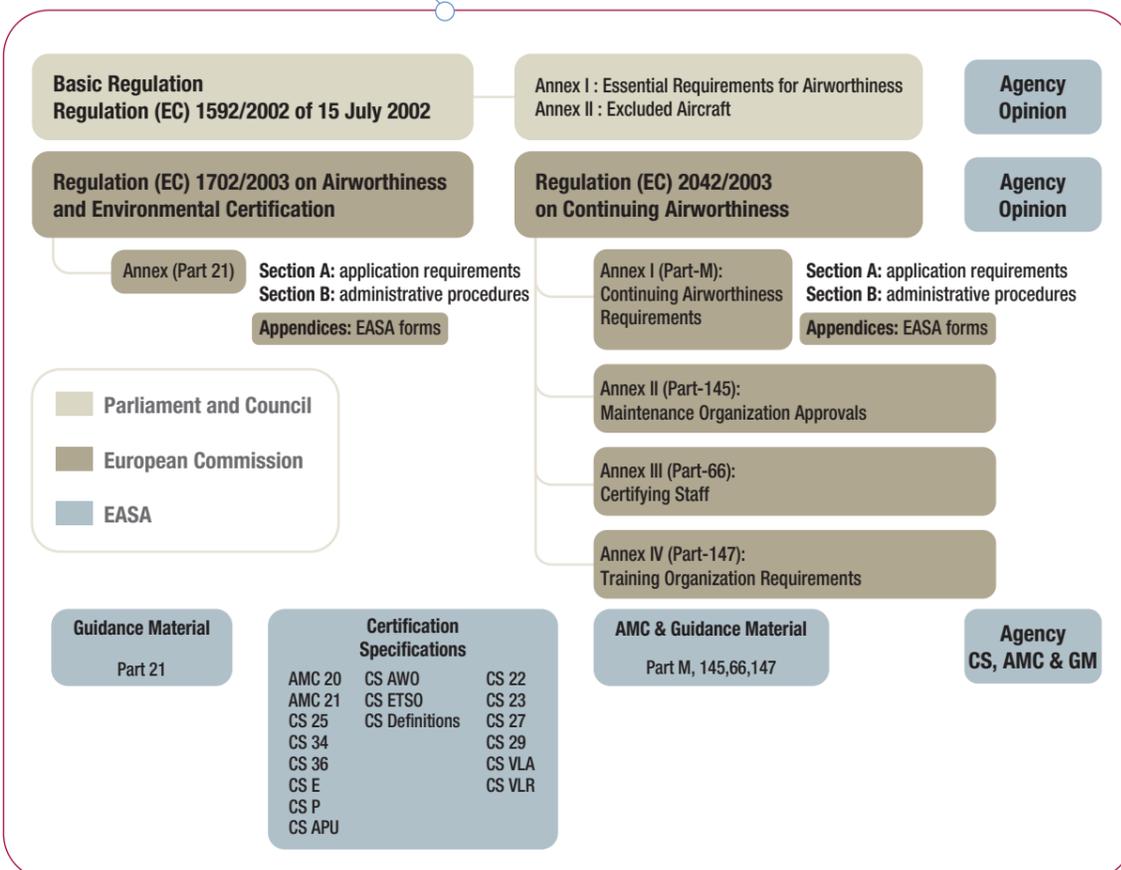
### The new European regulatory context

To allow EASA to take over responsibility from 28 Sept 2003 for product airworthiness and environmental aspects, which includes both certification and maintenance (continuing airworthiness) aspects, the prior adoption of relevant implementing rules by the Commission was necessary: this was achieved with the adoption of Commission

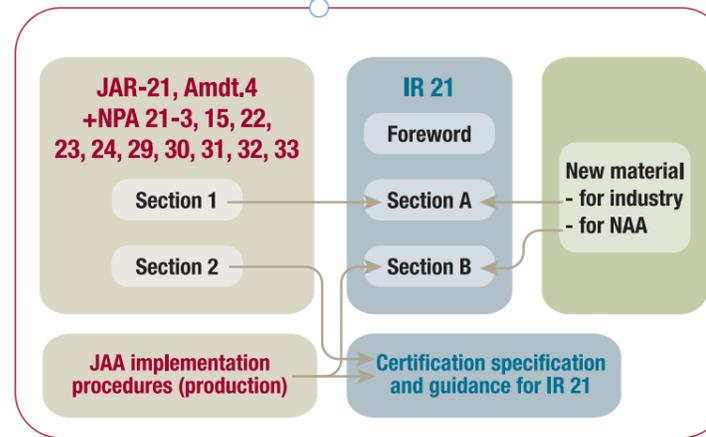
Regulations No. 1702/2003 and 2042/2003 (See figure below). Commission Regulation No. 1702/2003 provides, as an annex, the Part 21 implementing rule, dealing with the certification procedures for products, parts and appliances (type certificates covering airworthiness, noise and emission requirements, approval of parts and appliances, individual certificate of airworthiness, permits to fly, restricted certificates) as well as related organization approvals (design and production).

Similarly, Commission Regulation No. 2042/2003 provides, in several annexes, the implementing rules of Part M (continued airworthiness of individual aircraft), Part 145 (organizations involved in large and/or commercially operated aircraft), Part 66 (aircraft maintenance licence for staff allowed to issue certificates of release to service), and Part 147 (maintenance training organizations).

#### Rulemaking in EASA context



#### IR 21 architecture



These new regulatory parts are essentially based on former equivalent JAA JARs and associated acceptable means of compliance and guidance material, with the exception of Part M (which has no former equivalent JAR, as these aspects were addressed by individual member states and not by JAA). While the same paragraph numbering system is retained, slightly different numbering is visible in the new parts, which contain not only the applicable technical requirements (Section A) but also the procedures to be applied by NAAs (Section B) in cases where they are in charge of implementing the relevant rules in their territory (examples of Parts 21 and 145 numbering compared to former JAR rules are shown above).

Each of the above-mentioned EC regulations also contains, for each of the relevant parts, the modalities by which former certificates and approvals, issued by NAAs in accordance with former JAA or national requirements and procedures, are automatically 'grandfathered' and transferred into EASA certificates and approvals.

For product certification requirements EASA has adopted the 'Certifications Specifications' (CS) composed of the applicable 'airworthiness code' ('Book 1', equivalent to former JAR section 1) and

'acceptable means of compliance' ('Book 2', equivalent to former JAR sections 2 and 3). See figures above and right.

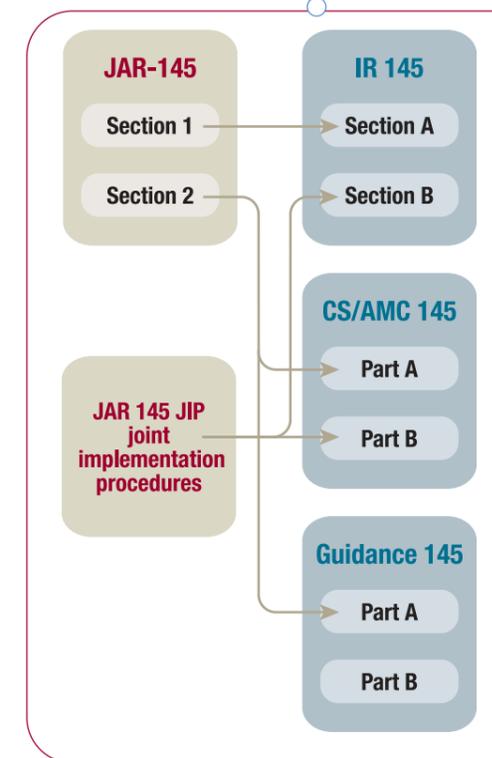
An important difference from the former JAA system is that member states may no more deviate from common rules, impose additional requirements, nor conclude arrangements with third countries.

### EASA working procedures

The EASA Management Board has adopted general principles that will govern the agency activities concerning rulemaking and certification of products and organizations. Detailed procedures, in line with these principles, have been, or will soon be, developed by the agency itself for both rulemaking and certification activities.

For rulemaking activities, EASA is assisted by the Safety Standards Consultative Committee (SSCC, representatives of interested parties) and the Advisory Group of National Authorities (AGNA, the representatives of NAAs) for the determination of rulemaking priorities and work programmes, and more generally the implementation of rulemaking activities. 'Drafting groups' may be called to prepare proposed texts, and in any case, a public consultation

#### IR 145 architecture



#### Certification specifications

- CS-Definitions: Definitions and abbreviations
- CS-VLR: Very light rotorcraft
- CS-VLA: Very light aeroplanes
- CS-22: Sailplanes & powered sailplanes
- CS-23: Small aeroplanes
- CS-25: Large aeroplanes
- CS-AWO: All weather operations
- AMC-20: General acceptable means of compliance
- CS-27: Small rotorcraft
- CS-29: Large rotorcraft
- CS-E: Engines



process is to be followed (NPA: Notice of Proposed Amendment). Similarly, detailed certification procedures for both products and organizations have been prepared and published by the agency.

### Finalization of transition and achievement of remaining EASA objectives

Naturally, industry is carefully watching the establishment phase of EASA and the transition from the former JAA/NAAs system, with particular attention paid to the necessity of maintaining the availability of the necessary authority expertise during and after this build-up phase. This requires careful management of a pool of sharable expertise, with appropriate sharing of this resource with national authorities, during the whole transition phase, until the agency is in a position to fulfil its responsibility and conduct all tasks with its own resources.

### International relations, bilateral agreements

Interested parties have requested that every step of EASA establishment be carefully made so as not to disturb the validation of European certifications and approvals by foreign, non-European, authorities and the international exchange of aeronautical products and services. In particular, industry has insisted on the necessity for the European Community to conclude appropriate bilateral agreements with foreign countries, in particular with the USA. Negotiations are progressing between the European Commission, EASA and a number of foreign authorities, and working arrangements are already agreed with a number of them.

No significant difficulties have been noted so far in the international exchange of products and services, probably owing to the fact that it has generally been agreed that existing bilateral agreements will remain valid as long as necessary until replaced by new agreements with the EU/EASA.

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## Conclusion

In line with the longstanding European industry principle of maintaining one level of safety for air transport throughout Europe, the establishment of EASA is considered by industry to be the logical final step to pursue the achievement reached by the former JAA system and transform it into a more coherent and efficient system, applying the principles of European Community treaties and

accompanying the restructuring of the European aerospace industry.

Airbus and the whole European industry are placing great hopes in EASA, which they consider potentially to become the best aviation safety system for Europe and a model for the world, as well as an efficient partner of their future development.



# Engine noise reduction programme

## Making aircraft engines better neighbours

Not long after the creation of the first regular air service between London and Paris, the residents of both cities started complaining about aircraft noise. The arrival of the jet age exacerbated the problem, Parisians and Londoners living under the flight paths took their cases to higher governmental bodies. The result was the introduction of operational restrictions and

timeframes where aircraft could not land or take-off. These types of restrictions are still in place today, both in London and Paris, as well as most other airports around the world. The newer types of restrictions have become more complex, with different restrictions and landing fees enforced depending on the certified noise level of an aircraft.



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Technical Manager  
Engineering Centre of Competence Powerplant

Modern jets are much quieter than those first jet aircraft, thanks to increasing technology in both engine design, with higher by-pass ratios and better internal aerodynamics, combined with improved nacelle design, increased sound absorption and flow mixers.

Nevertheless, Airbus, in association with the major engine and nacelle manufacturers, constantly strives to reduce aircraft noise to meet the requirements of both the public and the environmental authorities.

an A322 or A317 aircraft to be certified after 2006, and not to current aircraft.

During initial discussion by the ICAO council (where Airbus was represented), it was clear to Airbus and CFM that Stage 4 would quickly become the reference standard by which all aircraft are measured. Therefore, even before the noise reduction target was known, Airbus and CFM launched initial design studies targeted to be introduced on the current A321 aircraft powered by CFM engines. This would allow reduction of A320 Family noise levels to whatever the Stage 4 noise requirements would be.

Airbus and CFM, along with nacelle manufacturer Goodrich Aerostructures Group (GAG), started investigating ways to reduce the noise signature of the engine. The particular concern was for the A321 aircraft at the highest MTOW (Maximum Take Off Weight), as the other members of the A320 Family already had a very good margin over Stage 3.

Nevertheless, it was clear that all modifications would have to be interchangeable across the entire Airbus A320 Family fleet to ensure part interchangeability and mixability was maintained.

Noise is measured as the level of acoustic pressure variations (SPL: Sound Pressure Level) and its unit is the dB (decibel). In certification, to take into account the duration effect of an aircraft flyover and the presence of audible pure tones or discrete frequencies in the noise signal, aeronautics uses the EPNL (Effective Perceived Noise Level), expressed in EPNdB.

Increasing pressure from the public and governing bodies resulted in the ICAO (International Civil Aviation Organization) declaring a new noise regulation – Stage 4.

Stage 4 requirements only apply to new or derivative aircraft, for example, if Airbus were to develop

## Where to look?

Two major areas of improvements in acoustics were identified, these were both associated with the exhaust or jet noise of the engine.

The thrust reverser structure was acoustically treated along approximately half of its internal surface. It was clear that increasing this acoustic area would increase and hence decrease the overall measurable exhaust noise. The inner fixed structure was redesigned with increased acoustic area. In addition, the support struts and several

fairings were also modified to include acoustic treatment. The result was an increase in the acoustic area of the thrust reverser by approximately 2 square meters (21.5 sq ft).

This increase would provide significant noise reduction, but would not be enough.

Next, the specialists turned their thoughts to the exhaust nozzle. The CFM engine nacelle has a separate flow short duct nacelle, which means that the bypass air and the jet (or core air) stay separated until right at the exhaust of the engine where the two flows meet. These two regions of air are moving at very different velocities, the core air being at much higher temperature and velocity than the bypass air. The resulting difference in energy causes shock waves, and shear, which result in noise. This is typically the highest noise source created by a modern high bypass jet engine.

If the core airflow is distorted and mixed into the bypass air there are less shock waves and hence the sound generated is reduced. However, distorting the flow of core air can have a significant affect on engine behaviour, especially for performance and fuel efficiency. Any modification in this area would have to be rigorously tested for effects on engine surge margin, Exhaust Gas Temperature (EGT) and Specific Fuel Consumption (SFC) amongst others.

Any distortion in this area therefore needs to be performed in a subtle manner. Studies on core chevron nozzles had shown good results from analysis, however model testing would be required to ensure the analytical results could be proven in the real world. The model tests could demonstrate the effects the chevrons would have on performance, but were subject to the usual scatter associated to model testing. The existing nozzle on the CFM56 engine is a two-piece construction made from high

temperature resistant material. The idea was to utilize the current nozzle lines as much as possible to ensure a new chevron nozzle could be easily fitted onto existing engines, without modification of the actual engine hardware.

## Chevron nozzle design challenges

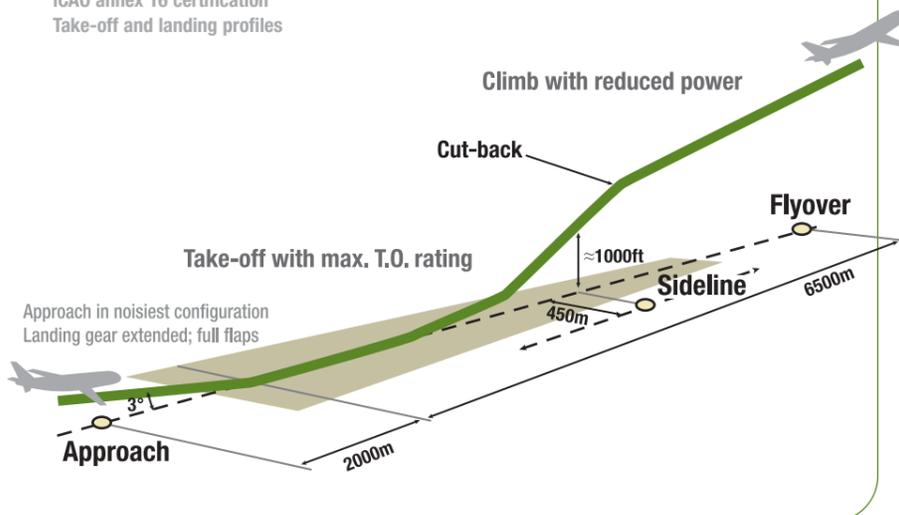
Through model testing, it became apparent that the chevrons had a small but measurable effect on engine performance. This performance impact would have to be countered to ensure that the end result would be no difference in the operation of the aircraft, i.e. the operation of the engine and the basic engine reaction to control commands would not be different from the pre-chevron nozzle standard. The answer was to introduce a thrust compensator, which thanks to the CFM FADEC (Full Authority Digital Engine Control) simply required a software modification and a way of identifying to the aircraft when a chevron nozzle was fitted. This is currently done through a FADEC software change and a programmable engine data plug, which has push-pull pins allowing a discrete to be set on or off for the thrust compensator. Additional verification from the MCDU (Multifunctional Control and Display Unit) allows programming on the aircraft side to tell the system a chevron nozzle is fitted, allowing a check between aircraft and engine to be made. This ensures that the thrust compensator logic is only applied when a chevron nozzle is fitted.

The result is full interchangeability and mix-ability of the chevron nozzle on A320 Family aircraft.

Another of the design challenges was durability. The introduction of the chevrons meant that there were now 'petals' of material in the hot air stream, which are subjected to high thermal stresses as well as high

### Take-off and landing/certification conditions

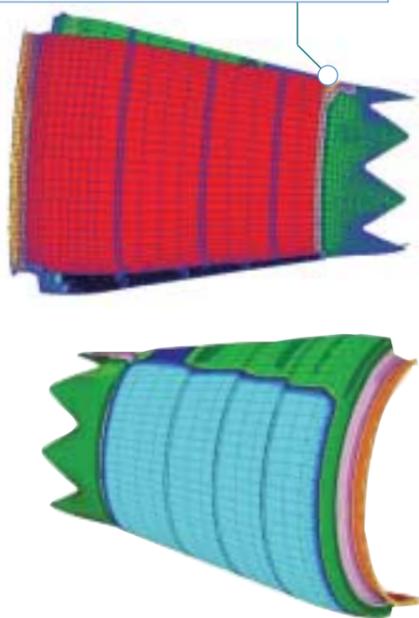
ICAO annex 16 certification  
Take-off and landing profiles



### Thrust reverser increased acoustic area



Chevron nozzle thermal & stress analysis



aerodynamic loads. The structure would have to be designed to ensure full life. Extensive testing both on an engine in a test cell, as well as fully instrumented flight testing, allowed GAG to correlate a detailed finite element model of the chevron nozzle. This model was then used to demonstrate full life capability at all the extremes of the operating envelope of the aircraft.

### The test

During their development, the actual noise reductions resulting from the improvements could only be estimated. The flight effects, particularly for the chevron nozzle, could not be fully represented by model analysis. Therefore, the true result would come only from flying the aircraft in the correct configuration in front of the airworthiness authorities.

For a new certification of aircraft noise, there are certain weather characteristics, which must be adhered to. There is a narrow band of climatic conditions, which means flight testing can only be performed at certain times of the year, to be certain of catching these weather conditions.

A production A321 was used for acoustic certification flights at an airport specially selected for its ideal weather conditions, which increased the chances of having 'good' weather.

The flight test provided good results with the high weight A321 having an 11.2 EPNdB noise reduction compared to Stage 3, which is 1.2EPNdB below the Stage 4 requirements.

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## Conclusion

The Airbus and CFM view at the time was correct; Stage 4 has now become the reference standard to which all aircraft are measured. With the application of the noise reduction programme the A321 can join its A320 Family stable-mates in being the quietest aircraft in service today.

The noise reduction package is currently offered as the basic standard on all CFM powered Airbus A321 aircraft. It is also optional on all the other A320 Family aircraft.

Due to the easily distinguished profile of the chevron nozzle, those airlines operating

aircraft with this modification package are easily identified as having associated lower noise characteristics and therefore being more environmentally friendly.

The acoustic benefits for the other A320 Family members will be less than for the A321, but would be able to be certified upon airline request - for airlines interested in achieving even more margin to Stage 4. This may be particularly interesting in the future if individual airports in highly populated city areas introduce penalties and landing surcharges based on noise levels even more stringent than Stage 4.



# A380 Airport ready

With the entry into service of the A380 less than a year away, preparations by the lead airlines and airports to receive the aircraft are in full swing. The coming months will see the culmination of many years of collaboration between Airbus and the airport community, all focused on ensuring a smooth entry into service.

To ensure that Airbus customers receive a reliable, mature aircraft with the capability to fit seamlessly into their existing ground operations environment, early dialogue with all stakeholders involved in airport operations was essential. This has been recognised on all Airbus aircraft programmes, and for the A380, the extensive consultation is now paying dividends. On 29 October, at 08:56, A380 MSN004 touched down at Frankfurt Airport to perform the first of a series of airport check exercises, coincidentally 4 years to the day

after the A340-600 visited to do the same before its entry into service. It was no coincidence however that the A380 arrived, was handled and departed using almost the same infrastructure, procedures and equipment that the A340 did four years earlier.

Many aspects of the A380 design have been driven by airport compatibility considerations, thus minimizing the amount of adaptation, and hence investment, required by airports to accommodate the aircraft. The main aim of this design optimization was to ensure that the A380 could be handled in the most part just like any other widebody aircraft. It was this capability that was validated by the tests at Frankfurt, which consisted of both an airside and landside element. The following describes, with figures from the tests, the process of handling the A380 and its similarities with other widebody aircraft.



**Thomas Burger**  
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## Airside compatibility

The airside element saw the aircraft arrive at a landing weight of 382 tonnes, just 4 tonnes below the maximum. It then taxied direct to stand E9 at terminal 2 where ground tests were carried out until 19:00, these are described in the following sections. The next day the aircraft departed at 09:34 at a take-off weight of 400 tonnes.

With a lower approach speed, better take-off, landing and climb performance than today's largest aircraft, the A380 completed the airside elements of the check successfully, and performed in much the same way as any other widebody aircraft operating into Frankfurt that day. Similarly, due to better ground manoeuvrability and pavement loading than aircraft such as the A340-600 and B777-300ER, no problems were encountered during the taxi to the stand.

current and future international guidelines. In comparative terms it will generate half the noise energy of today's largest aircraft and at the same time carry 35% more passengers per movement.

## Landside compatibility

### STANDS

The landside element started as the aircraft approached stand E9, shown on the left, one of eventually 18 A380 capable stands at the airport. With a mezzanine cockpit between its main and upper decks the A380 reference pilot eye height is 7.2m (23.6ft), between that of the 747-400 at 8.7m (28.5ft) and other widebodies at about 6m (19.7ft). This allows good forward visibility as well as compatibility with existing stand guidance systems, as was the case at Frankfurt.

At a width of 80m (262.5ft), stand E9 is an ICAO (International Civil Aviation Organization) Code F stand, capable of accommodating any aircraft up to a maximum wingspan of 80m. Many of the more than 60 airports that will see A380 operations by 2010 are taking advantage of the fact that Code F stands can have a MARS (Multi Aircraft Ramp uSage) capability. This capability allows two single-aisle aircraft to be parked in the same space as an A380. As terminal stands are used by many different sizes of aircraft during any given period, MARS stands allow airports to optimize gate usage and terminal efficiency. The A380 can also be accommodated at 65m (213.3ft) wide Code E stands if the size of aircraft on adjacent stands is limited to that of smaller widebodies.

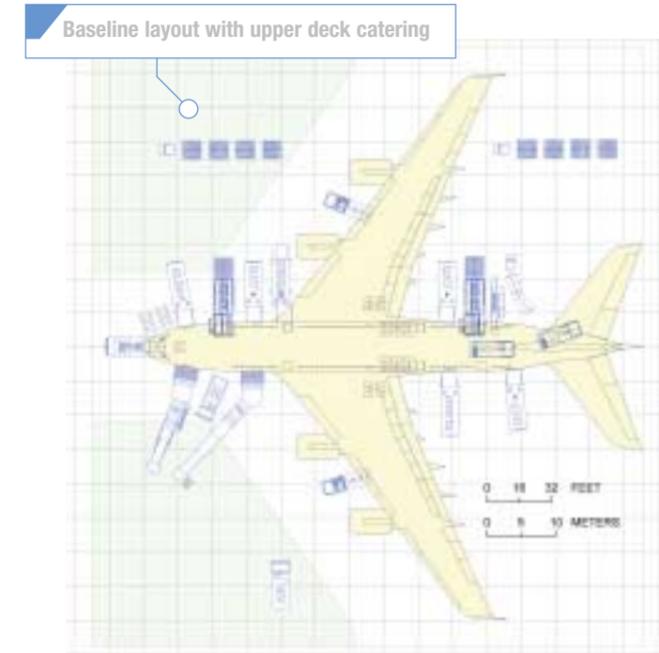
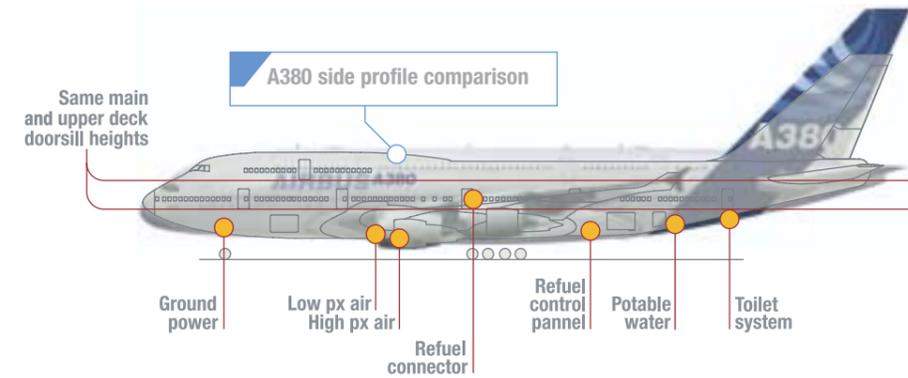
### RAMP OVERVIEW AND BRIDGE DOCKING

When the aircraft came to a stop and was chocked, the ground han-

dling tests could begin. Several ramp scenarios were simulated, based around the standard layout with upper deck catering, shown on the right. Other equipment, not normally part of the normal turn round process was also tested as well as multiple pieces from different manufacturers. In total around 40 different pieces of GSE (Ground Support Equipment) were used, this compares to around 21 for a standard A380 turn round, a similar number to existing large aircraft.

The first process to take place was the positioning of the passenger boarding bridges. Stand E9 is equipped with two boarding bridges, with the second able to reach the 8m (26.2ft) doorsill height of the upper deck. Although not an operational necessity, many airports are planning some form of upper deck access to enhance product differentiation and passenger service levels. Docking took place at main deck door M1L (main deck forward left door) followed by upper deck door U1L (upper deck forward left door), shown on the right. The main deck bridge was then moved to main deck door M2L. The docking process went smoothly with the desired clearances achieved, although the upper deck bridge canopy was not fully flush with the fuselage of the aircraft, a small case which a minor adjustment of the canopy rigging will solve.

Since MSN004 does not have a passenger cabin (it is equipped with a full flight test installation), boarding was restricted to the flight test crew. Full scale, timed, turn round tests including passenger boarding and cargo handling will be conducted during the route proving flights due to take place in mid 2006. These tests will validate that, due its superior cabin architecture, the A380 will offer similar boarding and turn round times to existing aircraft using two main deck bridges.



Bridges docked at doors M1L and U1L



A380 docked at Frankfurt, stand E9, Terminal 2



Many of those watching the aircraft arrive and depart noted how quiet it was. The A380 is the first aircraft to be designed, and guaranteed, to meet very stringent local noise limits (London QC2 departure, QC1 arrival) and consequently also has significant margins to

Most A380 servicing uses standard existing equipment



Getting ready for push back



#### GROUND AND CABIN SERVICING – ONLY TWO NEW GSE PIECES REQUIRED FOR A380 SERVICING

Following the successful docking of the bridges, the positioning and connection of the ground servicing equipment could commence. With main and lower deck doors as well as ground service connection points at the same height as those of existing large aircraft, the A380 is serviced using mostly existing ground servicing equipment and processes. Of the 21 pieces of equipment that are required to service the aircraft, 19 are standard widebody units, which can be found on any airport ramp today. As with any other aircraft, it is recommended to check the equipment manufacturers specification against the aircraft requirements to ensure compatibility of a certain piece of GSE. A380 requirements can be found in the Aircraft Characteristics for Airplane Planning (AC) document, available on the Airbus website (link at the end of this article).

The two A380 specific units are an upper deck catering vehicle, which allows direct access to the large upper deck galley in order to enhance catering times, and due to the aircraft's higher ramp weight, a more powerful tow tractor. These units are compatible with existing widebody aircraft, this being a clear requirement from the airlines and handlers that helped define them in regular Airbus organized working group meetings. They are available from several manufacturers, some of who provided vehicles for the Frankfurt tests.

#### A380 CAPABLE TOW TRACTORS

Carrying 555 passengers up to 8,000nm means that the A380 has a higher MTOW (Maximum Take-Off Weight and Maximum Ramp Weight) than today's largest aircraft. Although this extra weight does not result in higher pavement loading than existing widebody aircraft (the A380 has

more wheels to spread its weight) it does necessitate heavier and more powerful tow tractors. This is especially the case if push back at MRW and under low traction conditions is to be achieved.

Both conventional (towbar) and towbarless A380 capable tractors are available from several manufacturers. The requirements for these vehicles have been defined in Airbus organized working groups in which airlines, GSE manufacturers and ground handlers were involved. Today eight manufacturers are offering A380 capable tractors with several already in service.

Conventional A380 capable units weigh around 70 tonnes and have engines with around 300hp, which allow them to handle the A380 at MRW and under poor surface friction conditions. At weights below MRW and/or with good surface friction, it is also possible to use existing widebody tractor units. As for all other aircraft, the A380 requires its own dedicated towbar.

Existing towbarless tractors cannot handle the A380 due to its larger nose wheel size; therefore new models have been designed and are today available from five manufacturers. These new designs were again defined during the working group meetings. Due to the direct interface between these tractors and the aircraft nose landing gear these units need to be qualified prior to being used on the A380 on a regular basis. The towbarless tractor qualification procedure is a standard practice today for all Airbus and other manufacturers aircraft and ensures that the pushback and towing manoeuvres will not adversely affect the nose landing gear life cycle.

#### UPPER DECK CATERING

As a standard, the A380 is equipped with trolley lifts at the M2 and M5 doors (second and fifth main deck doors left and

right) where cross-aisle galleys are generally located, to allow transport of catering trolleys from the aircraft main deck to the upper deck. Servicing of the aircraft via the main deck only is therefore possible. So why direct upper deck catering? The answer is time. With almost all airlines having their largest galley blocks at the M2 and U1 door cross-aisle galley positions, the ability to access both directly, therefore avoiding the use of the trolley lift, can save up to 36 minutes. As catering is in the critical turn around path, the overall turn around time is also reduced by 36 minutes (assuming a standard 555 seat cabin layout - this time could vary depending on the airline layouts and galley locations). With two standard passenger boarding bridges to the main deck of the aircraft, the use of upper deck catering at door U1R allows the A380 to achieve a turn around time of 90 minutes, comparable to today's largest aircraft, though with 35% more passengers boarded.

Other doors on the aircraft upper deck could also be considered for direct servicing but the galley locations and sizes of most A380 customer airlines are such that servicing them would not provide as big a benefit as it does for the U1 position.



One of three upper deck catering vehicles tested at Frankfurt

The fact that nine vehicle manufacturers have announced the availability of prototype vehicles before entry into service (three of which were tested at Frankfurt) is again testament to the cooperation between Airbus, the airlines, caterers, and vehicle manufacturers. The upper deck catering working group, organized by Airbus, was successfully concluded in the summer of 2005 after eight meetings. During these meetings different concepts were analysed and basic functional requirements were defined. IATA has also developed a dedicated Airport Handling Manual standard (926) in its 2005 issue. A new ISO standard on upper deck catering vehicles is also under development.

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## Conclusion

The Frankfurt airport check exercise represented the culmination of many years of cooperation between Airbus and the airport community on the design of the A380. It also signalled the readiness of airports to accept the aircraft using mainly existing infrastructure and equipment, thus validating a design goal set from the start of the programme. In the coming months Airbus contact with the ground handling community will continue in conjunction with customer airlines

through a more general ground handling working group. This will ensure that all relevant information is passed to those who will shortly be regularly servicing the aircraft. The route proving campaign will then be the final validation of the airport optimized design of the A380, providing Airbus, customer airlines, airports and ground handlers with the knowledge and experience to ensure a smooth entry into service.

Link to A380 Airplane Characteristics for Airport Planning:

[http://www.airbus.com/store/mm\\_repository/pdf/att00004248/media\\_object\\_file\\_AC\\_A380.pdf](http://www.airbus.com/store/mm_repository/pdf/att00004248/media_object_file_AC_A380.pdf)

AIRBUS



# Airbus Training Airport

## A virtual airport for pilot training

To complete a pilot type-rating course and issue an adequate certificate Airbus training centre includes in its curriculum a number of instrument and visual approaches, as required by airworthiness authorities. To perform these it has become necessary to fly to several different airports because Toulouse Blagnac airport does not have the capacity to handle all the approaches.

Flying to several airports gives some experience of different runways, lighting systems, taxiways and parking, but the possibility to experience a wider range of these is limited by the facilities of the airports themselves. Furthermore, flying to these airports requires the maintenance of a substantial amount of airport charts, performance tables and visual scenes, which is time consuming, quite expensive and inconvenient for all involved.

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The ability to offer a wider range of experience, such as 'black hole' approaches, or airports in line with a pilot's future operating environment in different parts of the world is the ideal for pilot familiarization, but is not feasible in this situation. Considering these issues, and with a vision of what an ideal system should be like, Airbus training has developed and introduced an innovative tool for pilot training. This is the Airbus Training Airport - a virtual airport - that is used in the M/FTD (Maintenance/Flight Training Device) and in the Full Flight Simulator for the new Airbus Pilot Transition (APT) courses. Its objective is to provide functionalities to enable pilot training on most types of approaches, runways, signboards and ground markings etc that they will encounter worldwide.

This article describes the six steps it took to achieve the Airbus Training Airport: airport site, platform, terminal buildings and facilities, charts, FMGS (Flight Management Guidance System) database and visual scene.

### Airport site

The airport position is: 46 24. 4N/004 01.3E. The reason for this choice is the presence of a flying school that has available runway and radio aids. In addition, it is close to the centre of France, thus it is possible to fly a one-hour leg to the major airports of the neighbourhood.

### Platform

The airport platform was designed to provide the functionalities to train pilots on most of the types of runways, signboards, ground markings and so on. To achieve this, it was designed according to the airport on the selected site. However, this did not offer all the possibilities needed, so it was necessary to add a new runway at 90° to the existing one to allow particular circling approaches, which

necessitated diverting the course of the river Loire!

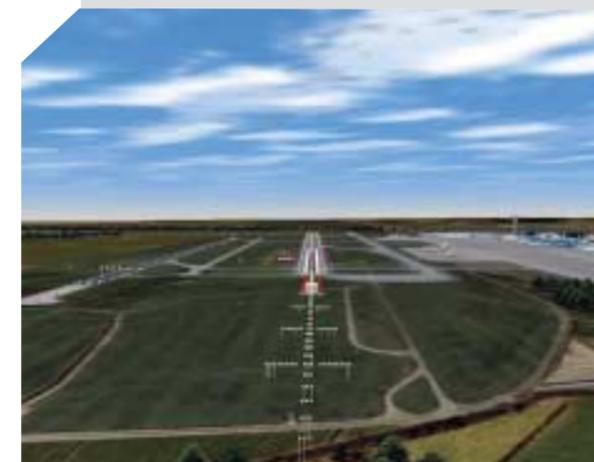
Fortunately, as this is a virtual airport and consequently a virtual river diversion the real residents of the new river course did not get wet!

For performance limitations: GPWS (Ground Proximity Warning System) training and ILS (Instrument Landing System) approaches with a 4° glide slope a hill was introduced in line with the new runway. Urban areas were also included for noise abatement restrictions.

The design of taxiways and ground markings was done with experts from the French Civil Aviation Authorities in compliance with ICAO (International Civil Aviation Organization) annex 14 as well as French regulations. Particular attention was paid to ground markings due to the taxi training recommended by the FAA (Federal Aviation Administration) in Advisory Circular 120-74.

The platform has three runways of different lengths and widths and an additional one under construction. All have several approach lighting systems (PAPI, APAPI, PAPI L, PAPI R, VASI\*). A LDIN (Lead-in Light System) approach is also available with a final turn over water as a lake was added to enable this.

The airport will be available in 2007 in Jeppesen ANS (Airport Navigation System). In addition, the software makes it possible to reproduce airport traffic moving on the ground so training exercises, in particular with low visibility, are achievable. One of the most difficult parts of a flight in some congested airports is the taxi from the gate to the holding point and from the runway to the gate. This is significantly eased when the airport is equipped with the SMGCS (Surface Movement Guidance Control System) and the airport also has this possibility.



**\* ABBREVIATIONS**  
PAPI: Precision Approach Path Indicator  
L: left - R: right  
APAPI: Abbreviated Precision Approach Path Indicator  
VASI: Visual Approach Slope Indicator

## Terminal buildings and facilities

The airport has a main central terminal building and two side satellites. Each is devoted to an aircraft size: the north satellite for the A380, the central terminal for the A330/A340 and A300 families and the south satellite for the A320 Family. Three different aircraft guidance systems are implemented at the gates. The airport has two control towers, a freight terminal, a maintenance hangar and several parking positions on the tarmac. A fire station is included, as well as some administration buildings. The service roads and antennas of radio aids are also shown on the visual scene.

## Airport charts

The airport charts were designed by ENAC (Ecole Nationale de l'Aviation Civile), which is the French aviation academy. With the airport it is possible to practise ILS approaches, CAT I, CAT II and CAT III with a 3° glide slope and also a 4° glide slope on different orientations of the same runway.

Non-precision approaches like VOR DME, ADF, localiser back course and even VDF (Voice Directional Finder) are also possible.

The basic issue of the charts is in AIP (Aeronautical Information Publications) format converted to Jeppesen format and it will be available in LIDO Flight Nav format as well. These formats are alternative versions of the charts available for airports (see examples and list on the left).

## FMGS database

The STARs (Standard Terminal Arrival Routes), SIDs (Standard Instrument Departures), and instrument approaches listed in the pilot documentation are included in the FMGS (Flight Management and Guidance System) database and coded according to ARINC (Aeronautical Radio, Inc) 424 norms. Due to the implementation of artificial terrain and the modification of the environment the EGPWS (Enhanced Ground Proximity Warning System) database is modified to match the surrounding terrain profile.

## Visual scene

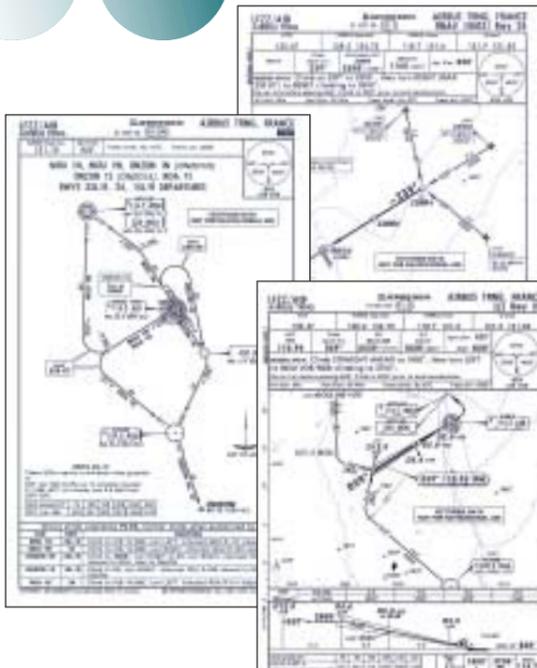
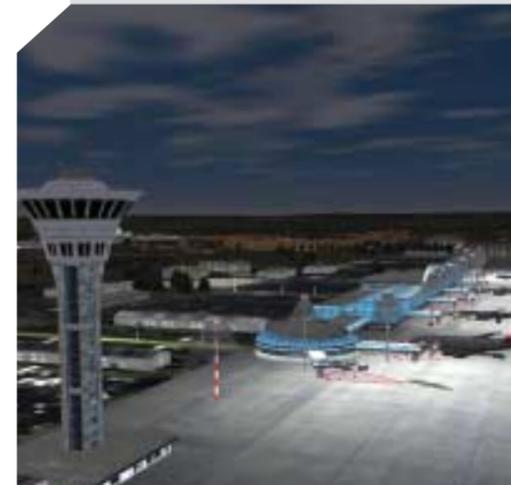
For training tools like flight training devices or full flight simulators the visual scene is of paramount importance, as its level of reliability and visual quality has a direct impact on the level of training.

The design of the airport visual scene started with a two-dimensional model drawing followed by building from this a three-dimensional model using appropriate software. The model data was then translated by another software into data to be processed by the simulator image generator. The airport is available for a number of visual systems of different manufacturers.

Particular attention was paid to details to obtain high definition of the close environment of the airport.

This was achieved by day, as well as by night, in all kinds of weather conditions such as nice weather, fog and snow. When the runway is wet or contaminated with ice, snow, or slush, the visual system reflects the runway surface and degraded braking action is reproduced.

Pilots in some regions of the world may have to land at night with only the runway lights as a reference, which is a so-called 'black hole approach'. Such an approach can be simulated with the airport by switching off all the lighting of the environment of the visual scene except the lights of the landing runway.



### List of Jeppesen charts

STAR ATN 1C, BUZIL 1C, DJL 1C FOR RWYS 33L/R  
STAR DJL 1A FOR RWYS 06, 07, 15L/R, 24  
STAR DJL 1B FOR RWYS 15L/R, 24

STAR CFA 1D, EB 1D FOR RWYS 06, 07, 33L/R

SID ATN 1E, ATN 1N, BUZIL 1E, BUZIL 1N,  
BUZIL 1S FOR RWYS 06, 07, 33L/R, 15L/R, 24

SIDMOU 1N, MOU 1W, ONZON 1S FOR RWYS 33L/R,  
24, 15L/R

#### AIRPORT PLAN

AIRPORT LIGHT DESCRIPTION

AIRPORT PARKING PLAN

APPROACH ILS RWY 06

APPROACH ILS RWY 07

APPROACH LOC (BCK CRS) RWY 15L

APPROACH ILS RWY 33L

APPROACH ILS RWY 33R

APPROACH CAT II ILS RWY 33R

APPROACH RNAV GNSS RWY 24

APPROACH VOR DME RWY 15R

APPROACH VOR DME RWY 24

APPROACH VOR DME RWY 33L

APPROACH VOR DME RWY 33R

APPROACH NDB RWY 33R

CIRCLING APPROACH FOR RWY 15L/R



## Conclusion

Airbus experience in the use of the Airbus Training Airport has demonstrated many benefits, some examples:

- Training in extreme conditions (short and narrow runway covered with ice, blowing snow, crosswind and degraded braking action). It is not necessary to have a Gander or Goose Bay visual scene to practise a localiser back course approach. Pilots who need to fly for the first time to New York (Kennedy airport) or Tokyo (Haneda airport) can practise an LDIN approach on the Airbus airport before their first trip and therefore be familiar and comfortable with it before doing it in reality.
- The airport can be customised to reproduce an operator's home airport and implemented in any place in the world, so can comply with an operator's local training needs.
- It is flexible, adaptable and enables cost savings (no update required for airport

charts and performance tables), offering benefits from a basic school to a professional training centre.

- Airbus Training Airport has been used since October 2004 in all Airbus training centres and since November 2005 in the centres of Airbus partners.
- The airport will evolve at the same rate as development of Airbus technology and airport regulation amendments.

Considering the trend of basic training for airline pilots towards increasing simulator time and reducing real aircraft handling, an increasing part (most) of courses will be performed on training devices and full flight simulators. Therefore, the Airbus Training Airport with its wide range of possibilities will be of great value to ensure good quality pilot training and generate increasing benefits for those using it.

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# Countering jet fuel price increases

## Guidance on fuel saving

In the last two years the average cost of jet fuel has doubled as shown in the report on the right, while competition in the airline industry is intense. Consequently, more and more airlines are looking to optimize their fuel consumption as a means of minimizing overall costs.

The mechanisms for maximising fuel economy are well understood as being *aerodynamically clean aircraft, well maintained engines and good flight planning and procedures.*

This article highlights existing Airbus 'Getting to grips with' publications where information on optimizing fuel consumption can be found and identifies some additional areas for consideration.



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### Information

None of the information contained in the 'getting to grips' publications is intended to replace procedures or recommendations contained in the Flight Crew Operating Manual (FCOM), but rather to highlight the areas where maintenance, operations and flight crews can contribute significantly to fuel savings.



getting to grips with fuel economy  
ISSUE 3 - JULY 2004



getting to grips with the cost index  
ISSUE 2 - MAY 1998

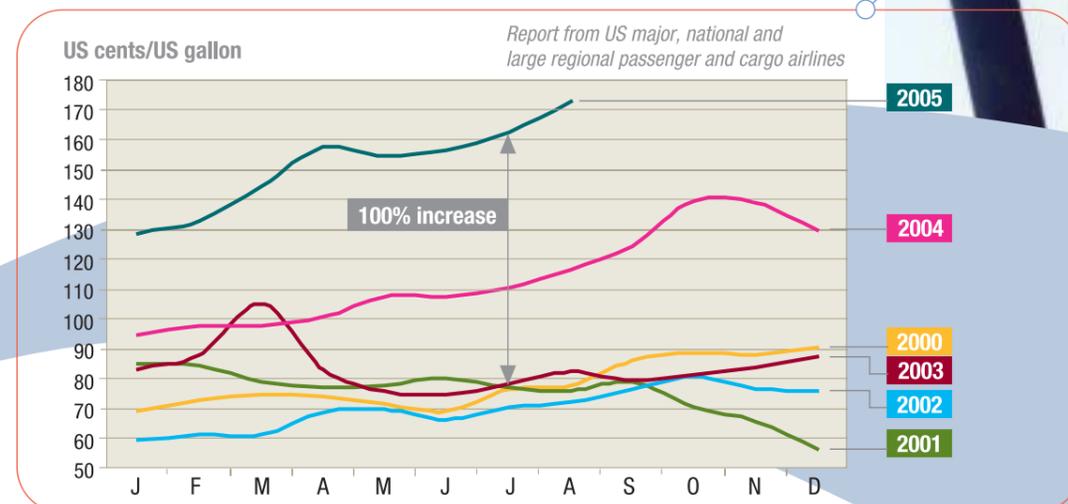
This examines the influence of flight operations on fuel conservation and provides recommendations to enhance fuel economy. It covers maximization of range for a given payload, the decrease of fuel uplift from high fuel cost airports and introduces the concept of cost index (see 'Getting to Grips with the cost index' on the right).

Also, it systematically reviews fuel conservation relative to ground and flight performance, including centre of gravity position, excess weight, flight planning, auxiliary power unit operations, taxiing, climb, step climb, cruise, descent, holding and approach.

In addition to navigation functions, the Flight Management Computer (FMC) carries out real-time performance optimization aimed at providing best economics, not simply in terms of fuel consumption, but rather in terms of direct operating costs. This is achieved using the cost index concept that helps fuel and time-related costs to be balanced.

Airbus has recently launched a new software tool called **AirS@vings**. It is designed to provide a dynamic determination of the cost index under a wide variety of operational criteria so that it can be accurately tailored to the specifics of an airline's operation on a particular route.

ATA monthly jet fuel report





getting hands-on experience with aerodynamic deterioration  
ISSUE 2 - OCTOBER 2001

This examines the influence of aerodynamic deterioration on operational costs. During an aircraft's life deterioration is likely to occur and drag can increase by up to 2% within five years. This in turn can result in a significant fuel consumption increase. However, this cost has to be traded against the cost of maintenance to establish when it is cost-effective to carry out corrective measures.

Cost-benefit analyses are a practical way to approach this and Airbus has carried out numerous performance audits in cooperation with airlines. Consequently this can help operators determine corrective actions that are financially beneficial despite the short-term maintenance costs.



getting to grips with aircraft performance  
ISSUE 1 - JANUARY 2002

This addresses three different aspects of aircraft performance:

- Physical aspect: Reminders on flight mechanics, aerodynamics, altimetry, influence of external parameters on aircraft performance, flight optimization concepts, etc.
- Regulatory aspect: Description of the main JAR and FAR certification and operating rules, leading to the establishment of limitations.
- Operational aspect: Description of operational methods, aircraft computer logics, operational procedures, pilot's actions, etc.



getting to grips with aircraft performance monitoring  
ISSUE 1 - JANUARY 2003

This provides guidelines for aircraft performance monitoring based on feedback obtained from many operators and on Airbus' knowledge of its aircraft. It has five-objectives:

- Introduce performance monitoring, presenting the different analysis methods and tools.
- How to deal with the amount of data required, the most common ways to get data routinely recorded are described via a quick overview of the available aircraft systems.
- Guidelines on the way to process the data using one of the Airbus aircraft performance-monitoring tools, namely the APM programme.
- Assessing data coming from regular cruise performance analysis.
- Airbus recommendations on how to use the results of analysis in daily aircraft operations.



## Other areas for consideration

In addition to the 'getting to grips with' publications an airline has many other routes available for minimizing fuel expenditure, including:

- **Minimizing dispatches under MEL** (Minimum Equipment List) **conditions** that include requirements for additional fuel reserves, or where fuel burn is increased.  
*Example:* dispatch with wing anti-ice valve failed in open position may increase fuel consumption by up to 6% depending on aircraft.
- **Implementing an engine health monitoring system**  
*Example:* engine component defects may increase fuel consumption while remaining operational and engine health monitoring can highlight such increases.
- **Working closely with the engine shop** to establish an optimized refurbishment workscope that provides the best compromise between cost, reliability and performance restoration

- **Developing an engine water wash schedule**  
Over time, dirt accumulation on the compressor airfoils reduces engine compressor efficiency. Engine core water washes are recommended to remove this. Contamination levels depend on the aircraft's operation and environment, so wash frequency must be optimized by each operator. Periodic engine water washes also have a positive effect on the exhaust gas temperature margin and consequently on engine life
- **Trading passenger comfort or service against weight** (carrying newspapers, magazines, blankets, reducing potable water carried, etc.).



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## Conclusion

Airbus has previously published a wide range of information and recommendations for the optimization of both aircraft performance and fuel economy. These publications remain as valid today as when they were published (with the exception of certain economic conditions). The breadth of these recommendations illustrate that an airline wishing to minimize its fuel bill will

be best served by adopting a holistic or airline-wide approach and not making fuel economy the responsibility of any single entity in the organization.

Airbus also recognizes the increasing importance of fuel efficiency to its customers so further support will become available during the course of 2006.

# Giants of the skies, past and present



A 'giant of the skies', a seven seater Fokker D378 of Aero Lloyd, lands at Hamburg Fuhlsbüttel airport in Germany in 1926 - the same year Germany's main airport Frankfurt opened.

Almost 80 years later, on 29 October 2005, another 'giant of the skies' landed at Frankfurt airport and is shown docked. This is the 555 seater Airbus A380 - how things have changed, not only for aircraft but airports too!





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Bangalore	India
Bangkok	Thailand
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Berlin	Germany
Brussels	Belgium
Buenos Aires	Argentina
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Casablanca	Morocco
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Delhi	India
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Hangzhou	China
Haikou	China
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Helsinki	Finland
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Paro	Bhutan
Phoenix	United States of America
Pittsburgh	United States of America
Prague	Czech Republic
Qingdao	China
Quito	Ecuador
Rome	Italy
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Tehran	Iran
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