European Transonic Windtunnel GmbH
Ernst - Mach - Strasse D - 5114 7 Köln

Issue No. 6, April 1997

News

AEM/YAK 130 S Advanced Trainer Aircraft

In January 1997 a large test campaign was carried out for AerMacchi S.p.A. with a complete 1/10th scale model of the AEM/YAK 130S advanced trainer aircraft. The test comprised both low speed and high speed configurations and covered the whole flight spectrum of the aircraft. To obtain the highest possible Reynolds numbers a test temperature of 0 degrees Celsius (273 K) was selected thus avoiding any material problems with this basically conventional model. Pressures were varied between 1.1 and 4.5 bar depending on the model loads and Reynolds numbers required.

The AEM/YAK 130 Model on Model Cart 1

The test campaign covered about 60 different configurations and more than 250 polars, both symmetrical and asymmetrical, over a Mach number range from 0.15 to 0.95.

The test demonstrated the capabilities of ETW for testing non-cryogenic models over a large Mach number range with strict temperature control in combination with high data quality and the highest Reynolds numbers achievable with such models.

ISO 9001 QUALITY CERTIFICATION

Following two years of steady development and implementation of our quality assurance system ETW commissioned one of the foremost accredited international certification bodies, LRQA,

- Lloyd's Register Quality Assurance Ltd. -

to undertake the ISO 9001 initial assessment. This was carried out in March 1997 and LRQA recommended that ETW be issued with the formal certificate of compliance.

The scope of activity covered by this certificate is:

> **"Wind Tunnel Aerodynamic Testing of Customers Models, particularly in the High Reynolds Number Transonic Regime"**

We are delighted to announce our success in gaining this approval and we wish also to assure everyone concerned that we plan to continuously develop improvements so that we can offer ever better **value for money and data of the highest possible quality** to our clients based upon our internationally certificated QA management system.

Supersonic Commissioning Completed

During early March ETW succeeded in completing the commissioning of the supersonic operation of the tunnel under cryogenic conditions. Nozzle settings were optimized with the help of special control algorithms for Mach numbers up to 1.3, tunnel pressures up to 2.6 bar and temperatures down to 120 K. By using the full 50 MW drive capacity of the compressor this now opens the envelope of the tunnel for supersonic tests at full model mean chord Reynolds numbers up to 37 million at the highest design Mach number M = 1.3. The first client that will benefit from the supersonic capability including full use of the transonic Mach number range has been scheduled for July 1997.

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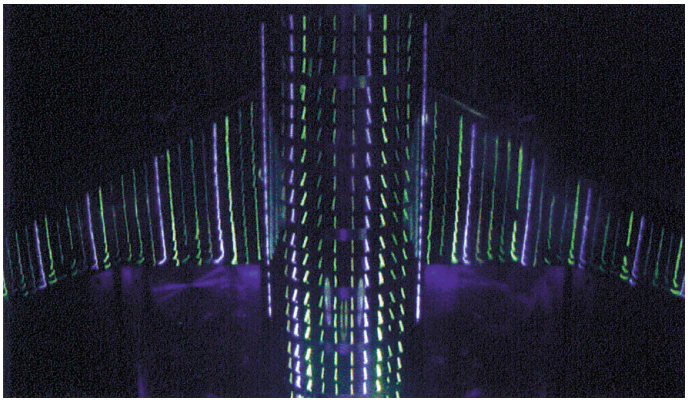
AerMacchi/Yakovlev YAK-130 Tests

By commission of AerMacchi SpA a test campaign was carried out with a 1/10th scale model of the AEM/YAK-130-S3 advanced trainer aircraft in ETW on Model Cart 1. The model was fitted with a horizontal tailplane balance and was supported by means of an internal balance on loan from ONERA. A double crank sting was specifically designed to keep the model reference centre at the tunnel centreline point of rotation of Cart 1. Yaw angles were realised by combination of angles of incidence and roll of the sting.

Although the model, made from aluminium with steel winglets, was not specifically designed for cryogenic operation, the materials fracture toughness properties allowed the test to be executed at 273 K. The ability to control independently the tunnel's Mach number, pressure and temperature, offered the opportunity to do the test at the lowest possible model temperature giving a Reynolds number higher than achievable in any other European wind tunnel with the same model and stress constraints. The temperature of 273 K was maintaned during the whole test campaign thus contributing to a very accurate and consistent data base. The Mach numbers were varied between 0.16 and 0.95, the largest range so far applied with a single model. Pressures were varied between 1.1 and 4.5 bar depending on maximum model loads and Reynolds numbers required. The test campaign covered about 60 different configurations and more than 250 polars, both symmetrical and asymmetrical.

Another novelty during this test campaign was the application of minitufts to visualise the flow over the model's surface. A special digital camera and ultraviolet light sources were installed in the test section for this purpose. Also video recordings with blended-in data legends were made by the tunnel's own surveillance cameras and facilitated the interpretation of processed digitised data by comparison to the recorded flow patterns. An example of the quality obtained with this new feature is shown in the adjacent picture of ETW's reference model which was used to try out the technique first. A further development for cryogenic applications is foreseen, already.

In summary, the test demonstrated ETW's capabilities for testing non-cryogenic models over a large Mach number range with strict temperature control in combination with high data quality and the highest achievable chord Reynolds numbers.



Reference Model with Minitufts

News in Brief

ETW has procured a stock of material suitable for manufacturing cryogenic models and stings. Prospective users of ETW may benefit because it could help them cut the lead times for these items considerably by using this material. For detailed questions also concerning design issues, please contact Thierry Vohy at our Design Office (tel. +49.2203.609.215).

A contract for the provision of a Commissioning Half Model was placed with Northwest Aerodynamic Models in Stockport near Manchester, U.K. The model serves to aerodynamically load the External Balance and get first hand experience with the complete Half Model Support System under pressurised and cryogenic conditions. The model is due for delivery in September 1997. First tests are scheduled for March 1998.

Visitors to ETW

– Mr. A.Galasso, Director Research of CIRA, and Mr. S.Caristia, Italy.

– Prof.Dr.H.Hornung, Director of Guggenheim Aero Lab., Caltech, USA.

– Mr.S. Nakamura, Manager, K HI Ltd., Japan.

– Mr.L.Visintini, Chief Engineer AEM, and Mr.R.Pertile and Mr.F.Pacori, Italy.

– Dr.L.M.Laster, Technical Director, AEDC, and Mssrs. D.Bond, D.Cahill, D.Horn, D.Williams, and M.Sellers, USA.

– Mr.R.Gregg, Senior Manager Aerodynamic Technologies. MDC, USA.

– Mr.S.Davies, Chief Fluid Mech.Lab., NASA AmRC, USA.

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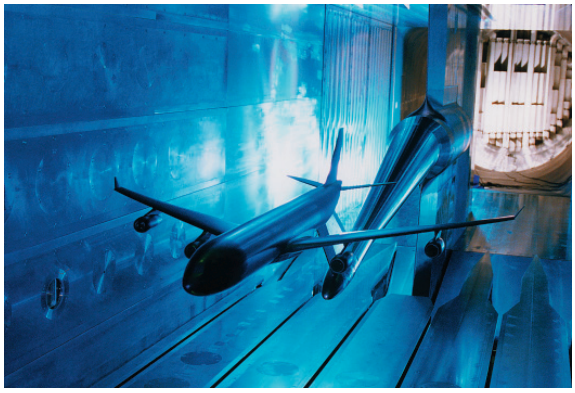
Airbus Partners report at European Forum

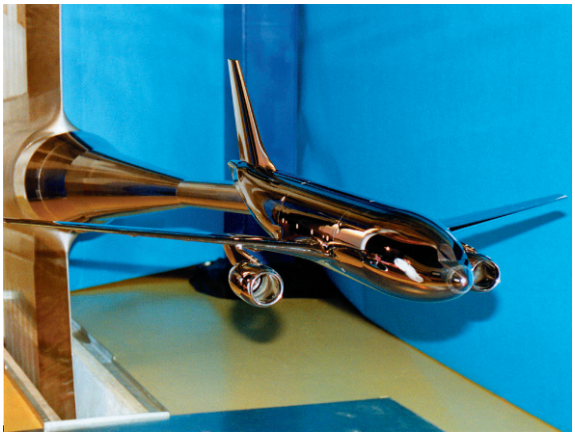
The Airbus partners Aérospatiale Aircraft Business, British Aerospace Airbus and Daimler-Benz Aerospace Airbus revealed the results of their first test campaigns in ETW during the 1997 European Forum on Wind Tunnels and Wind Tunnel Test Techniques organized by the Confederation of European Aeronautical Societies (CEAS) in Cambridge, U.K. from 14 to 16 April. The test campaigns, which were performed in co-operation with ETW, were held in 1995 and 1996 and used three cryogenic models of Airbus types A340, A320 and A310 at scales of 1/39, 1/22 and 1/30, respectively. Balances and stings as well as the incidence and pressure measurement instrumentation for these models were provided by ETW. A full report of the tests by the authors and acting test directors, Th.Angeli of AS, M.Hawker of BAe, and Th.Balden of DA, is incorporated in the Conference Proceedings (Paper 1). Some first results were published earlier by ETW in this Newsletter, Issue No.4, at the AIAA 34th Aerospace Sciences Meeting in Reno, NV, in January 1996, and at the 5th International Aerospace Symposium in Nagoya, in December 1996.



Aérospatiale A340 Model

The AS model of the A340 was tested with the aim of gaining first hand experience in ETW and to acquire results for comparison to existing wind tunnels such as ONERA S-1. AS was also closely involved in infrared detection of boundary layer transition. The BAe A320 model was tested in different configurations and at conditions ranging from those obtained in existing wind tunnels such as the DERA-8ft and ARA-TWT to near flight conditions. Measurements of model forces and wing pressure distributions were obtained over a wide range of Reynolds number (3.2 mio < Re < 24.4 mio). The DA A310 model was tested in 3 entries in different configurations including a force wing and a pressure plotting wing for comparison to flight and to other wind tunnels such as DNW and KKK beside the aforementioned facilities. In addition, the test programme included a comparison of different ETW balances while the test conditions were chosen in such a way that they allowed for an assessment of the influence of pseudo Reynolds number effects caused by aeroelastic deformation of the wing to separate these from real Reynolds number effects.

The Airbus partners concluded that the outcome of these first, exploratory test campaigns was very promising and demonstrated ETW's capabilities to establish real Reynolds number effects and separate them from pseudo effects due to aeroelastic deformation or temperature contraction. On top of this, the tunnel demonstrated excellent performance in repeatability which compared well with the best conventional wind tunnels on the market implying the good flow quality and good standards for flow control, data acquisition and data reduction required for aircraft industry testing.



Daimler-Benz A310 Model

British Aerospace A320 Model

The excellent results obtained during these exploratory test campaigns are highly encouraging and will help to stimulate the completion of the remaining development steps to achieve the status of an industrial wind tunnel in every respect. For a new wind tunnel, the performance of which is scrutinized so closely by the Airbus partners and other industries, clearly no simple task.

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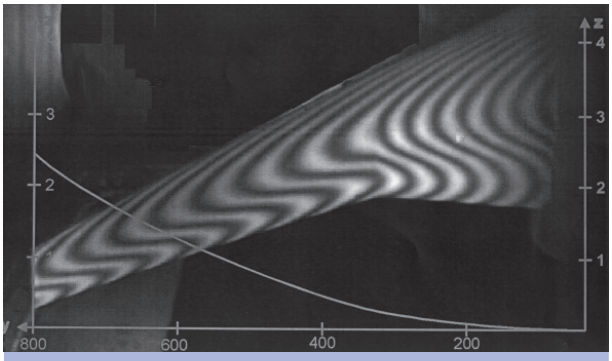
Test Technique Development

Model Deformation Measurement System Commissioned

Despite the use of very high strength and stiffness alloys, models tested in ETW will show some deformation when subjected to the high aerodynamic loads generated by the high dynamic pressures of which the facility is capable. Estimates for wing bending for a typical transport type aircraft model could be as much as 40 mm at the wing tip and up to 2 degrees of wing twist at mid span at the highest pressure. Clearly, the effects of these deformations should be isolated from those caused by true Reynolds number effects. In order to make this possible, ETW, as already announced in ETW News Issue No.2, has procured a Model Deformation Measurement System. After evaluation of various tenders, DLR was commissioned for the supply of a system based upon the Moiré interferometry technique. This system projects a grating on to the surface of a model wing which is accordingly viewed and captured by a CCD camera. The information can then be down loaded to a computer where a full analysis can be made by comparison of the patterns of the loaded and unloaded wing. The optics for the system are installed in the top wall of Model Cart 2. The DLR system has been commissioned under cryogenic conditions and worked satisfactorily. It is anticipated that the accuracies of bending and twist can be measured to 0.2 mm and 0.02 degree respectively. This opens the prospect of separating socalled pseudo Reynolds number effects from real Reynolds number effects.



Typical Moiré Pattern of Reference Model

Supervisory Board Changes

Several positions in the Board of ETW have changed hands. Dipl.-Ing. H.Max has retired from DLR and is replaced by Prof. Dr.A.Bachem, Member of the Board of DLR. IGA. G.Dorey, former Director Large Facilities of ONERA, has been replaced by his successor ICA. X.Bouis, former Director of ETW. IGA. J.Chéret, who has been with the Board for many years, has joined ONERA and is succeeded by ICA. A.Brémard of DGA. At the UK side, Dr. Coleman, who has been with the Board for 9 years, will be succeeded by Dr. Mowbray of DERA. Dr. Woodward also left because he retired from DERA. In its new composition the Board reads as follows.

France:	ICA. X. Bouis	ONERA	Germany:	Dr. H. Diehl	BMBF
	ICA. E. Lisack	DGAC/DPAC		Prof. Dr. A. Bachem	DLR
	ICA. A.Brémard	DSP/SREA		Dr. H. Körner	DLR
U.K.:	Mr. S. Charik	DTI	Netherlands:	Ir. H. Wolleswinkel	RLD
	Dr. D. E. Mowbray	DERA		Dr. Ir. B. M. Spee	NLR

Personnel

Olivier Piccin

Olivier Piccin joined ETW as Test Engineer in 1994. His prime responsibility is to coordinate and supervise Client and ETW test campaigns. In this capacity Olivier was in charge of test campaigns for AerMacchi, Aérospatiale and Dassault. Previously, he worked during four years as Test Engineer at ONERA Le Fauga-Mauzac centre in the F1 pressurised low speed wind tunnel experimentation group.

Olivier is married with one son and one daughter and has interests in aviation and building model aircraft.

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