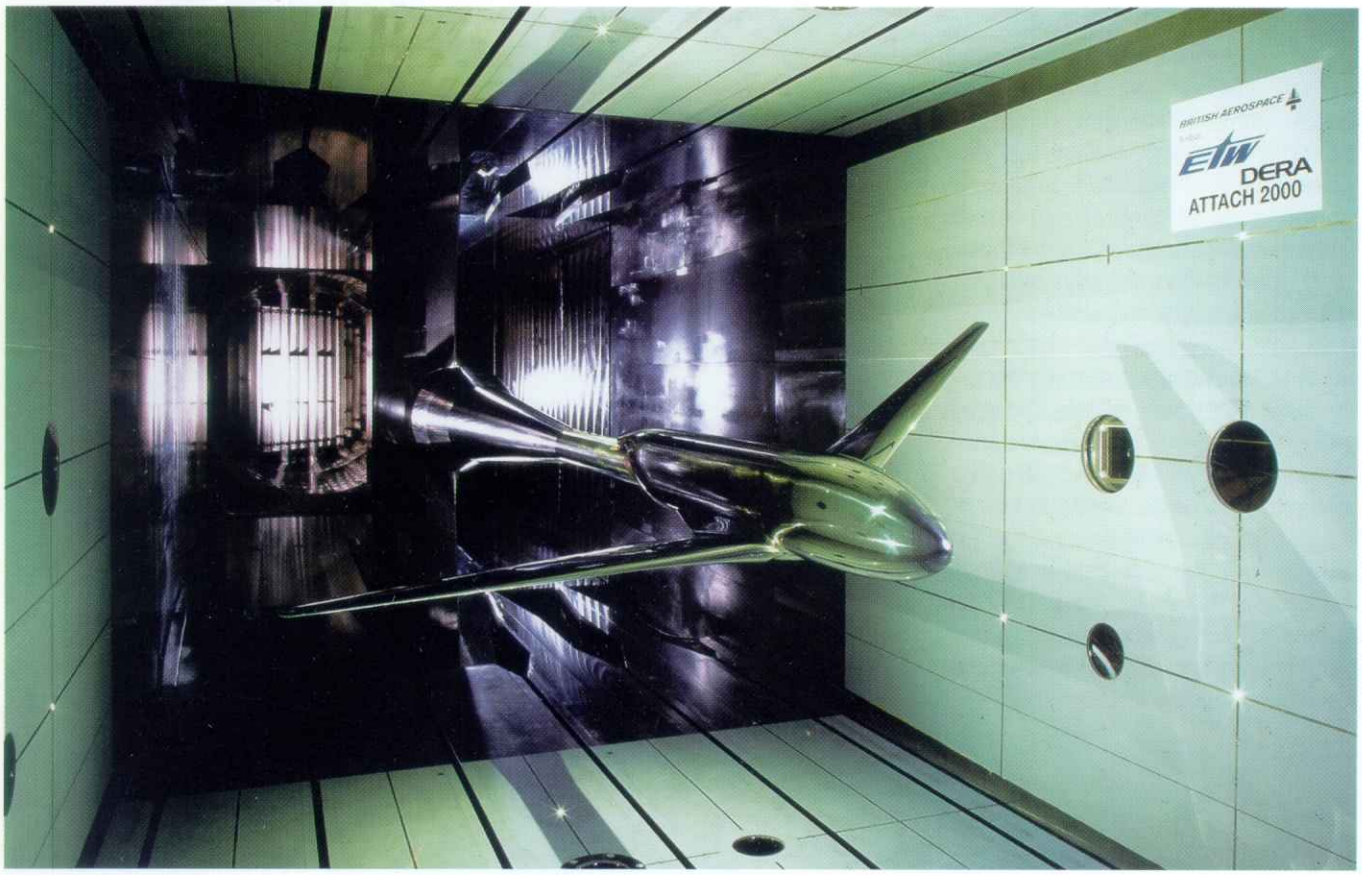
European Transonic Windtunnel GmbH
Ernst-Mach-Strasse D-51147 Köln

Issue No. 8, March 1999

News

ATTACH 2000, VLA Research Test



Attach 2000 Model in the ETW Test Section

ETW has recently completed, ahead of schedule, an extensive wind tunnel test campaign for British Aerospace on its ATTACH 2000 model. This research model is a full span representation of future generation Very Large Aircraft type configurations. The tests were performed at both low and high Mach numbers covering a large dynamic pressure, temperature and Reynolds number range. A number of wing design concepts together with a body alone configuration were tested, fully exploiting ETW's unique capabilities within Europe to test at high Reynolds numbers. High Reynolds number testing at ETW, from low speed to high speed cruise conditions, on one model within the same test entry, provides a seamless correlation between the low and high Mach number data bases.

ATTACH 2000 is a collaborative project between BAe, DERA and the DTI. The acronym ATTACH stands for Advanced Turbulent flow Technology Applied to Civil aircraft -High speed.

The primary objective of this research programme is to develop and validate turbulent flow wing design methodology and exploit the benefits of designing for high Reynolds numbers. In a cryogenic wind tunnel, such as ETW, it was possible to demonstrate and quantify the potential benefits of designing wings for high Reynolds numbers. Establishing such a comprehensive wind tunnel data base will enable a valuable assessment and validation of CFD design methodologies to be made. The advantages of establishing clear Reynolds number trends for parameters such as lift, drag, pitching moment and buffet onset together with wing pressure distributions are vital for future aircraft designs.

The 1/50th. scale model was manufactured by ARA from high strength maraging steel to tight tolerances and demanding surface finish requirements. Each wing set was extensively pressure plotted and wing root strain gauges were also fitted to each wing.

High productivity testing is a prerequisite for commercial cryogenic testing and this was fully applied throughout the test campaign. To minimise tunnel

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BAe/DERA ATTACH 2000 (continued)

down-time the model was designed to enable a complete wing change and pressure checkout to be completed within one working day. Based on experience gained in earlier test campaigns the combined force and pressure measurements were recorded over a complete range of temperatures. A large part of the test programme was performed in the continuous traverse mode with data recorded at high acquisition rates. Although not a primary objective for these polars, the data quality for the pressure measurements, insofar as agreement with pitch pause data, proved to be excellent for the majority of cases. Even beyond the lift break point, the comparisons were good, where the model was particularly stable. This resulted in the client receiving a more comprehensive data base than originally planned.

To summarize ETW demonstrated its ability to deliver a high quality high Reynolds number data base, for a complex test programme, within the timescales demanded by the client. The application of advanced test techniques significantly improved the productivity whilst maximising the data throughput, and thus minimising the overall test costs.

Changes in ETW Management

T. B. Saunders, Managing Director of ETW GmbH since August 1993, retired end of July 1998 after reaching age 65. His successor as Managing Director is J. F. Moutte who has been with ETW since December 1988 and who is supported by his colleagues Jean-Pierre Hancy, Manager Operations, with ETW since June 1981 (Project Group), and Dr. Gerhard Hefer, Manager Aerodynamics and Projects, who joined ETW in December 1993.
Hans van Ditshuizen, Marketing Manager with ETW since September 1993, left the company in April 1998. His former marketing and public relations tasks with ETW have been assigned to the Test Engineers, Dieter Schimanski, Ian Price and Martin Wright, and to Uso Walter, Group Leader Administration.

EDITORIAL

Over the last year ETW has successfully completed several major test campaigns for our clients throughout the world. Comparisons with other well-established facilities, including high Reynolds number testing and flight test comparisons have given our clients sufficient confidence to include ETW in future aircraft development plans.

By fully exploiting the benefits of test techniques developed for productive, high Reynolds number testing, ETW has shown its ability to deliver high quality test results at competitive rates in a commercial environment.

During 1998 ETW has also been very active in developing windtunnel corrections which are now available to clients on-line, and in implementing new measurement techniques to satisfy the requirements of the Clients.

ETW has produced infra-red images of a model in the test section at a temperature of 115 K for visualisation of boundary layer transition which has not been done before in a large cryogenic windtunnel. Cryogenic minitufts have also been successfully tested in 1998 and a Model Deformation Measurement System has successfully undergone and passed preliminary testing and will be commissioned in the first half of 1999.

Since mid-1998, ETW has taken on the direct responsibility for completion, adjustment and calibration of the Half Model facility. The commissioning of the half model facility is on schedule for completion in the second half of 1999.

Also in mid-1998, the company has been restructured and this change has affected almost exclusively management level and administration. The technical competence and expertise is being maintained in order to offer high quality services and performance to all Clients interested in using this most advanced windtunnel in the world.

I am confident that the ETW team with its experience and very high level of motivation, commitment and dedication has all the capability to continue producing the high quality test results that our clients expect from a wind tunnel facility like ETW.

I wish all my colleagues every success for the new year which I am convinced will be fruitful and gratifying to our Clients and to the ETW staff.

J.F. Moutte
Managing Director

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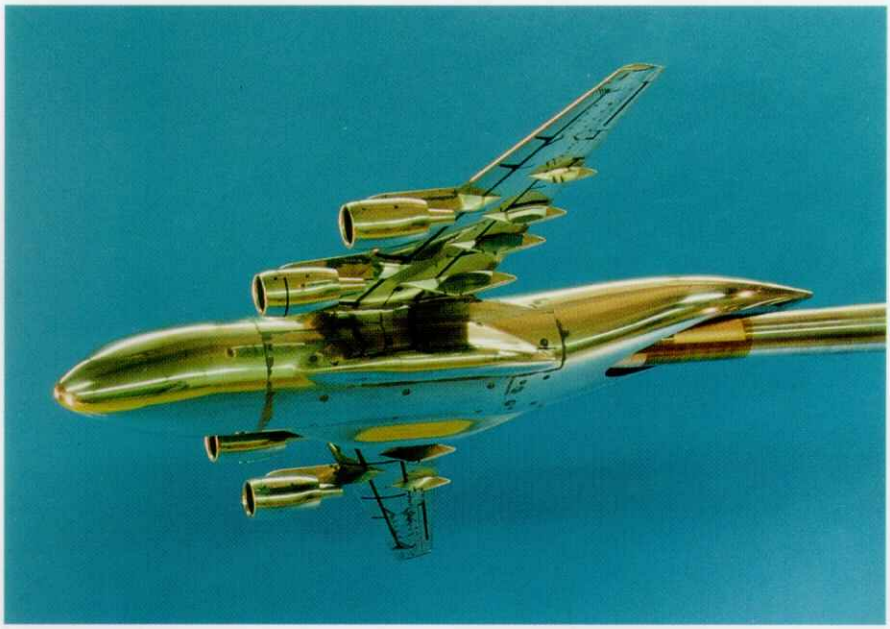
Benchmark Testing & High Reynolds Number Data Quality



During the course of last year ETW along with the Boeing company, performed a benchmark test programme. These tests were performed during two test campaigns, on a well known and tested transport configuration over the complete test envelope of ETW.

Boeing was particularly interested in many aspects of data quality whilst achieving good productivity without compromising accuracy. From a tunnel operators point of view, ETW wanted to demonstrate that the required confidence levels in the data could be attained without having to perform several repeat polars. In addition ETW wanted to prove that it is possible to measure combined forces and pressures on a model incorporating high density pressure plotting. Back to back tests were therefore performed with and without the pressure services crossing the metric gap at chord Reynolds numbers of up to 40 million. The resulting drag difference was less than one drag count up to the lift break point. Beyond these conditions this particular configuration experienced some model dynamics which are currently being investigated. A similar evaluation was performed between pitch pause and continuous traverse techniques. Figure 1 shows the resulting drag difference between these two cases as being better than half a drag count at the model design point.

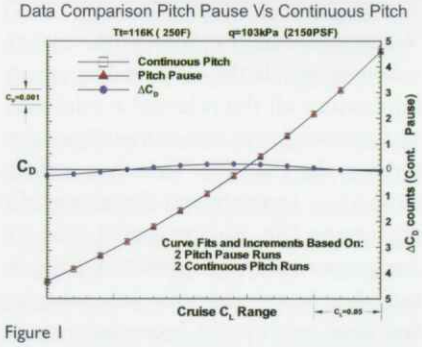


Figure 1

During this test campaign it was also possible for ETW to demonstrate to Boeing the excellent repeatability at high Reynolds numbers that ETW clients have come to expect from the facility. As shown in figure 2 the near term repeatability (within the same test campaign) was within half a drag count. The long term repeatability (between two separate test campaigns) was within one drag count, which was equally impressive. These results were particularly significant considering that the tests were performed at flight Reynolds number using high dynamic pressures combined with cryogenic temperatures. This fully demonstrated ETW's ability to accurately measure small drag increments with high confidence levels.

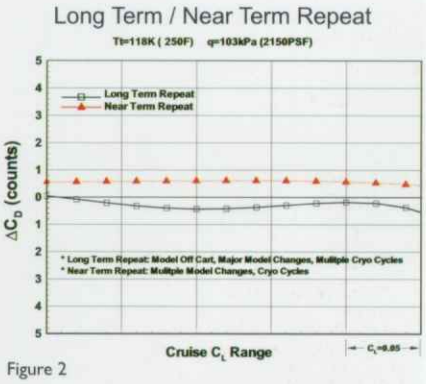


Figure 2

The implementation of a high quality cryogenic mini-tufting technique that provides both still and continuous video was demonstrated during the test campaign. The results obtained from this technique provided a unique insight into the flow development on the model surface at flight Reynolds numbers. See related article in this newsletter for further information on developments of this system.

In summary, during this test series Boeing has validated ETW's claims on data quality, repeatability, accuracy and confidence level on a fully pressure instrumented model with significant instrumentation cabling crossing the balance metric/non metric gap.

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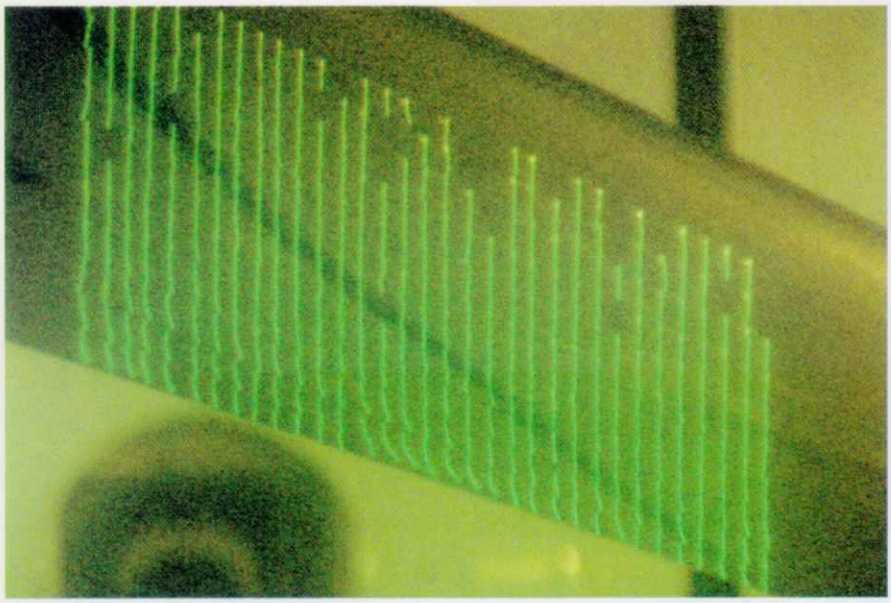
Flow Visualization with Cryogenic Minitufts

In response to client requests to visualize flow features at flight Reynolds numbers, ETW has successfully developed a cryogenic minituft technique. One of the major achievements during 1998 was the integration of a Colour Camera System (CCS) to enable the visualization of the gas flow by means of fluorescent minitufts. A previous newsletter reported of the successful application of this technique for an ambient test, and due to this initial success ETW has further developed the concept into a sophisticated system which is now able to take continuous colour video and still images over the full cryogenic operating range of ETW. To achieve this, a high quality CCD camera has been installed inside a heated enclosure, which can be mounted above any of the windows of the test section top wall. This camera has full RS 232 remote control features and is connected to a PC in the Instrumentation Cabin. This PC is equipped with a frame grabber board and various other control boards and acts as a server to another PC located in the Main Tunnel Control Room. Thus the complete system can be controlled remotely.

Images can be taken either manually from the PC in the control room or, more usually, on demand from the main Data Acquisition System (DAS). Taking images under the control of the DAS ensures that the images are taken at precise times and are directly correlated to test conditions.



Whenever images are taken, either manually or via the DAS, a data string containing all the relevant model and test parameters is transmitted from the DAS to the CCS PC. This data is then stored as a separate text file alongside the image file, thus ensuring that all images are correctly annotated. Images may then be printed with their associated data or directly imported into a range of software uses for report writing or presentation.

For further information on this subject please contact ETW GmbH.

News in Brief

ETW's E-Mail address in the Internet has been simplified and for general communication is now:

info@etw.de

For more information regarding ETW capabilities and testing please contact

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(U. K. and the Americas)
Martin Wright **mcw@etw.de**
(Asia and Pacific)

Since the end of last year, ETW is represented with a Home Page on the Internet which will regularly be updated:

http://www.etw.de

Visitors to ETW

– High level political/technical group from the German-French Defence Research Steering Committee.
– Dr. C. Raffoul, Chief, Aeronautical Sciences, EOARD, USAF, London, UK.
– Prof. Schraewer, Process Technology, Technical College, Frankfurt/Main
– Prof. Hamacher, Aerospace Lecturer, DLR Cologne and Techn. Univ. Munich.
– Prof. Ley, Aerospace Engineering, Technical College, Aachen.
– Prof. Mueller, Dasa Hamburg and Techn. Univ. Aachen.
– Prof. Rossitto, ESA EAC Cologne, and Prof. Ercoli Finzi, Aerospace Engineering, Politechnico di Milano, Italy,
– Prof. Sullivan, Purdue University, West Lafayette, Indiana, USA.
– Dr. Prahlad, Director, and Dr. Visvanath, Deputy Director, NAL, Bangalore, India.
– Mr. Sagata, and Mr. Katoh, KHI, Japan.
– Mr. Garcia Arroyo, Director, with Colleagues of Directorate-General XII, European Commission, Brussels, Belgium.

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