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

Issue No. 5, September 1996

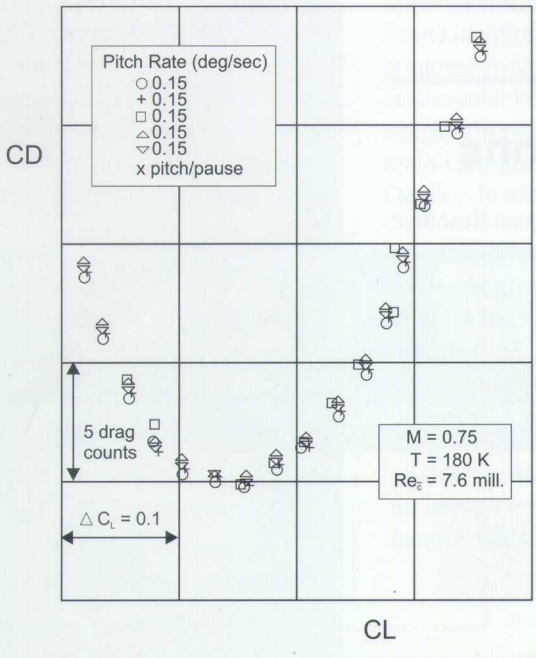
News

High Data Quality Demonstrated

Extensive testing has been performed to select the most suitable method of acquiring data during a polar, particularly at cryogenic conditions without compromising the data quality. Groups of polars have been acquired at several test conditions to assess the impact on data quality and polar repeatability of:

- the effect of pitch pause,
- the effect of model traverse rate,
- the effect data acquisition rates,

Typically up to 10 polars were recorded at the same set point conditions. The first 6 polars were acquired at a model traverse rate of 0.15°/sec with a data acquisition rate of 1Hz. This was followed by one polar with a 10Hz acquisition rate. Additional polars were then recorded at model traverse rates of 0.05°/sec and 0.5°/sec. Finally, a pitch pause polar was performed. A comparison of the data is shown in Figure below, the polars with the high acquisition rate and low and high speed traverse rates have been omitted for clarity. The data was taken on a transition free model at 180K, M=0.75 at a chord Reynolds number of 7.6 million. A statistical analysis of the polar groups between C_L zero and C_L cruise has shown a 2σ value of 0.65 drag counts.



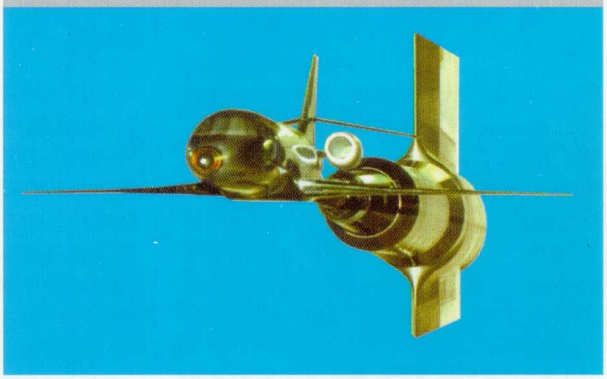
The optimum condition for standard 6 component testing has been determined to be the continuous model traverse mode at 0.15°/sec with a data acquisition rate of 5 Hz.

Falcon 2000 in ETW

Dassault Aviation recently had the opportunity to fully appreciate the huge potential of ETW. A co-operative test campaign took place last winter involving an existing Falcon 2000 1/15th scale full span model.

The ETW test campaign had two main test objectives. Firstly, to compare experimental and CFD obtained pressure distributions and secondly, to compare force and moment data with former ONERA S2 Modane wind tunnel results for various configurations, at the same time, assessing the Reynolds number effect.

See page 2 for more details.



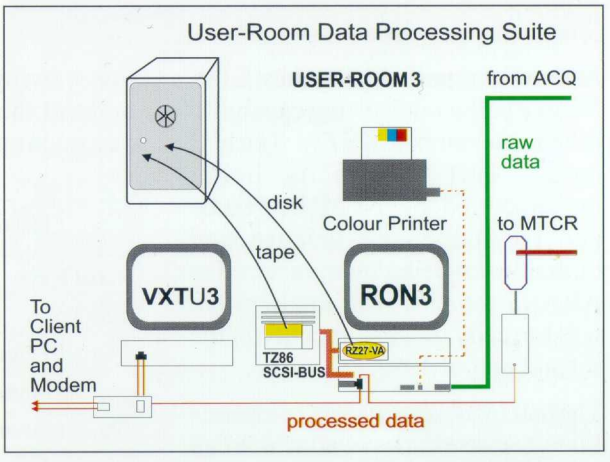
In this issue

Issue No.5, September 1996

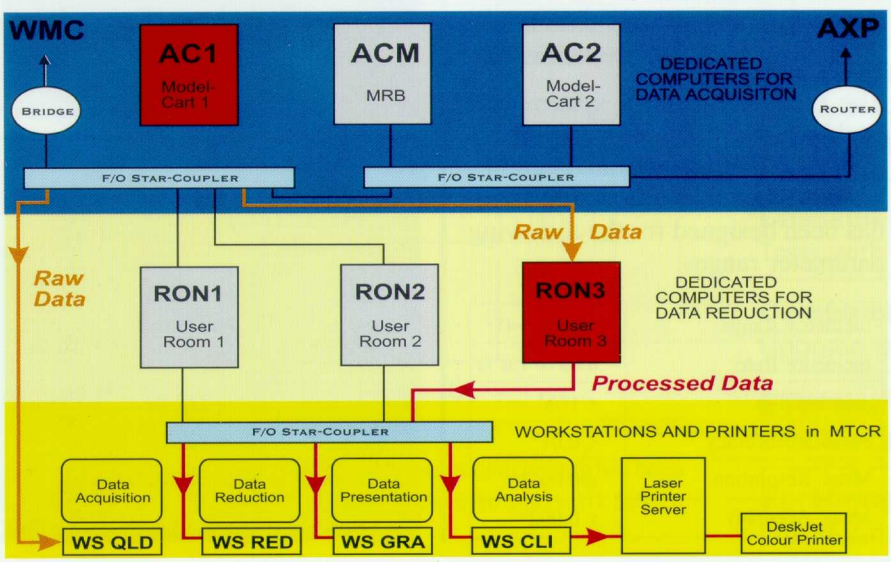
Computer Services Updated

In the spring of this year, the Data Processing Computers have undergone their second major upgrade as planned. Originally, ETW started with a Central Computer solution for the test data processing tasks. For reasons of security, however, a separate Test Data Systems Network has been set up which consists of dedicated model data acquisition computers, and dedicated data processing computers and work stations in the Clients' User Rooms. If necessary all computers including the model data acquisition computer can be physically disengaged from the network and operated by the client, if desired, in stand-alone mode.

The two model data acquisition computers (VAX 4000-600A) are situated in the instrumentation cabins on top of the model carts with a third mobile computer (VAX 3800) available for instrumentation and data acquisition checking in the Model Rigging Bay prior to erecting the model/sting assembly on a model cart. The Test Data Systems Network provides the fibre optic link to the dedicated data reduction computer in the relevant client room. The network allows large flexibility in accessing different systems and files from various locations. It can be reconfigured physically and logically for meeting the requirements for a particular test by means of junction boxes and star couplers. Opto-fibres are used for sensitive links to reduce the risk of tapping.



The reduction computers are powerful workstations (DEC AlphaStation 600 5/266) under OPEN-VAX-AXP and can be made available also for data processing using client programs. These can adequately handle the data flows during the test, control the output devices and reduce all data in real time. Much attention has been paid to data security and company confidentiality. The access restrictions (passwords, etc.) are fully exploited and data disks and tapes can be removed and stored in a safe in the client room. Whether the processed data are made visible in the Main Tunnel Control Room is entirely up to the client. For this purpose two workstations DEC 3000 - 600 are available both equipped with graphics adapters in a dual screen configuration as main Graphics Display and main Data Display. In addition, selected data can be displayed on 9 19" colour displays and plotted on 3 Laser Printers and 3 Colour Desk-Jet Printers.



For post-processing the client and the test engineer can work in the User Room which beside the Alpha workstation is equipped with an additional X-terminal and 2 19" colour graphic displays for viewing test results. When the client wants to use his own Personal Computer and programs to process data ETW will, after checking the imported equipment for viruses, provide a suitable interface for transmission of files between his PC and the data reduction computer. For reasons of security against data tampering ETW has banned any connections from the outside to their data systems network. If the client wants to transmit data to his home base this can be arranged off-line via Internet and the available ISDN/ Telephone communication lines, preferably by using his own modem and software to ensure compatibility with his home office.

In addition to the above-mentioned facilities, ETW has a small computer centre based on Digital Equipment computers under OPEN-VMS. It functions as host computer for the office network, for software development and for application programs for internal wind tunnel control and aerodynamic analysis.

Issue No.5, September 1996

Dassault Falcon 2000 Tests

In collaboration with Dassault Aviation a test campaign was carried out with a 1/15th scale full span model of the Falcon 2000 business jet.

Early in the nineties, several test campaigns took place with this model, in particular in the ONERA Modane S2MA transonic facility. The model, made from aluminium and steel, was not designed for ETW maximum capabilities nor for the cryogenic environment. The wings are equipped with rows of pressure taps, Kulite pressure transducers and buffet gauges. ONERA loaned to Dassault the internal balance and the forward sting adapter.

Despite the constraints linked to the temperature and the allowable stresses, this model achieved its greatest ever Reynolds number of 8.8×10^6 which was reached at a stagnation pressure of 330kPa. The test is also providing interesting data comparisons coming from different facilities as well as flight conditions.

Due to time constraints and tunnel availability, the campaign was split into two entries, one in December 1995 and the other in February 1996.

The first test entry was mainly devoted to the comparison of experimental and CFD obtained pressure distributions. This exercise, according to Dassault representatives, demonstrated an excellent match between both sets of data. In particular, local and rather small predictable C_p variations were fully confirmed by the experimental results.

The second test entry focused mainly on the force and moment data for three configurations differing by stabiliser setting. Three sets of flow conditions were explored.

1. A low Reynolds number case where the stagnation pressure was kept to a minimum, i.e. 125kPa

2. A match to the S2 Modane tests, with a dynamic pressure close to 39kPa and a Reynolds number of about 4.0×10^6.

3. A high Reynolds number case, with the highest possible dynamic pressure the model can withstand at a C_L value of 0.4, i.e. 78kPa.

The Mach number ranged between 0.7 and 0.9.

Although Dassault has yet to compare the results to the S2 Modane data at the same correction standard and to the in-flight data, the distinctive ETW quality of repeatability has again been brought into evidence.

To conclude, the goals for this co-operative test were achieved. The Dassault engineers have data which will enable them to tune their CFD codes and to make comparisons with other facilities and in-flight data. On its side, ETW has gained further experience of operation and has introduced the facility to another future user.

Publications

The book "ETW - A European Resource for the World of Aeronautic" by Jan van der Bliek has recently been published. The book descibes the history of ETW in the context of European Aeronautical research and development cooperation.

ETW presented two papers at the AGARD-FDP-VKI Special Course on Advances in Cryogenic Wind Tunnel Technology in May 1996.

ETW presented the paper "Development of Testing Techniques and Cryogenic Model Handling" at the AIAA Meeting in New Orleans, USA in June, 1996.

News in Brief

A contract for a Twin Sting Rig to evaluate sting interference effects has been placed with NLR in the Netherlands. The rig which is suitable for supporting models that incorporate split rear fuselages will be delivered to ETW in 1997.

ETW has recently placed an order with PROSIG in the UK for a 32 Channel Dynamic Data Acquisition System and a dedicated 8 channel Balance Stress Monitoring System.

ETW is currently inviting tenders for a Gas Supply System. The system will provide a maximum mass flow of 4kg/sec of nitrogen gas at a balance inlet pressure of 75bar over the temperature range 170K to 360K.

Visitors to ETW

Recent visitors included:

- Dr. S. Nomura, Deputy Director General of NAL, Tokyo and delegation.
- Mr. N. Suzuki, FHI, and Mr. Ishimoto, NAL, Japan.
- Mr. J. Crowder, Boeing, Seattle.
- Mr. Jiao Hongbo, Chief Editor of Sciences and Technology Daily, China.
- Prof. A. Bachem, Board Member and Dr. K. Pixius of DLR.
- Drs. EA. van Hoek, Director Research of the Ministry of Defence (NL) and Ministerialrat Dr.-Ing. M. Hartl, BMVg, (D).
- Col. M. Wiedemer, Commander, Dr. B. Davies, Chief Scientist and Mr. M. Russom, Chief International Affairs, AEDC, USA.

Issue No.5, September 1996

ETW Half Model Capability

As briefly reported in the last ETW News a half model testing capability is being developed at ETW. The half model cart system is being manufactured by NFM in France and the associated balance and turntable are being manufactured at ARA in the UK. The total system will be ready for customer use in the second half of 1997.

The half model cart system comprises a new test section top wall which can be exchanged for the present top wall on model cart 1. The half model is mounted on the top wall in the Cart Rigging Bay (CRB). Here all model and cart systems can be checked out prior to its transfer to the Variable Temperature Checkout Room (VTCR) where all pre test checks can be conducted down to tunnel test temperatures. The VTCR and CRB are being equipped with the necessary model handling and temperature conditioning systems to ensure that all functions can be undertaken safely and efficiently.

The half model system uses a thermally conditioned balance. The thermal control system ensures that the balance is decoupled from ETW's variable temperature operating environment. The thermal control system has been designed to have minimal effect on the temperature of model components supported from the balance adaptor.

The balance has been designed for the following maximum combined static and dynamic loads. Accuracy is specified as a complex function of the combined operating loads. For normal force, axial force, and pitching moment the accuracy is 0.1% of the maximum load over 50 to 100% of the range and 0.05% below 50%. For yawing moment and rolling moment the accuracy is 0.2% of the maximun operating load.

Component		Load Range
Axial Force	X	± 5,500 N
Side Force	Y	± 2,200 N
Normal Force	Z	± 55,000 N
Rolling Moment	L	± 33,000 Nm
Pitching Moment	M	± 4,400 Nm
Yawing Moment	N	± 3,300 Nm

To extend the versatility of the half model capability a gas transfer system is being incorporated which should cater for most foreseen requirements. The high pressure gas supply system has initially been sized for Turbine Powered Simulators (TPS) testing but could be updated to suit other needs such as blown nacelles and afterbody drag tests if required.

A twin pipe high pressure gas transfer system has been incorporated into the half model balance. The system has been designed to minimise the effects of temperature and pressure on the performance of the balance and any residual interactions are allowed for in the balance calibration.

The incidence control system will enable pitch/pause and continuous traverses to be incorporated within a test programme. The turntable system has been designed for the following parameter ranges:

Incidence Range	-45° to +45°
Incidence Rate	0.05 to 1.0°/s
Acceleration	$< 1°/s^2$
Position Accuracy	$\leq 0.01°$
Meas. Resolution	$\leq 0.001°$
Meas. Accuracy	$\leq 0.002°$

Personnel

Test Engineer

Ian Price joined the ETW project team in 1990 as a Model Handling Engineer seconded from British Aerospace. Previously, Ian worked for many years in the High Speed Wind Tunnel at Warton where he was a Project Supervisor on many different types of tests. During the peak years of construction of the facility Ian managed the work packages connected with major aspects of Model Handling under cryogenic conditions.

In 1994 Ian joined the ETW GmbH as a Test Techniques and Mechanical Applications Engineer, one of his prime responsibilities being a Test Engineer on Clients and ETW test campaigns.

Ian is married with two sons and has interests in aviation, motor sport and computing.

ETW News is issued by ETW GmbH,
Ernst-Mach-Strasse,
D-51147 Köln.

Editor:
J.C.A. van Ditshuizen,
Marketing Manager
Tel.: +49 2203 609150
Fax.: +49 2203 609270

Print:
Druckerei Thierbach, Mülheim an der Ruhr