European Transonic Windtunnel GmbH
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News

Half Model Testing Capability

ETW has recently completed a series of half model commissioning and calibration tests and is now able to offer this system to customers for production and development testing over the complete operational envelope. This marks a significant milestone in the expansion of the testing capabilities at ETW, providing the ability to test at low speed and high speed conditions over a wide range of Reynolds numbers up to flight conditions.

DaimlerChrysler Aerospace Airbus Half Model in the ETW Test Section

In June 1999 ETW started the first half model commissioning and calibration activities in the tunnel. First experiences were gained with this new technique in the following months by using two different models in the commissioning, calibration and validation phases of the half model concept.

DaimlerChrysler Aerospace Airbus provided the model shown here for the purposes of validating the ETW half model system against their existing low speed database. This model is equipped with adjustable slats and flaps to enable representation of various high lift configurations together with a clean configuration suitable for testing at conditions throughout the entire envelope. During this initial validation series the model was tested at incidences up to and beyond maximum lift at low speed for a substantial Reynolds number range. The model was also tested at high speed over a range of incidences up to buffet onset at flight Reynolds numbers.

The ability to test over such an extensive range of conditions is unique within Europe. The data quality obtained to date has been demonstrated to be similar to full model data and this, in itself, is a significant achievement at such an early stage in the development of the half model system. The lessons learnt from these early tests have helped to further develop the system, to establish appropriate techniques that can be used to acquire high quality test results, and to achieve levels of productivity compatible with commercial operation.

A thermally conditioned balance was selected for the ETW half model system primarily for reasons of minimising development risks, but also with a view to achieving high levels of productivity. The essential aspect of this concept is the ability to condition the balance to a uniform temperature and then to control

Half Model Testing Capability (Continued)

the temperature to close tolerances independent of ETW's variable temperature operating environment.

In practice, this concept has been shown to work effectively and the resulting balance temperature stability is impressive, even at cryogenic conditions, as demonstrated in Figure 1. These stable characteristics are the key to the success of ETW's half model system and it is in this area that significant developments have been made.

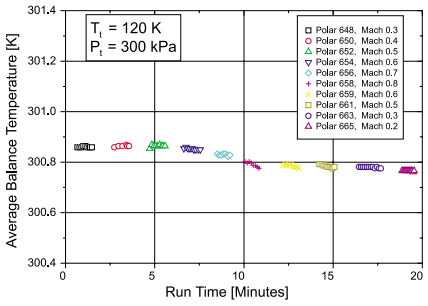

Figure 1

The balance has been designed for a combined loading in normal force of 55 kN, pitching moment of 4.4 kNm and axial force of 5.5 kN. 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 %.

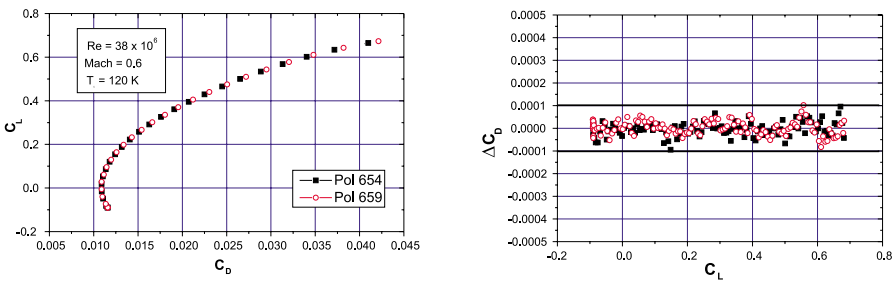

Figure 2 (Results from ETW Commissioning Model)

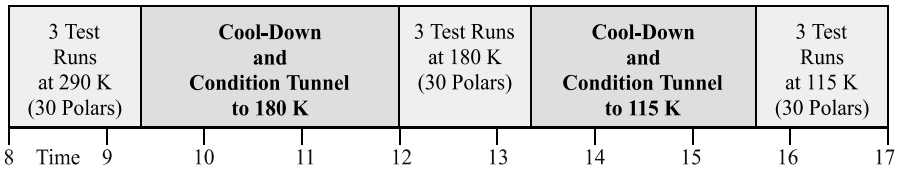

Figure 3 Typical Operating Schedule

The results achieved with the new system have been very promising throughout the complete test envelope. An example of the short term repeatability is presented in Figure 2 for a Mach number of 0.6, a temperature of 120 K, and a total pressure of 300 kPa. Under these test conditions the standard deviation of the drag coefficient was well within 1 drag count. Similar levels have also been demonstrated for both medium term and long term repeatability. The half model system has also been used successfully at low speed and at reduced levels of dynamic pressure where balance stability strongly influences the quality of results.

A significant advantage of this concept is that temperature changes in the tunnel can be completed rapidly, providing that the model is designed accordingly, with no additional overhead required for balance conditioning prior to a test run. The only overhead that may be required is a few minutes of run time in order to condition the model surface temperature and avoid any boundary layer effects. This aspect has been demonstrated during early model tests and a typical test schedule based on this experience is provided in Figure 3.

This article forms an extract from a more comprehensive document which is available from ETW on request, (please contact UsoWalter, uw@etw.de)

News in Brief

PSI Upgrade

ETW have recently completed a major upgrade of all their PSI multiport pressure measurement and flow reference systems and are now running the most current firmware versions.

New Balance

The procurement of a new strain gauge balance, for after-body testing of transport aircraft, is progressing well with the anticipated delivery by the middle of this year.

Dynamic Data System

ETW recently took delivery of a dynamic data acquisition system. This system allows high speed data acquisition (up to 50,000 samples/sec for 32 channels) and real time, on-line displays in engineering units and FFT. It also comes complete with a very comprehensive data tool kit to enable off-line data analysis.

Aerospatiale Matra A340 Model
Fin Sting and Pressure Plotted Wing Tests

Two different configurations of an A340 model of Aerospatiale Matra were used in tests during 1999.

In June, a co-operative fin sting test campaign was successfully completed. The test assembly is presented in figure 1.

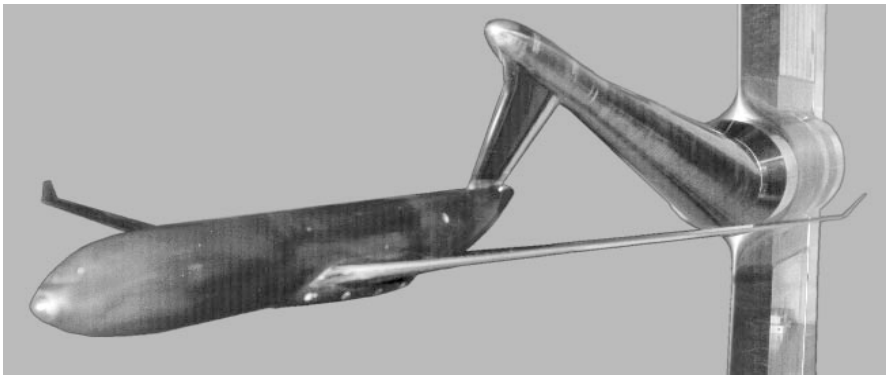

Figure 1

During test preparation, ETW devised a special sealing system for the fin sting assembly, which was successfully adapted for the cryogenic test conditions and to the demanding requirements on accurate drag measurements. Valuable experience was gained with model coatings and their influence on the aerodynamic data.

The November test campaign with a pressure plotted wing assembly also used the technique of model coating for further infra-red images through the complete operating envelope of ETW.

A special coating technique for pressure tapped wings was effectively applied and figure 2 presents a zoomed-in view of one row of pressure taps (Ø = 0,1 mm) on the upper wing surface.

In total more than 300 infra-red images were taken with two standard IR-cameras of the wing upper and lower surfaces, the horizontal tailplanes and the fin. The test conditions were varied from ambient temperatures down to about 220 K, which is the limit for the standard IR-cameras, and up to 450 kPa in total pressure.

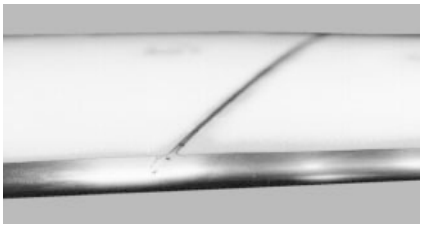

Figure 2

The specially developed CRYSTAL IR-camera was then successfully used for the low temperature range down to 120 K resulting in chord Reynolds numbers up to 37 Mio.

The tests were completed to the Client's satisfaction and the excellent results were presented to Airbus Industry in February 2000.

On 1 January 2000, Members of the ETW Supervisory Board were:

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Successful Validation Test with the Model Active Damping System

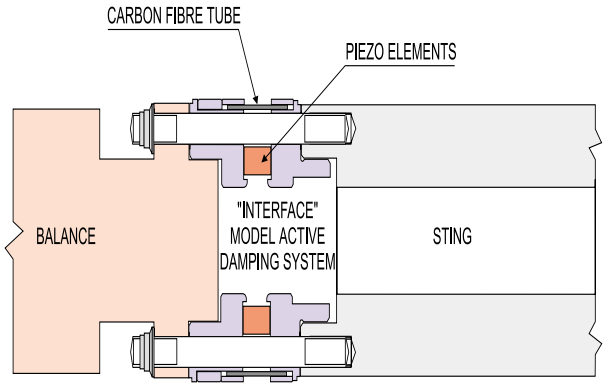

Figure 1: Active Balance Interface

The High Load Range Unit of the Model Active Damping System (ADS) developed by ETW in co-operation with ERAS GmbH was tested successfully in January 2000 when it was used with the ETW Reference Model.

Figure 1 presents the basic set-up of the system. It is installed between the flanges of the six-component strain gauge balance and the sting, in the support line of the wind tunnel model.

14 piezo ceramics capable of bearing the load are simultaneously excited to attenuate vibrations in 5 degrees of freedom (without roll).

The design has taken into account the special requirements of modularity, limited space, high load levels and different eigenfrequencies due to different test assembly configurations.

The test programme performed during the validation test included stepwise increases in dynamic pressure up to 89 kPa at temperatures of 294 K, 185 K, and 120 K which resulted in a Reynolds number range from $3x10^6$ to $26x10^6$.

At each condition, two polars were measured, one with the ADS inactive and one with the system active. The result of these comparisons at high Reynolds number is presented in figure 2.

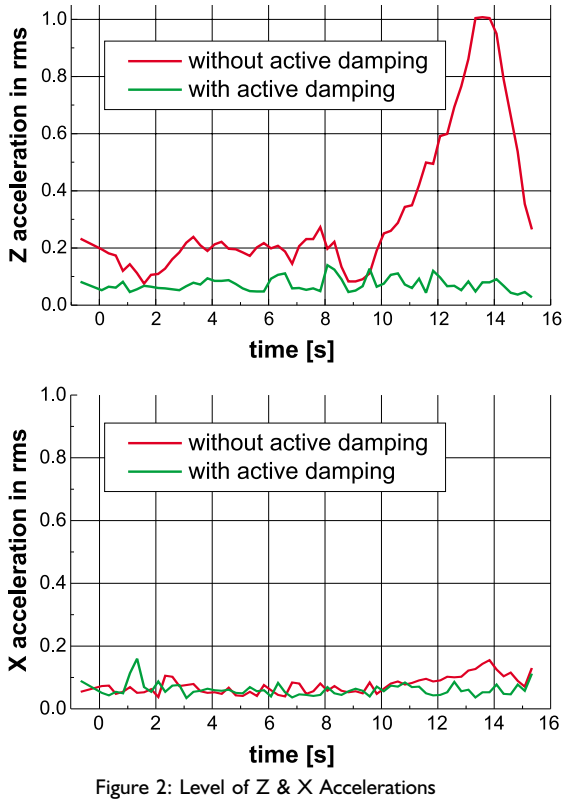

Figure 2: Level of Z & X Accelerations

Personnel

Wolfgang Burgsmüller

Wolfgang Burgsmüller was appointed Managing Director of ETW GmbH at the end of January 2000 following the retirement of Jean F. Moutte.

Mr. Burgsmüller was previously with DaimlerChrysler Aerospace Airbus in Bremen, where he worked in the Flight Physics department.

In recent years, amongst other duties, he has successfully coordinated several EC-funded research programmes in aerodynamics.

Mr. Burgsmüller's association with ETW spans some 25 years. His initial involvement was in the early studies and planning for the facility and, since 1989, he was a member of the ETW Technical Committee which counsels and advises ETW management on behalf of the European aerospace industry. In his new position as Managing Director at ETW, Mr. Burgsmüller is supported by Jean-Pierre Hancy, Manager Operations, and Dr. Gerhard Hefer, Manager Aerodynamics and Projects.

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