8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

TELFONA Pathfinder Wing for Calibration of the ETW Wind Tunnel

Karl Heinz Horstmann[1], *Jürgen Quest[2] and Geza Schrauf[3]

[1] DLR
Lilienthalplatz 7,
D-38108 Braunschweig
k.h.horstmann@dlr.de/www.dlr.de

[2] ETW
Ernst-Mach-Straße
D-51147 Köln
jq@etw.de/www.etw.de

[3] Airbus Deutschland
D-28183 Bremen
geza.schrauf@airbus.com/
www.airbus.com

Key Words: *TELFONA, ETW Wind Tunnel, laminar turbulent transition, N-factor method, TS-instability, CF-instability*

ABSTRACT

The laminar-turbulent transition in a boundary layer is of utmost importance for engineering applications in aviation. There are efforts to predict the transition on the basis of the non-linear growth of the instabilities in the boundary layer or on their direct numerical simulations, and with today's computers these computations are becoming more and more feasible. However, to apply such methods, one would need to know the initial boundary layer disturbances that will grow and later cause the transition. Because this is generally not the case , simpler methods, such as the e^N-method are being used for engineering purposes. In this method, simply the linear growth of characteristic disturbances is computed, i.e. Tollmien-Schlichting waves and stationary cross-flow vortices. The amplification rates of both instabilities are integrated and their values at the measured transition location expressed in terms of so-called critical N-factors are determined. To predict transition at other flow conditions, the corresponding linear amplification rates will be computed again and it is assumed that the transition will occur at the same N-factor.

At wind tunnel tests the initial disturbances within the boundary layer are influenced by turbulence and noise levels and spectra. Consequently also the transition location and with it the critical transition indicating N-factor are influenced. Thus for every wind tunnel its own N-factor correlation has to be tested and established. Within the TELFONA programme such a calibration will be performed for the ETW tunnel with the so-called "Pathfinder Wing" model. The "Pathfinder Wing" has a special shape which allows a reliable detection of TS- as well as CF-N-factors. In this paper firstly the design of this model we will be presented, see Figure 1.

Secondly the paper gives an overview of the definition of the testing programme which partly has been determined by CFD support and analysis. Besides the standard force and moment measurement techniques additional equipment will be used. At two sections the pressure distribution on both wing sides will de measured, and in between these two sections the transition line can be determined by means of a pressure sensitive paint surface (TSP).

Finally a first evaluation of the measured pressure distributions and the corresponding measured transition locations will be given. The analysis will be performed by means of

the boundary layer stability theory for TS waves and CF vortices. It is assumed that the resulting critical N-factors will occur in the range between the flight data of ATTAS / Fokker 100 and the S1Ma data.

This work has been supported by the TELFONA project of the Industrial and Materials Technologies Program of the European Commission.

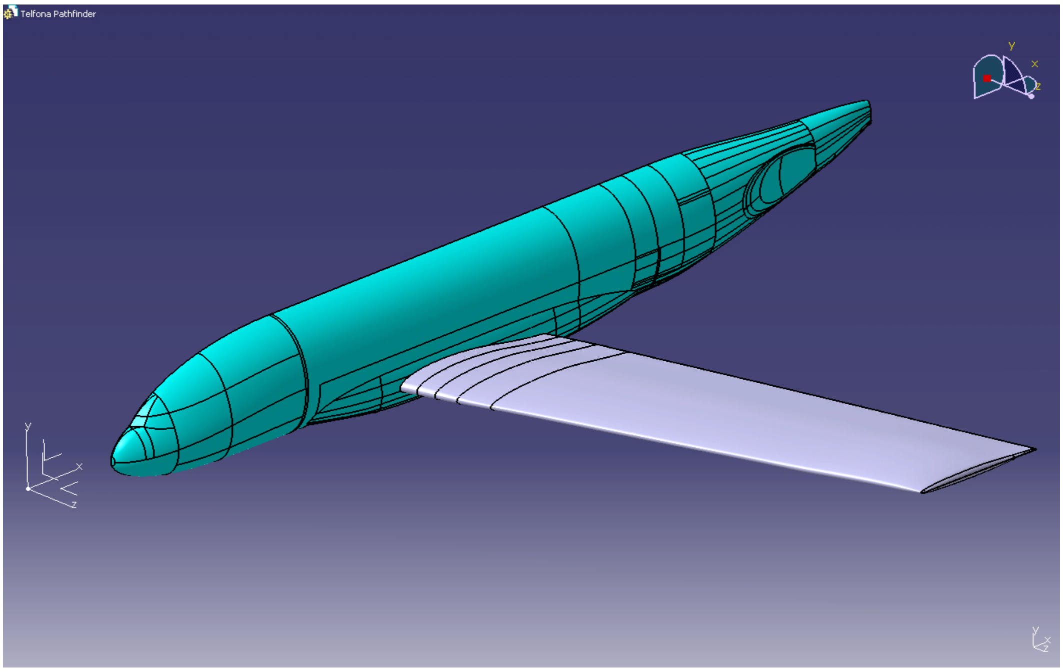

Figure 1: TELFONA Pathfinder model for ETW testing

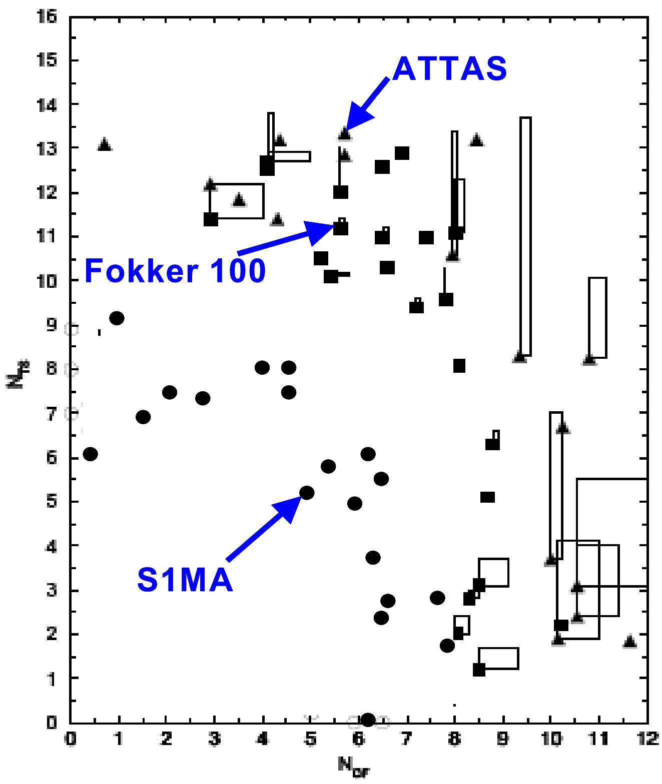

Figure 2: Transition indicating N-factors of flight and wind tunnel tests