



Realisation of the contact-free drag measurement with a wake rake

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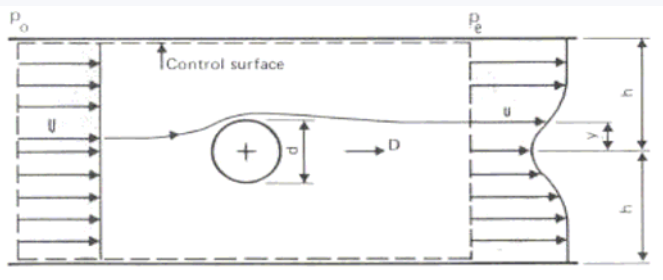
<http://www.fh-regensburg.de>



1. Introduction

Lift and drag measurement should be completed with contact-free measurement of the drag coefficient by a wake rake. In the Regensburg Wind Tunnel, this process is the only remaining to determine c_d and c_l with two independent methods, the force and the pressure measurement.

For calculations imagine a control volume around the wing.



The following force is acting on a wing section per unit of length:

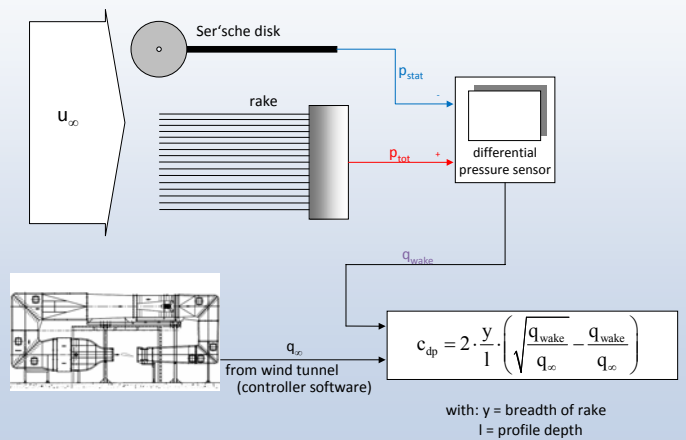
$$W_p = \int_{-\infty}^{\infty} [(p_{\infty} - p) + \rho \cdot (u_{\infty}^2 - u^2)] = \int_{-\infty}^{\infty} [(q_{\infty} - q) + \frac{\rho}{2} \cdot (u_{\infty}^2 - u^2)]$$

After converting:

$$c_{dp} = 2 \cdot \int \left[\sqrt{\frac{q}{q_{\infty}}} - \frac{q}{q_{\infty}} \right] d\frac{y}{l}$$

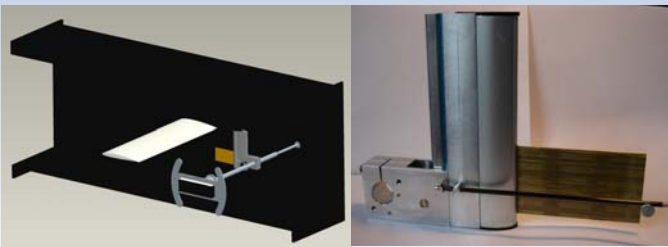
2. Setup

An integrating wake rake is used for less complexity in the measurement technology. It is hydraulically integrating the pressure from the Pitot tubes in a damping volume. A static pressure measurement is also needed and done by a Ser'sche disk. The c_d coefficient can be calculated from the differential pressure and wind tunnel data.



3. Construction / Building

The construction of the wake rake should be as easy as possible and allow a moving in z - and y - direction. Instead of milled parts, turned and purchased parts were employed as far as possible.

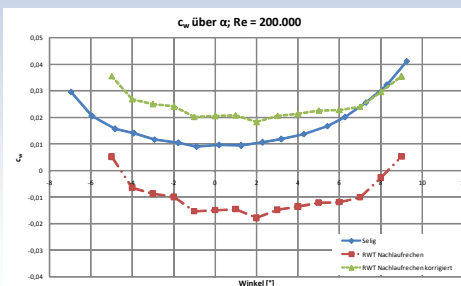


2-component glue was used often for fitting parts together. It is light weight and proved itself.

An automatic moving inside the test section is not implemented yet but was considered during construction and can be upgraded later.

4. Conclusion

After the first measurements it has shown that the resulting c_d -values differ clearly from the reference values (blue).



Although you can get good congruence with the reference values by using correction factors for the angle of attack and the c_d value, the physical background for the deviation remains unclear and needs further investigation.

