German-Dutch Wind Tunnels

High Reynolds Number Testing of a high speed train model in the Cryogenic Wind Tunnel Cologne

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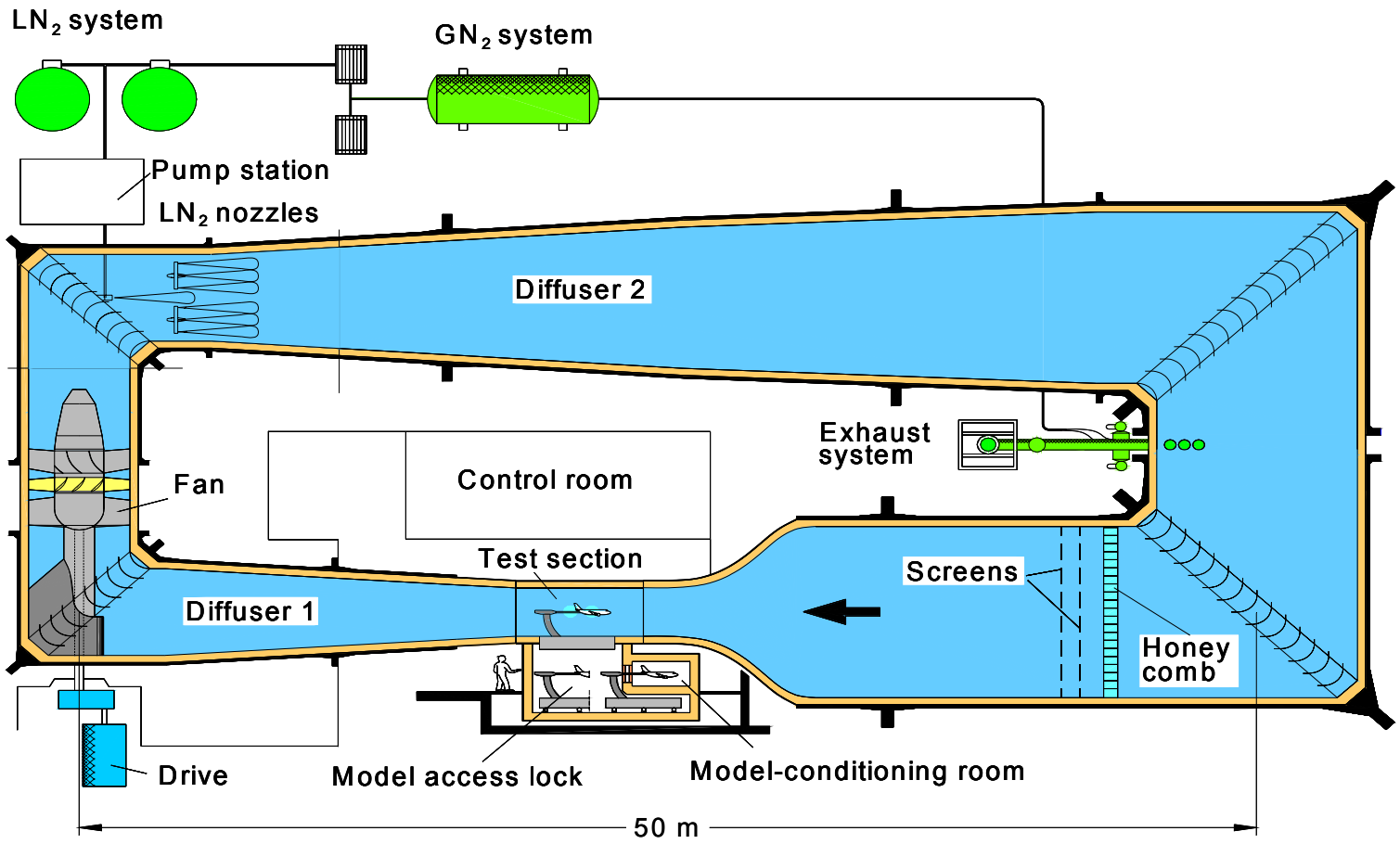
German-Dutch Wind tunnels (DNW-KKK)
Cologne, Germany

German-Dutch Wind Tunnels

Circuit of DNW-KKK



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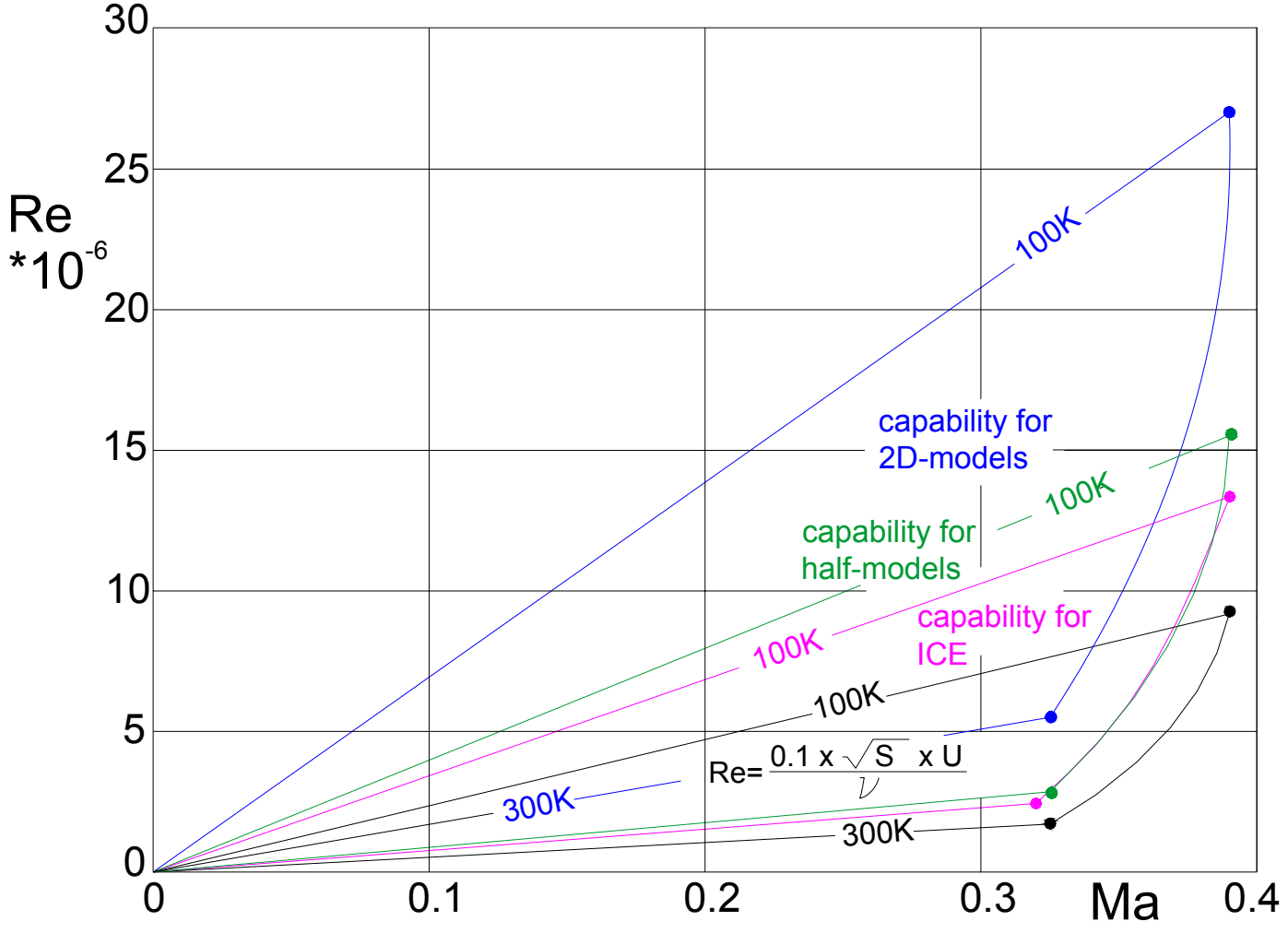
Re – Ma capability of DNW-KKK



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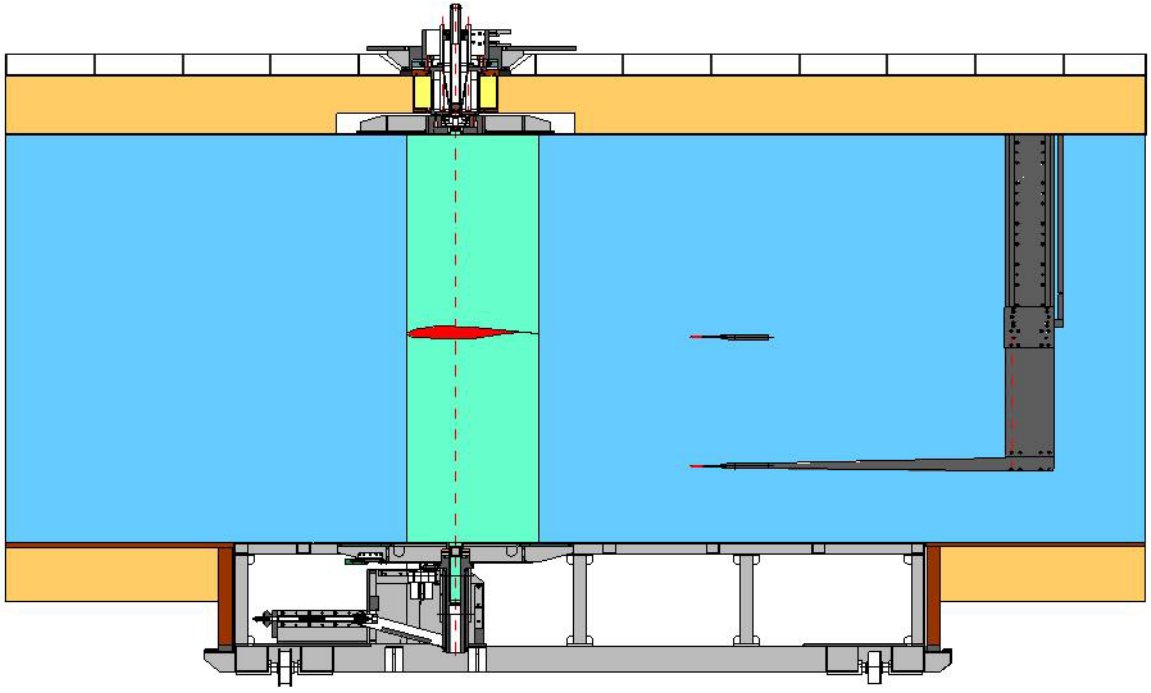
2D-model setup



- Alpha: -180° ~ 180°
- Chord (max): 0.7 m
- Span: 2.4 m

- Synchronized drive
- Blowing at two ends

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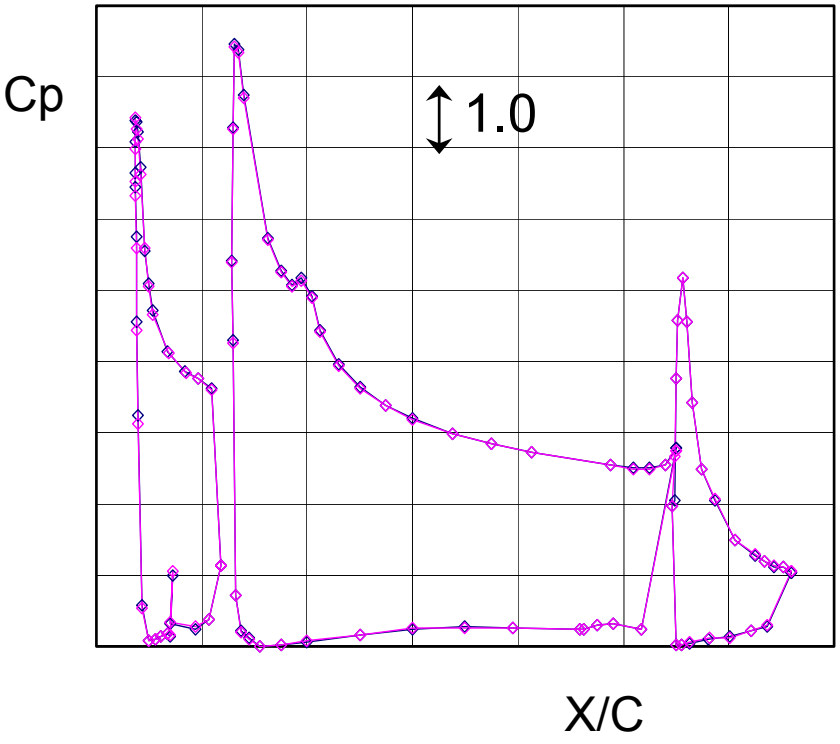
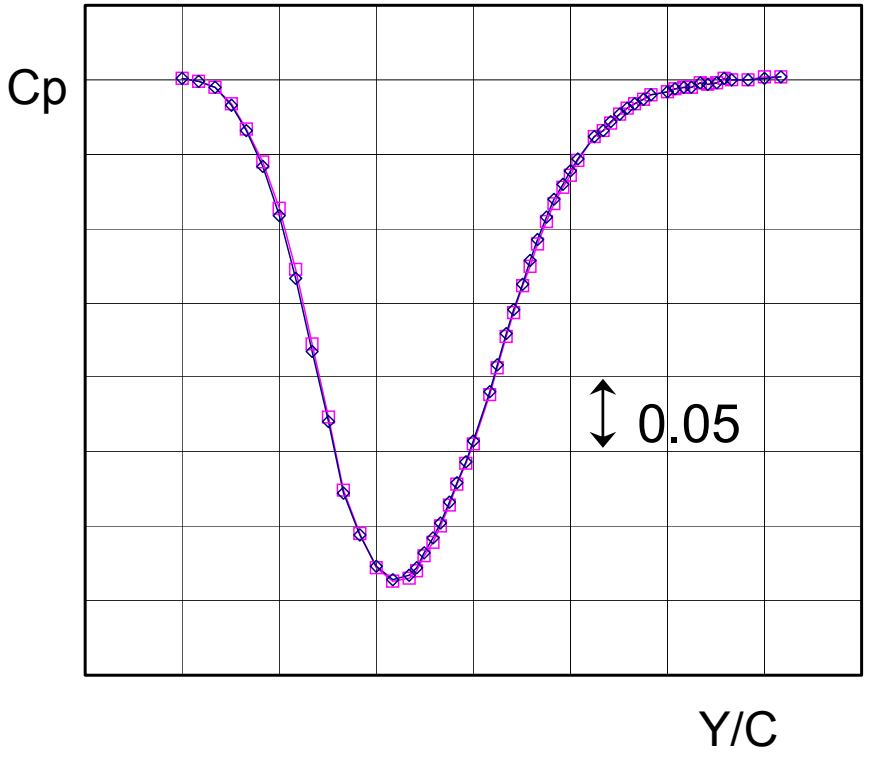
Repeatability of Half-Model Testing

Mach=0.2 Temp=90K Re=14.6E6





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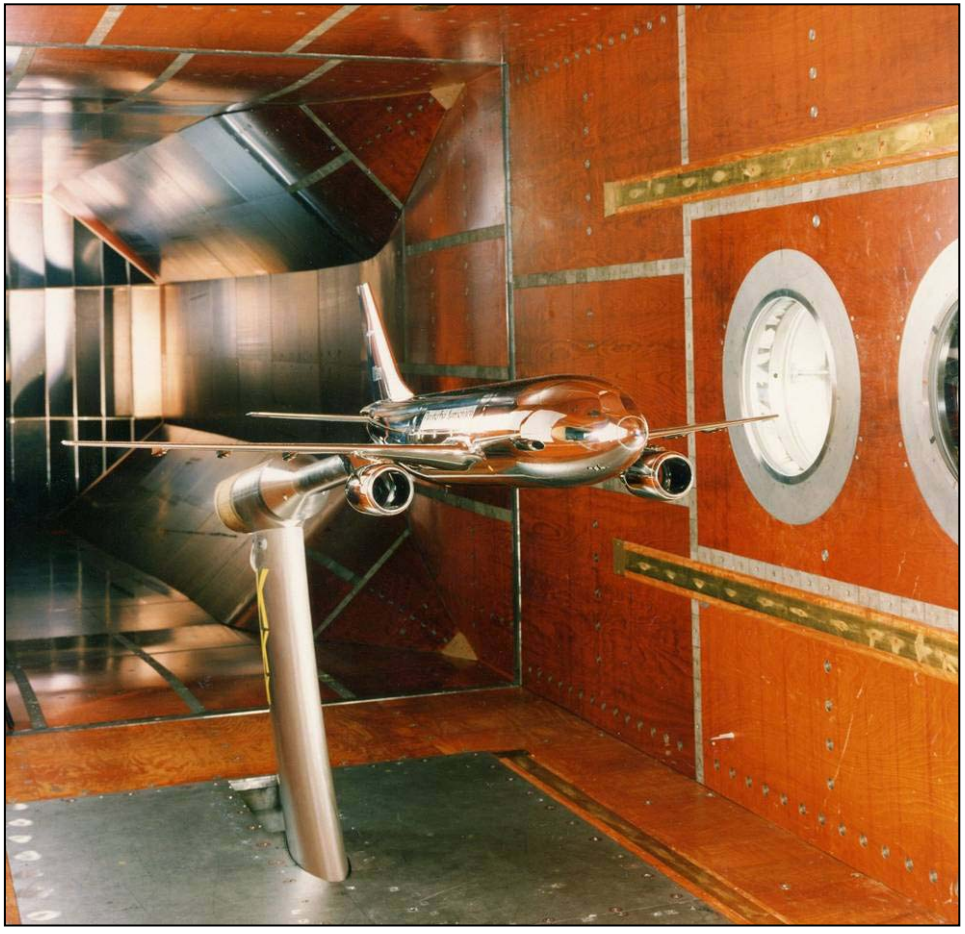
3D-Model Setup



Pitching: ***-10° ~ 30°***

Rolling: ***-180° ~ 180°***

Two inclinometers in model

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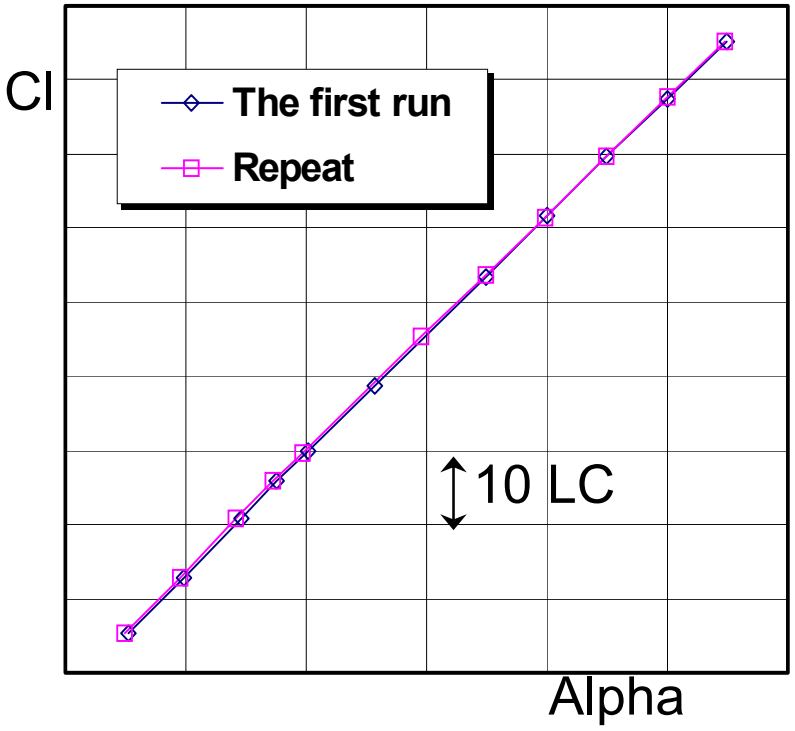
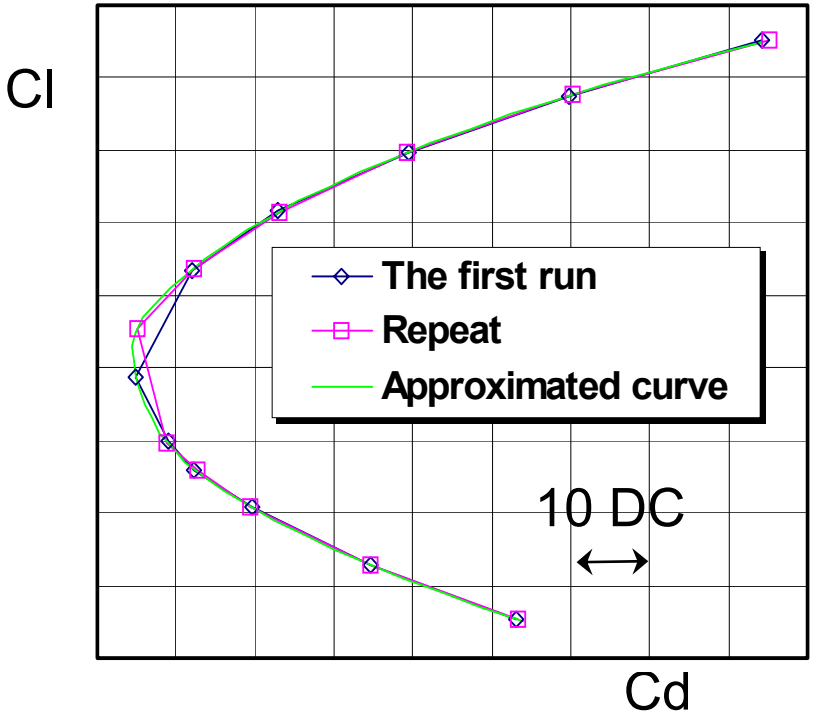
Repeatability of 3D-Model Testing

Mach=0.2 Temp=109K Re=5.6E6





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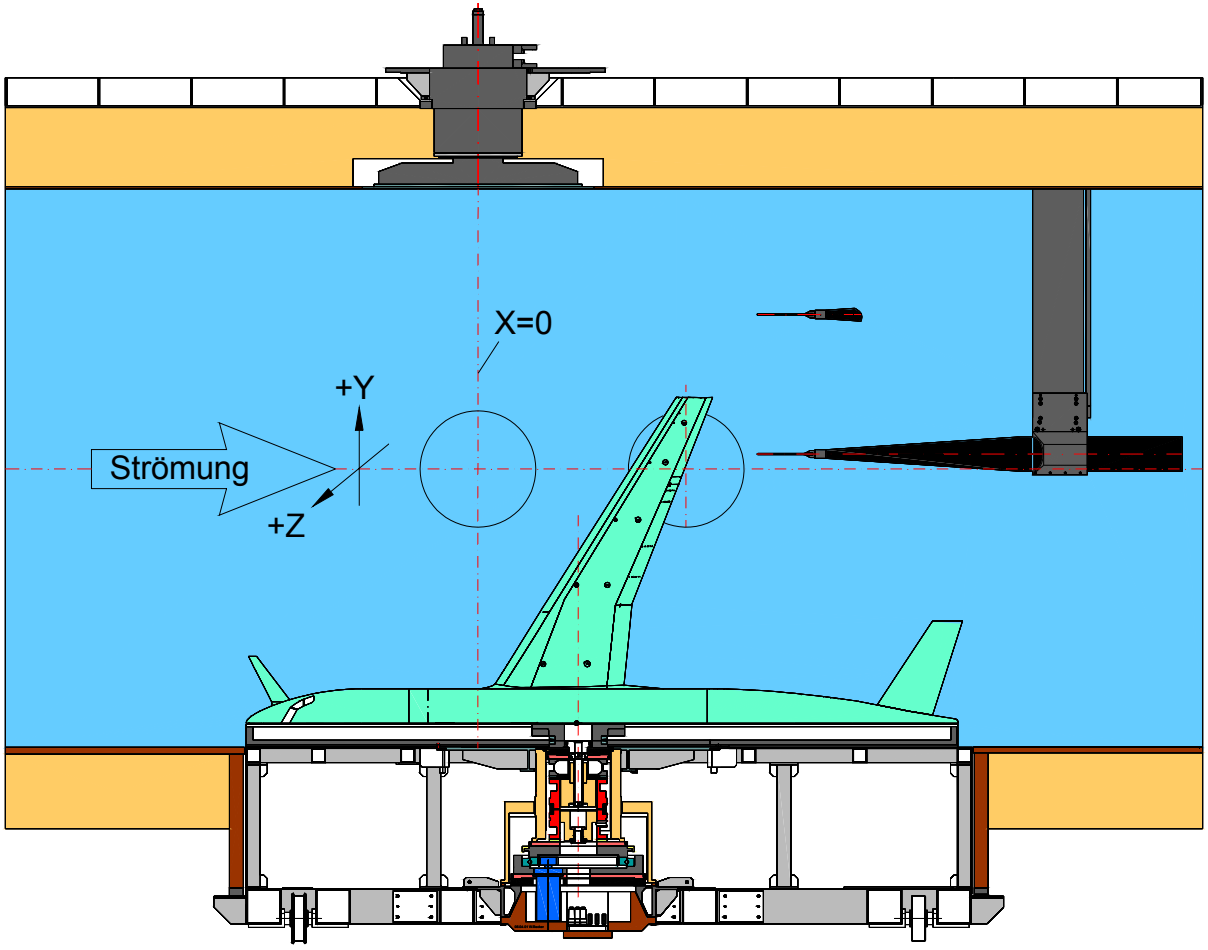
Half-Model Test Setup



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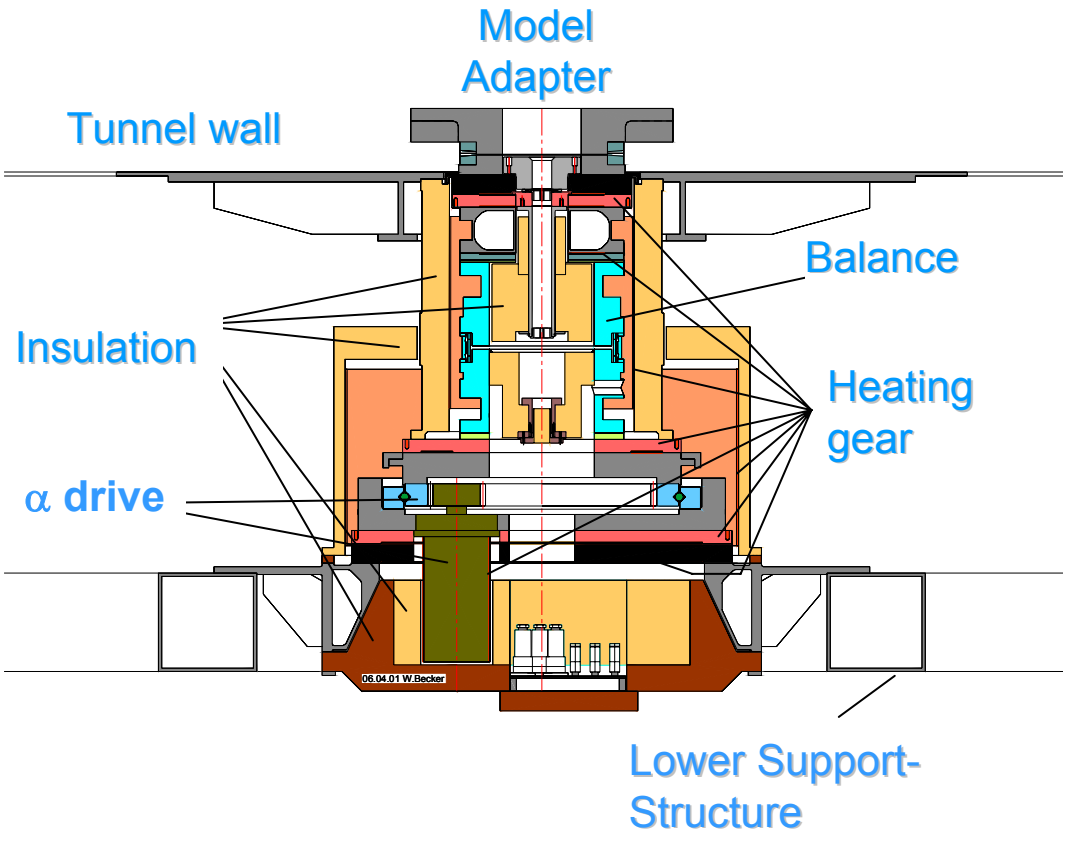
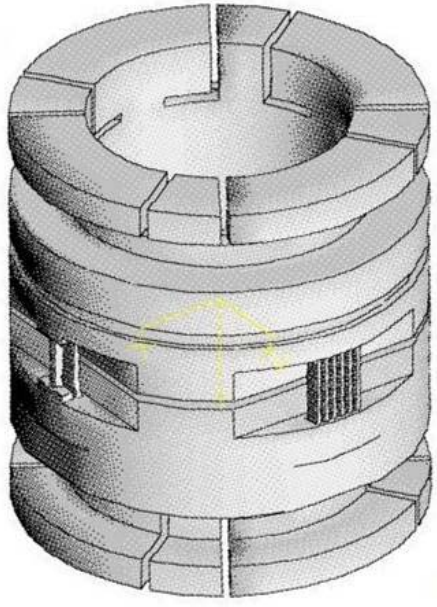
Force Measurement System





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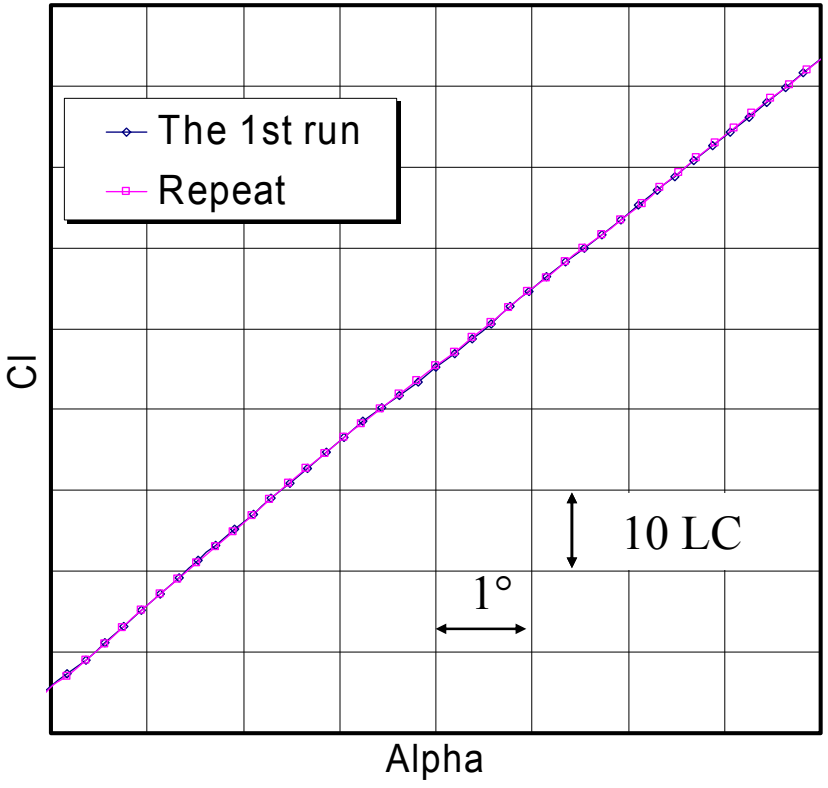
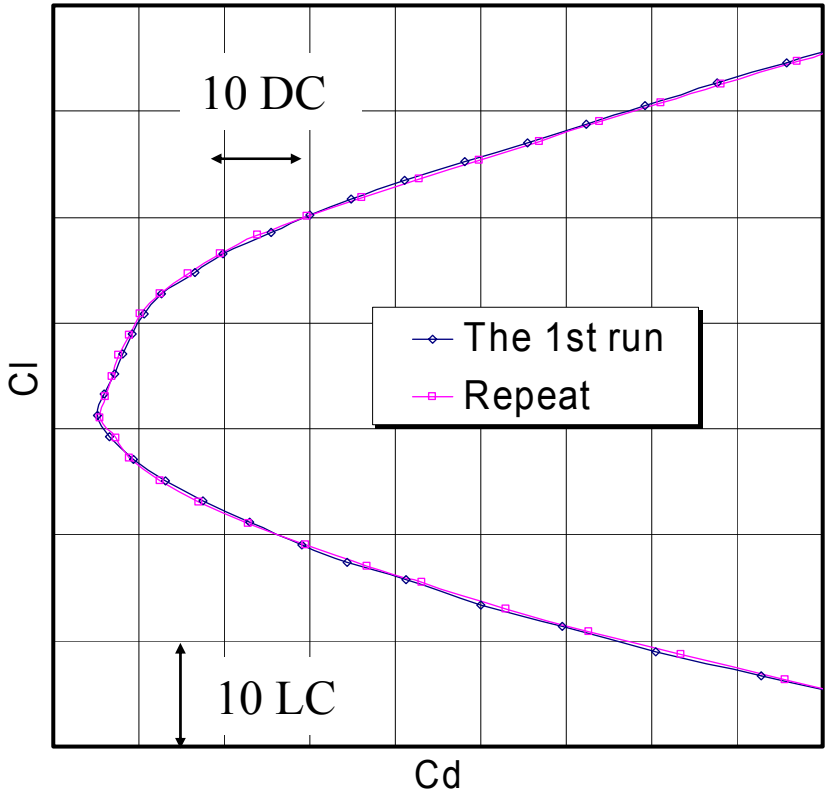
Repeatability of Half-Model Testing

Start configuration
Ma=0.2 Re=7.5 milo. T=102 K





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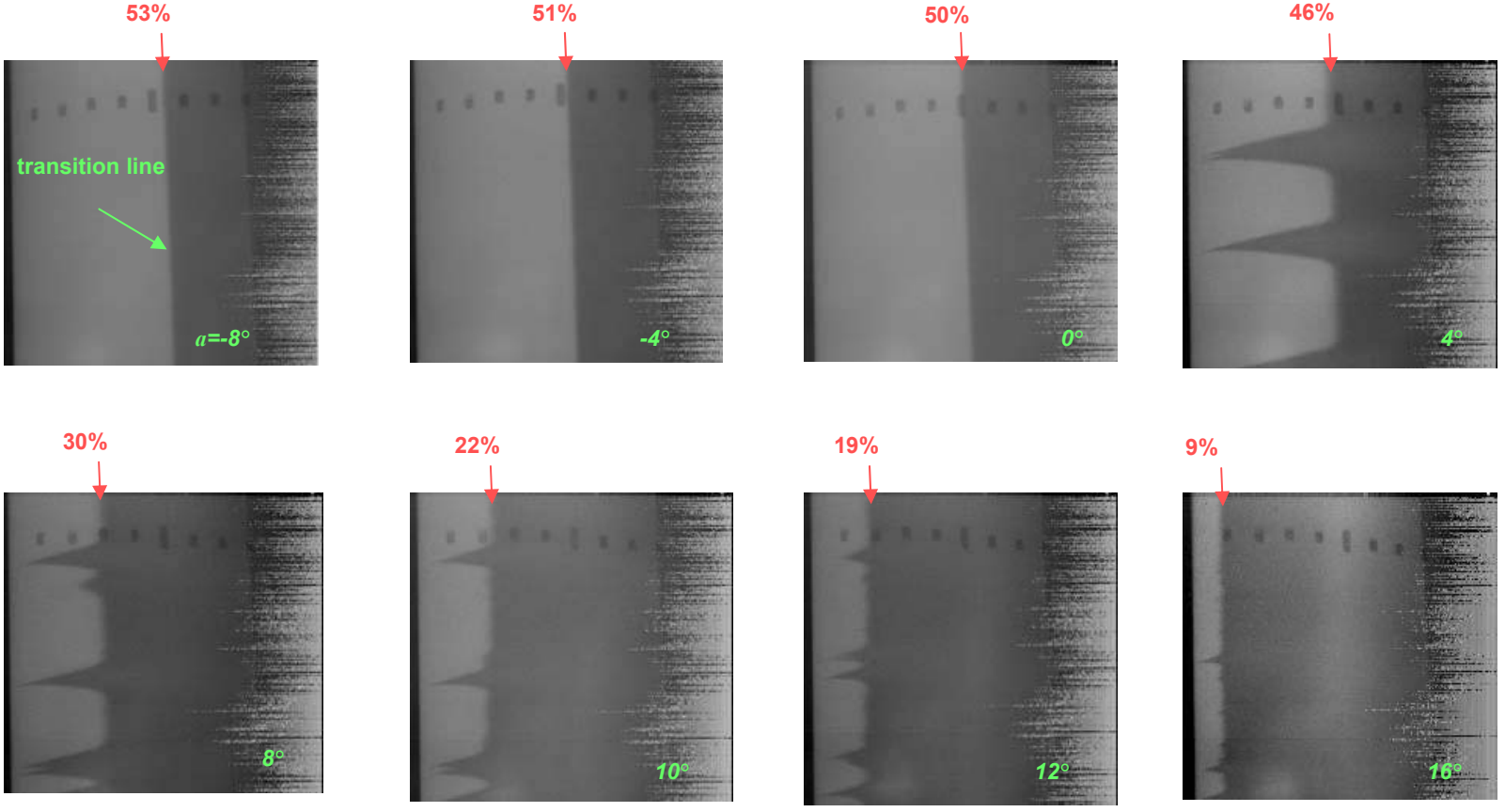
Transition Detection

Infrared Thermograph

T=200K, Ma=0.26, Re=3.0 milo.



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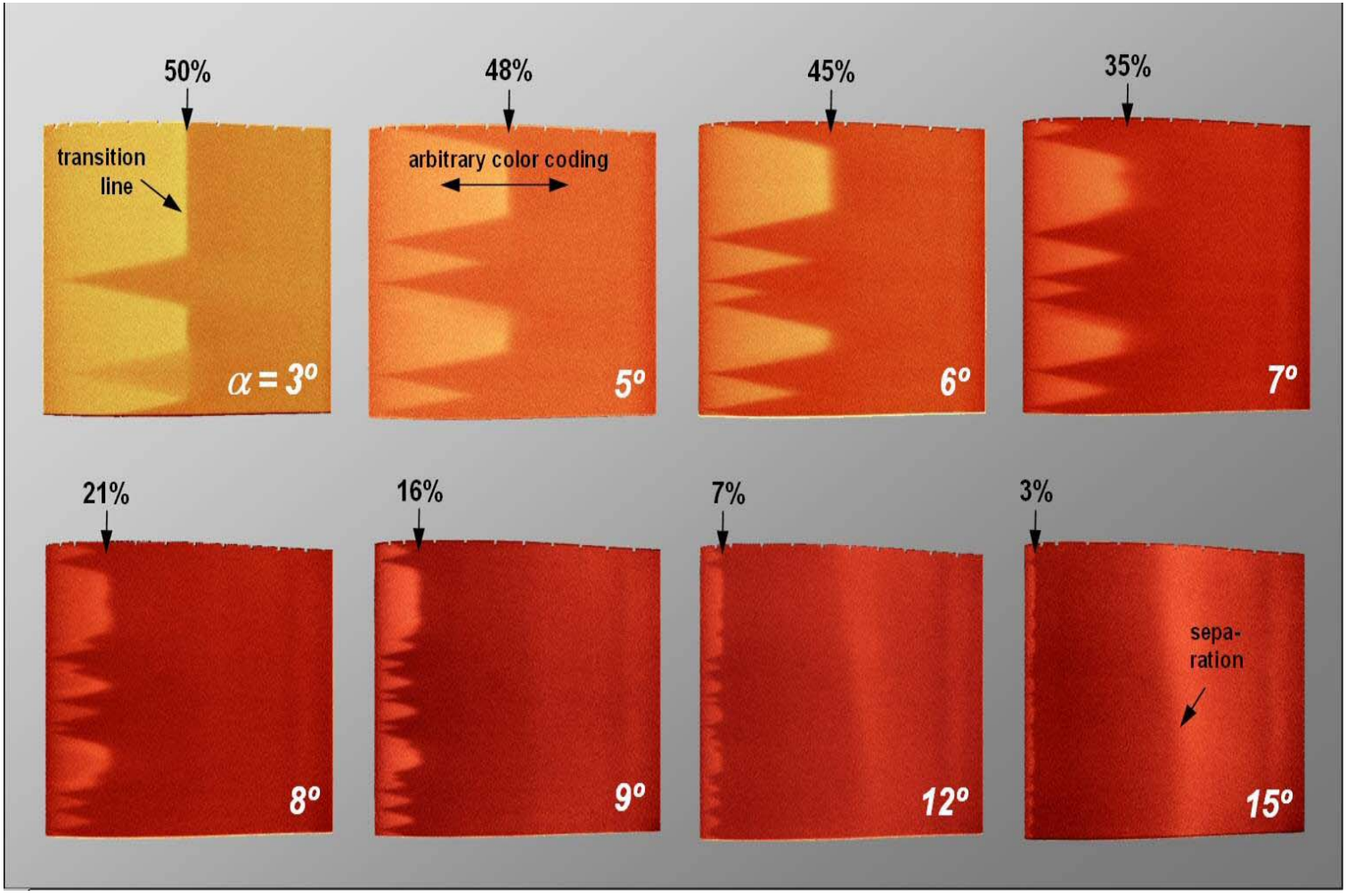
Transition Detection

Temperature Sensitive Paint

T=178K, Ma=0.25, Re=3.3 milo.



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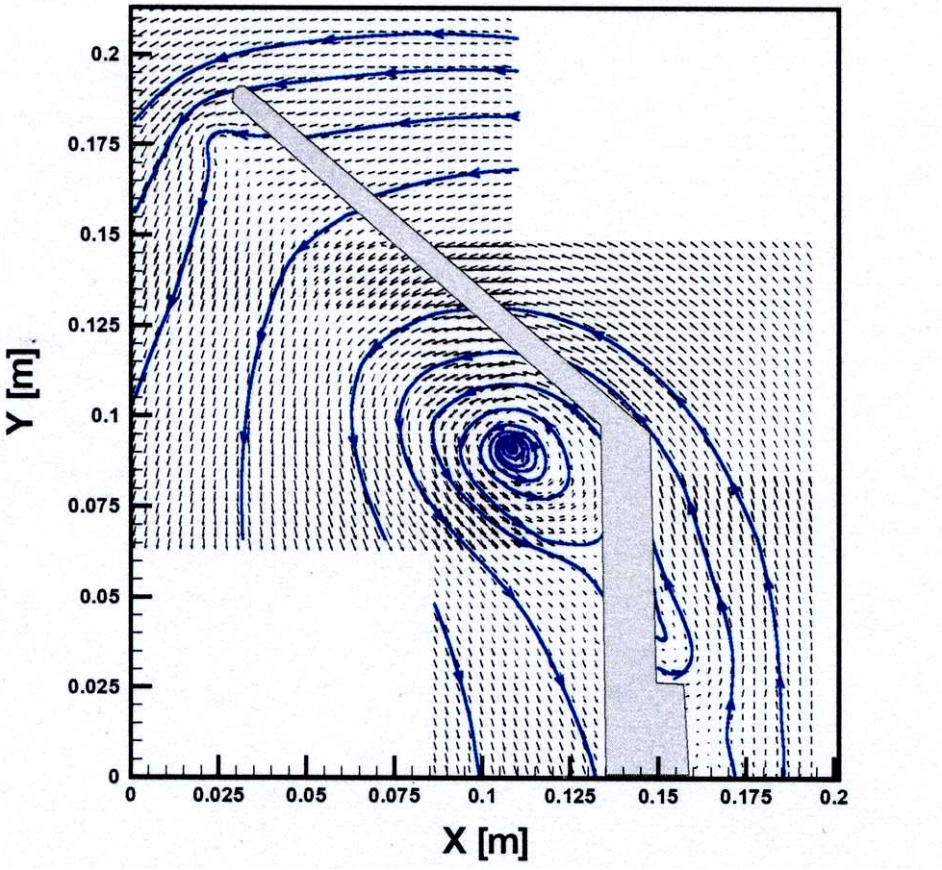
Particle Image Velocimetry (PIV)



Vorticity field behind a winglet tip device

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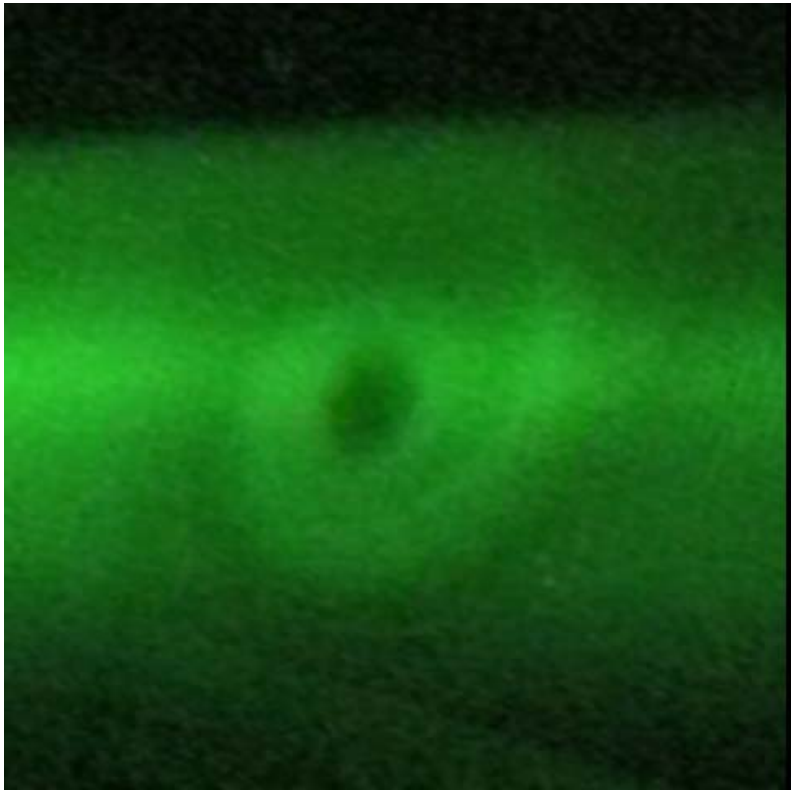
Other Optical Measuring Method

Background Oriented Schlieren (BOS)

Laser Light Sheet (LLS)



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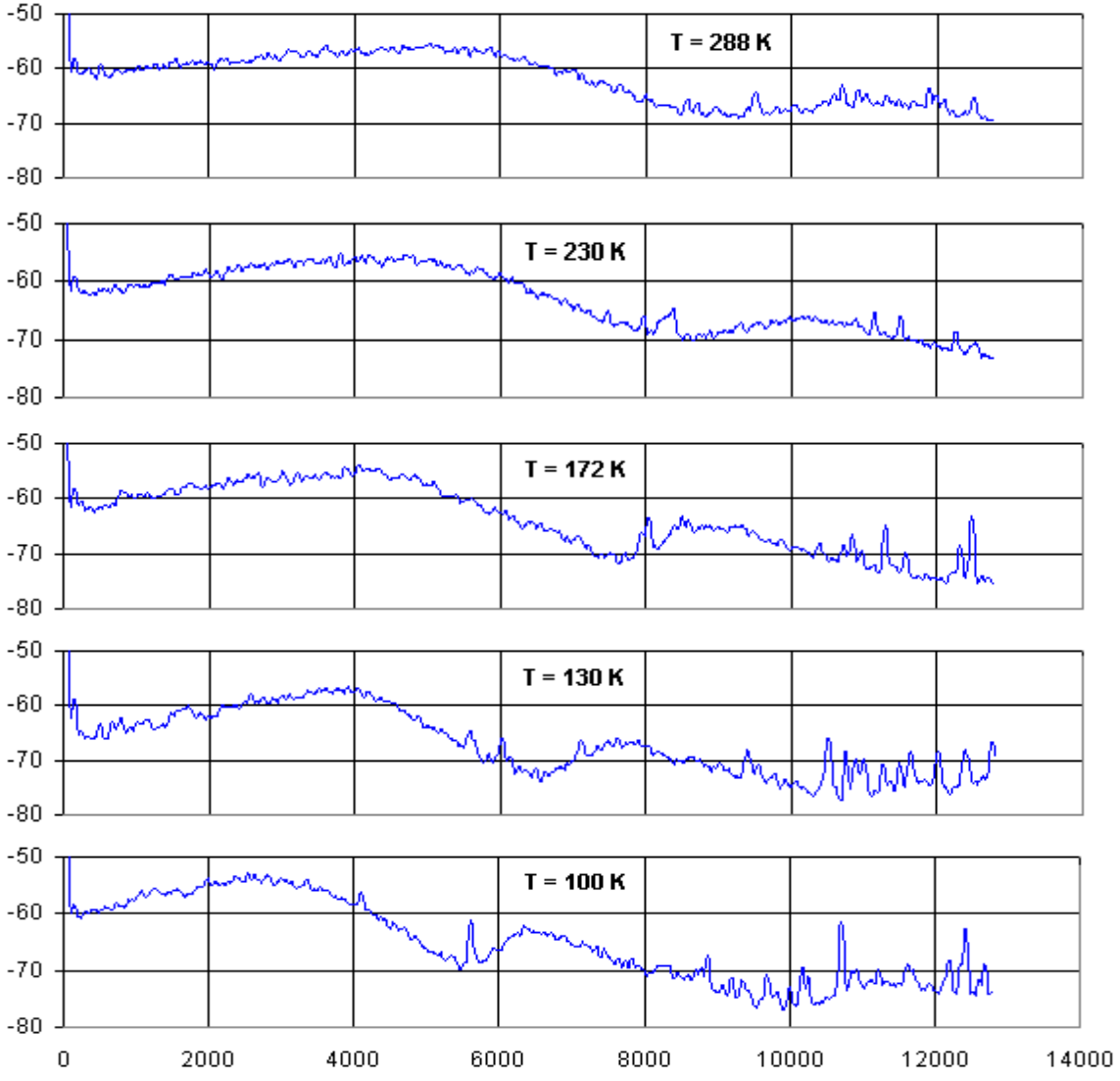
Re-effect on the frequency spectrums at Ma = 0.2; Kulite



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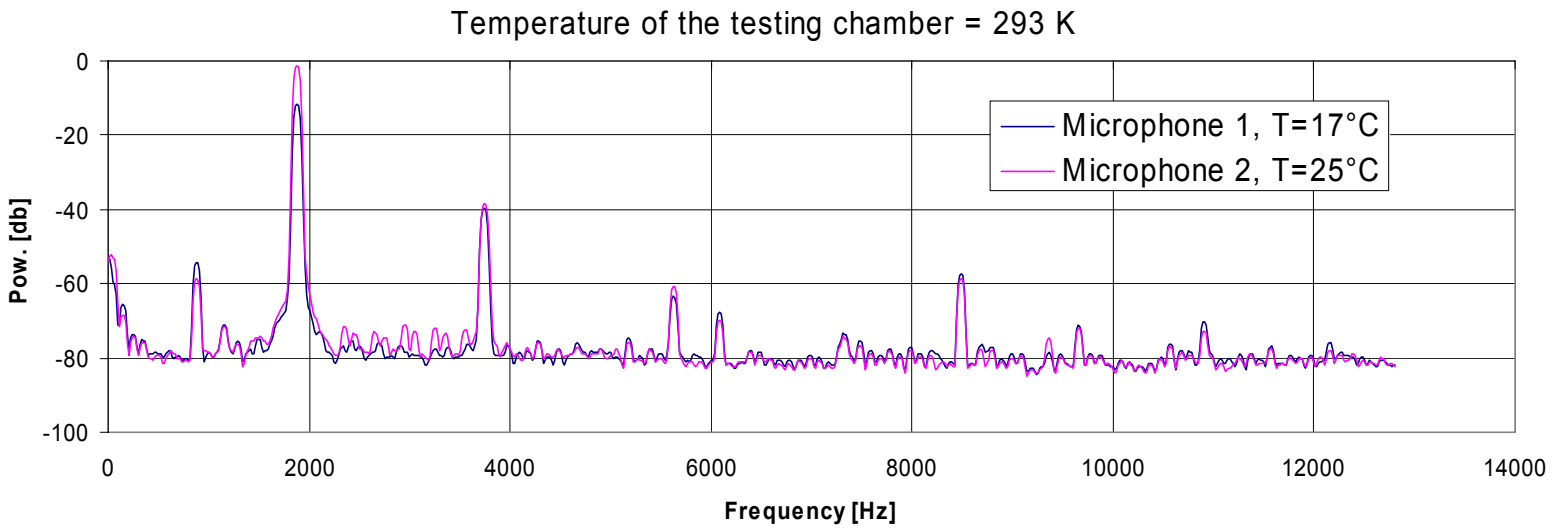
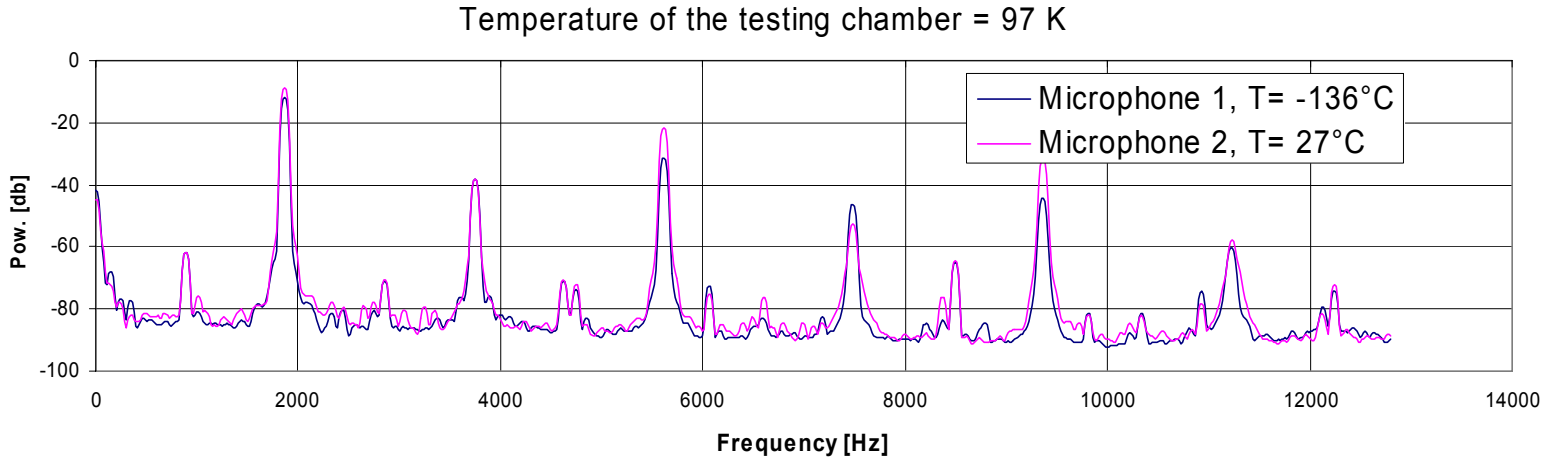
Temperature Effect of Condense Microphones





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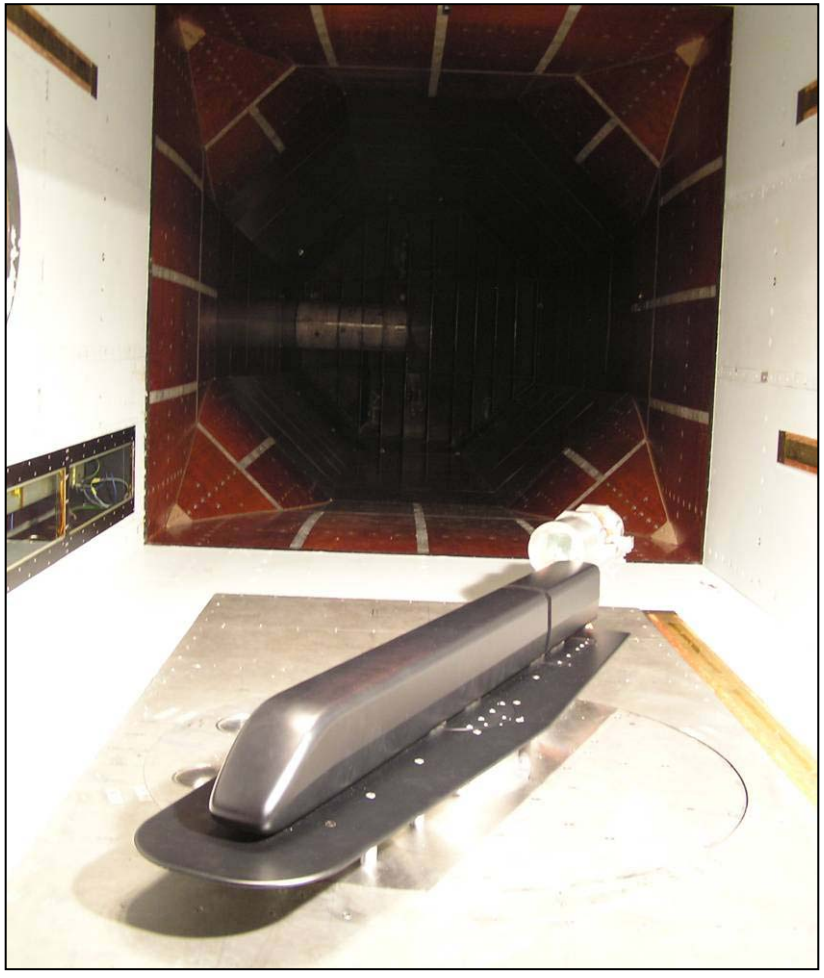
Setup for Train Testing



Scale 1:20

Material Alu. alloy

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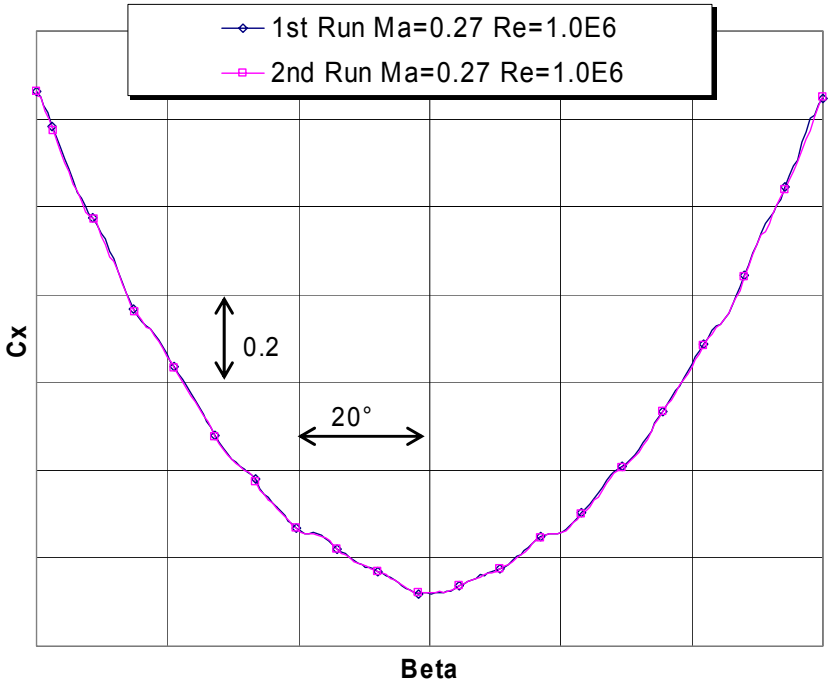
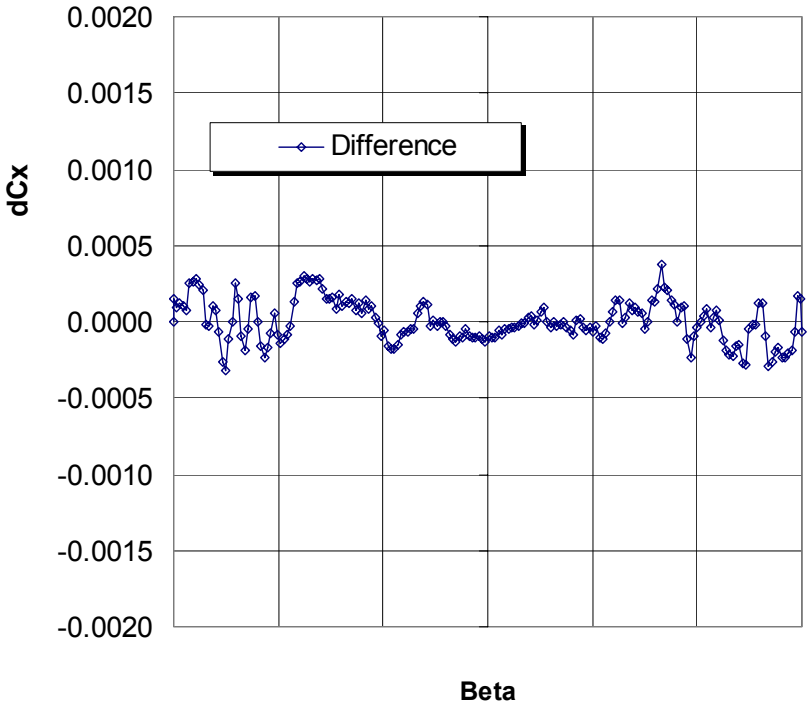
Repeatability of the Testing





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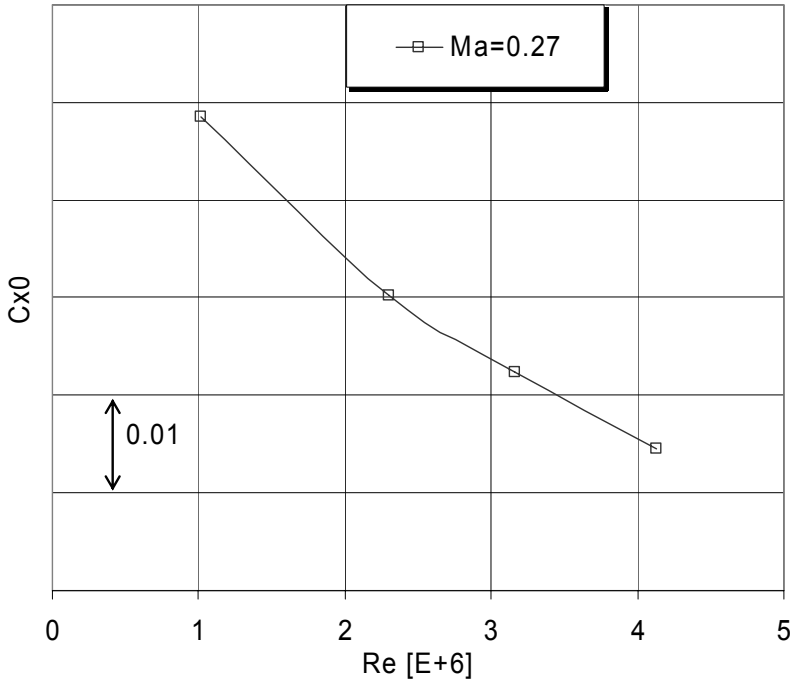
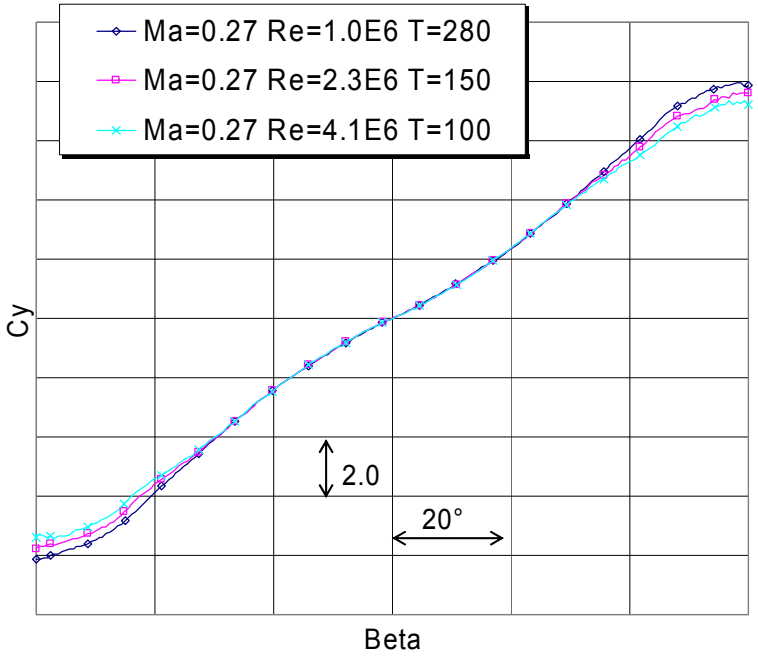
Influence of Reynolds Number



Influence of Re on Cx0



Influence of Re on side force

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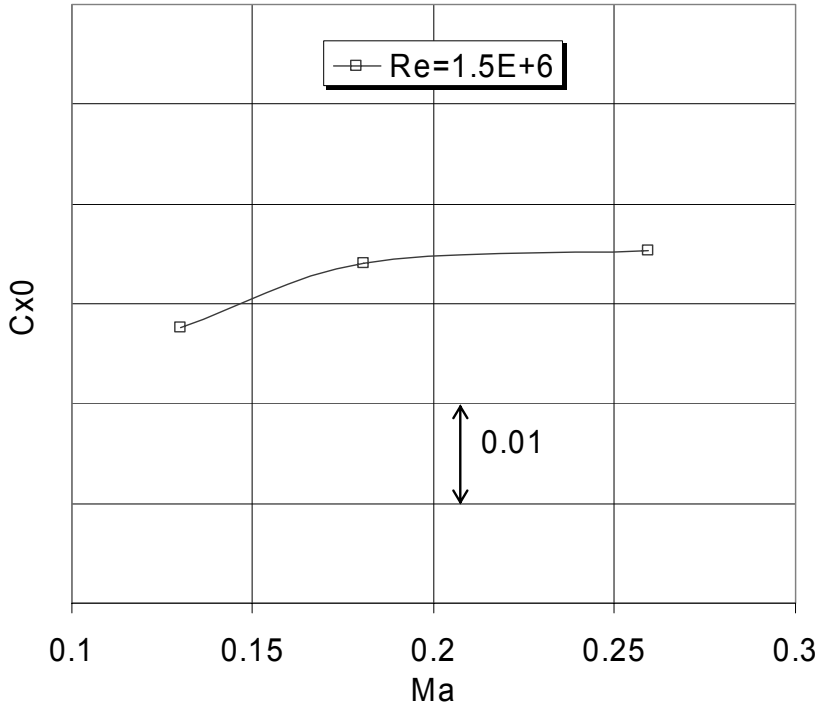
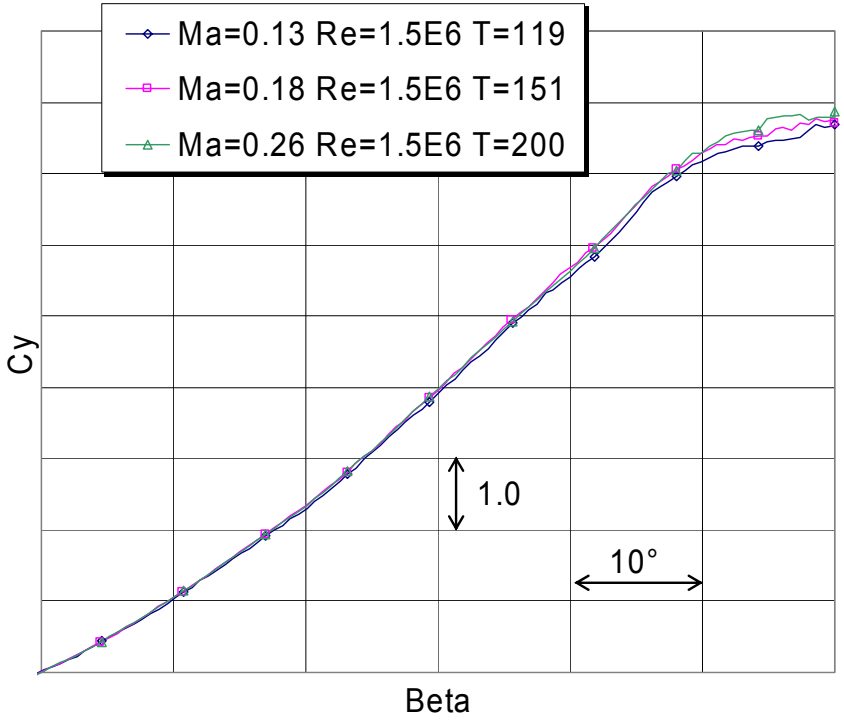
Influence of Mach Number



Influence of Mach number on Cx0



Influence of Mach number on side force

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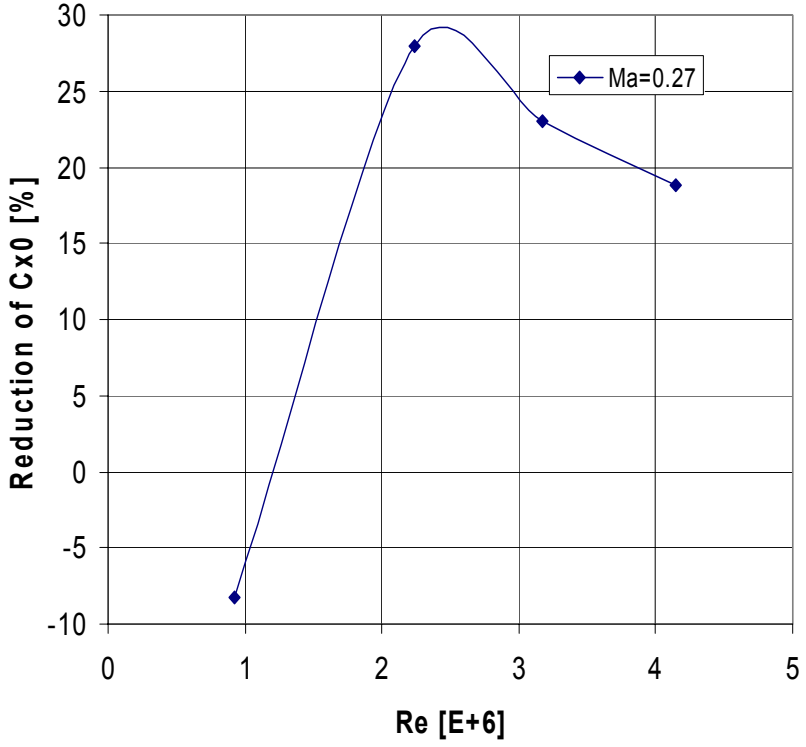
Comparison of two Models



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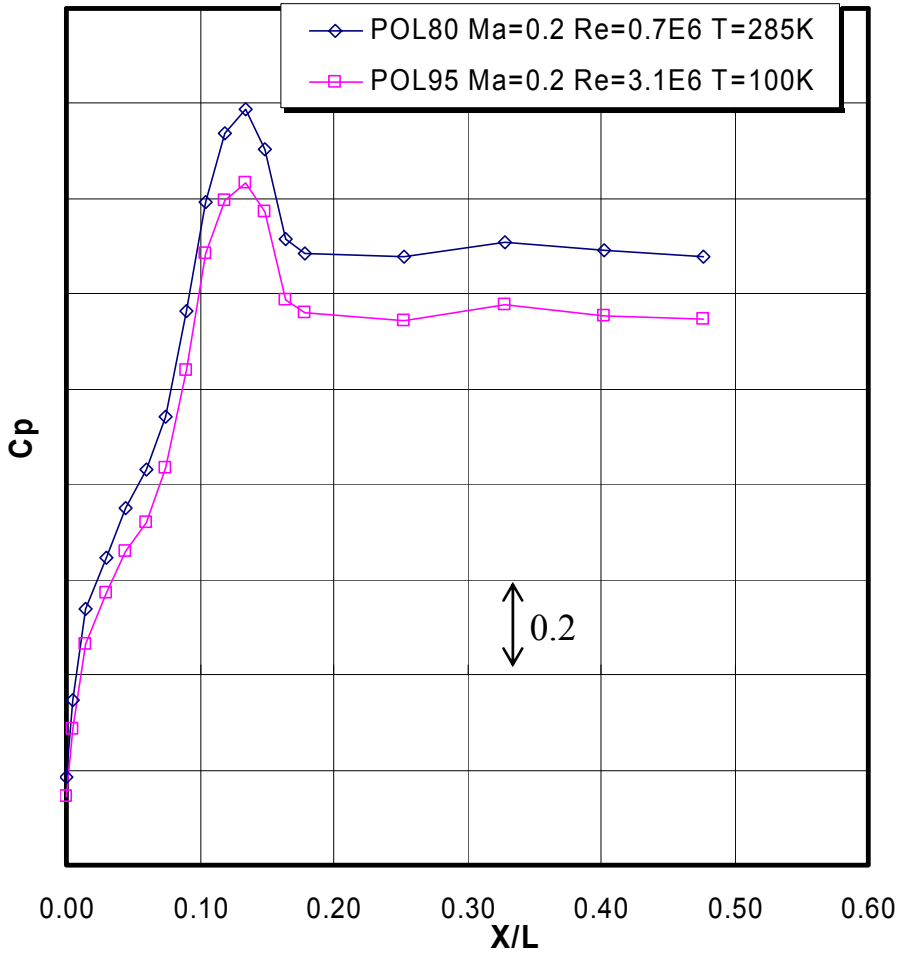
Influence of Reynolds Number On the Pressure Distribution

Cp distribution at the train center line

$\beta = 34°$

Re-Effect at Ma=0.2



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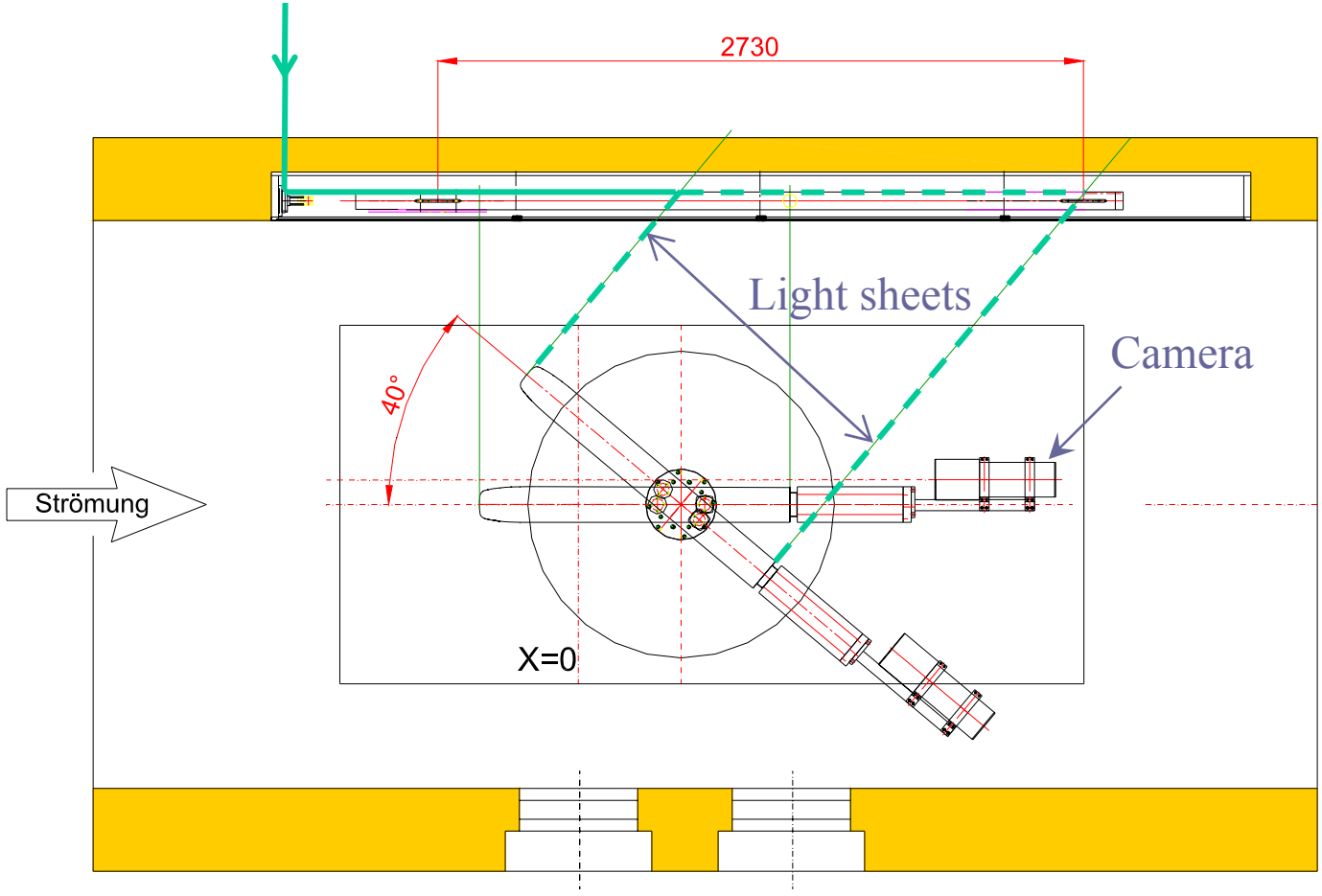
PIV measurements in DNW-KKK



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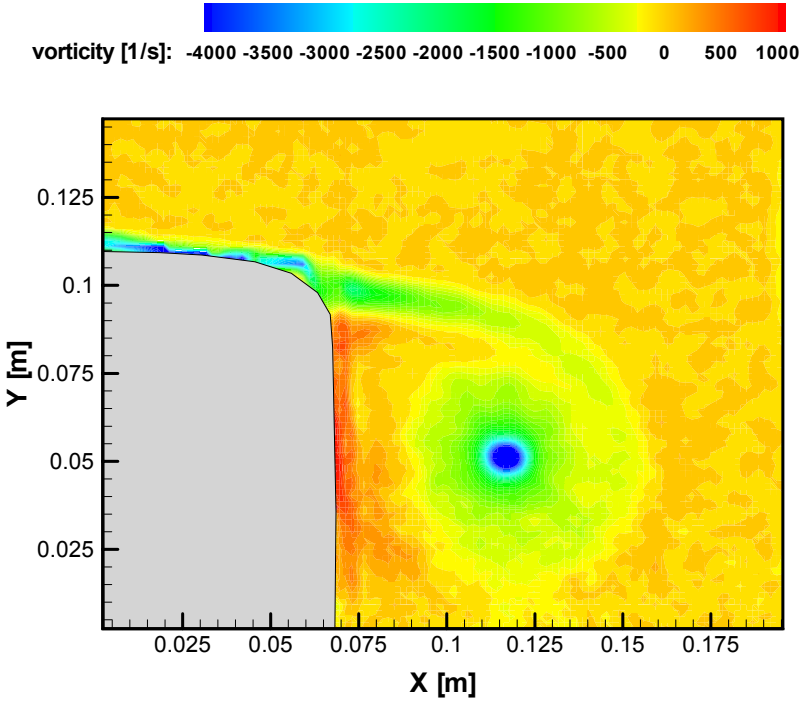
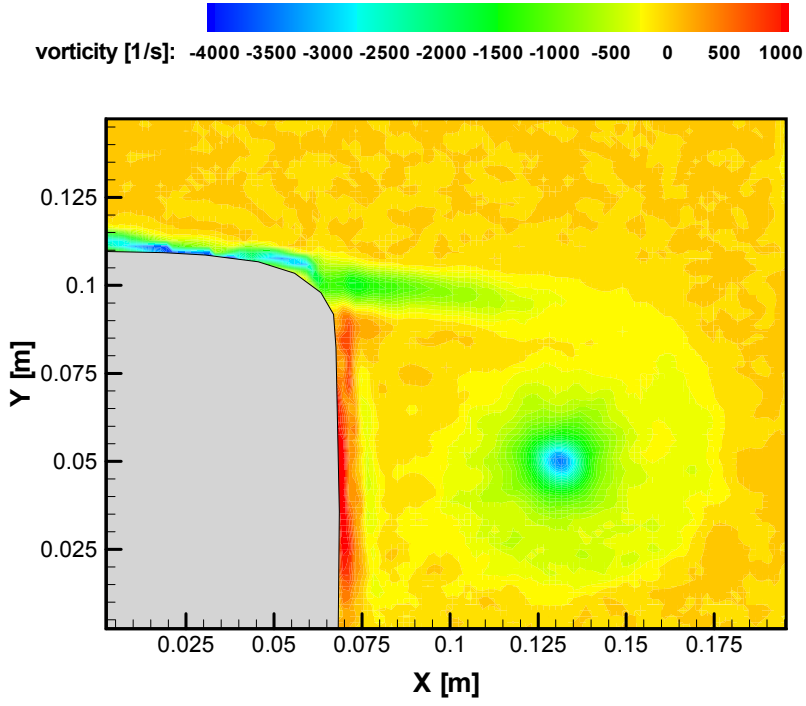
PIV Test Result

Averaged vorticity field:

Re=3.1×10^6, T=100K, Ma=0.20, β=25°



Clean model



Dimpled model