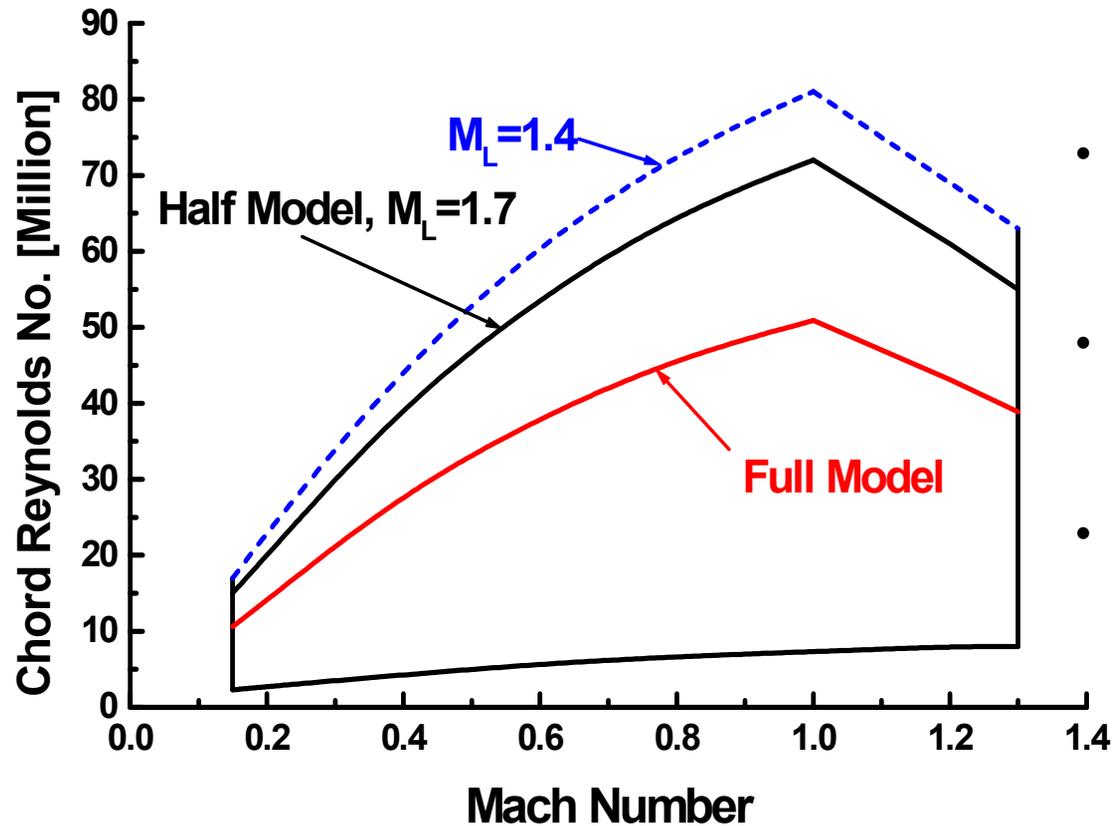


Development of the Half Model Testing Capability at ETW

Martin Wright
European Transonic Windtunnel

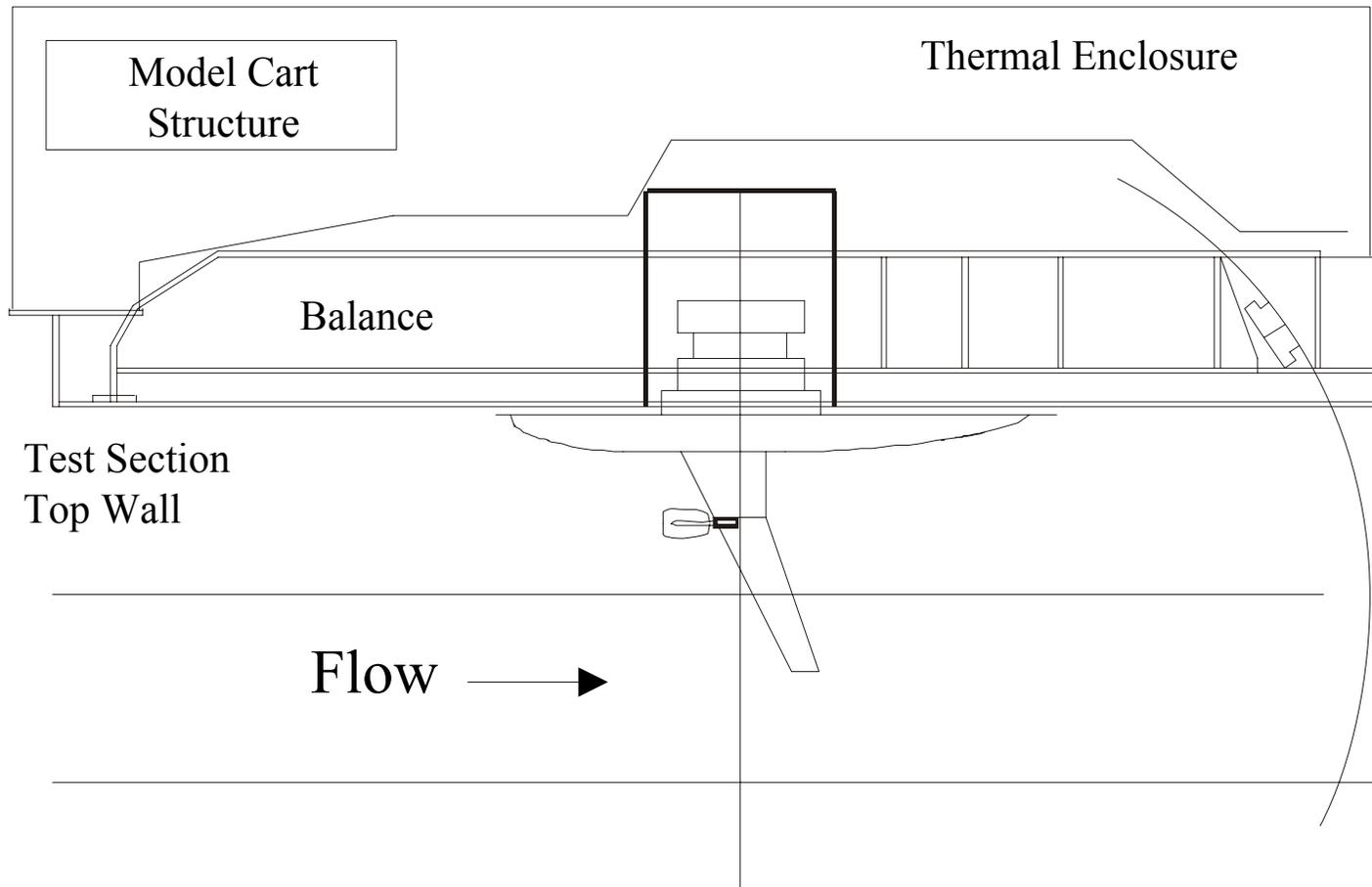
Messtechnik in Kryogenen Windkanälen
TU München, Garching

Reynolds Number Envelope Envelopes



- Half model extends ReC from 50 to 70 million
- Improved model representation
- Powered testing as a future development

Model Cart Considerations - Half Model Operation



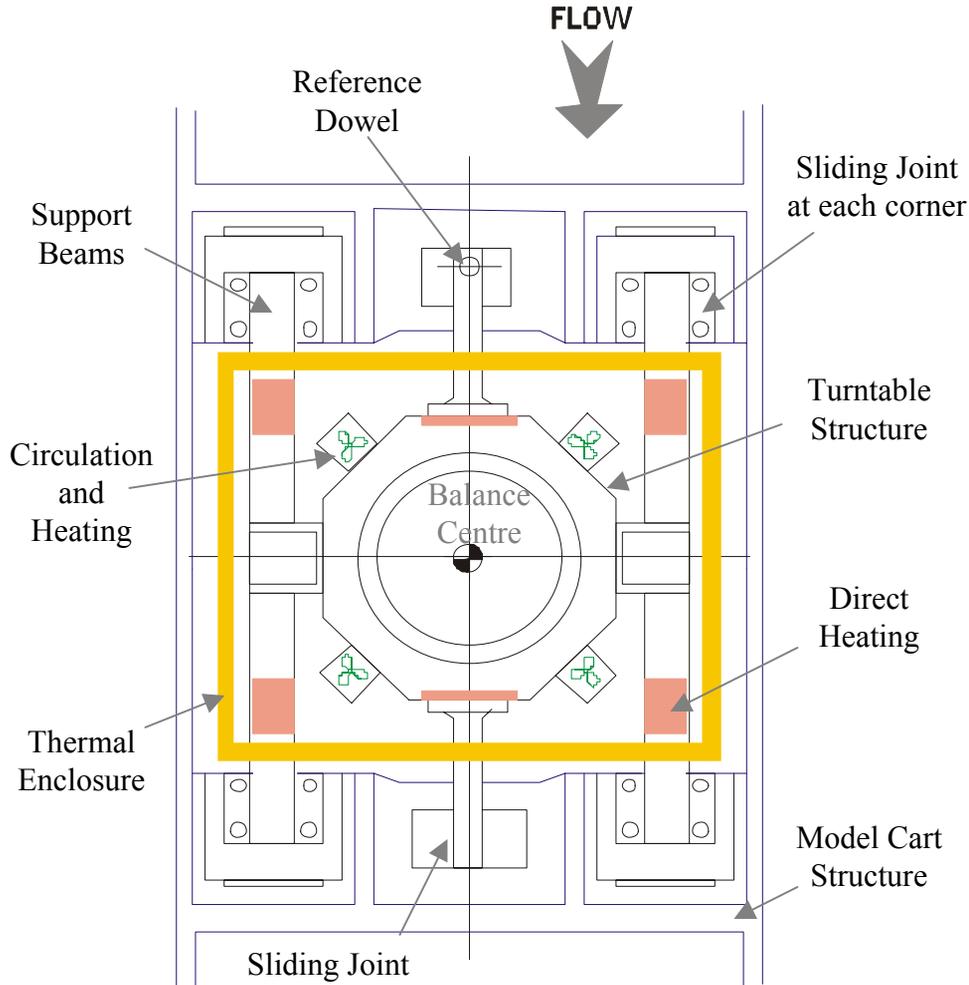
Load Ranges and Sensitivities

Component	Load Range	Sensitivity
Normal Force	55,000 N	8 N/ μ V
Axial Force	5,500 N	0.9 N/ μ V
Pitching Moment	4,400 Nm	0.35 Nm/ μ V
Rolling Moment	33,000 Nm	0.7 Nm/ μ V
Yawing Moment	3,300 Nm	1.0 Nm/ μ V



Half Model Balance

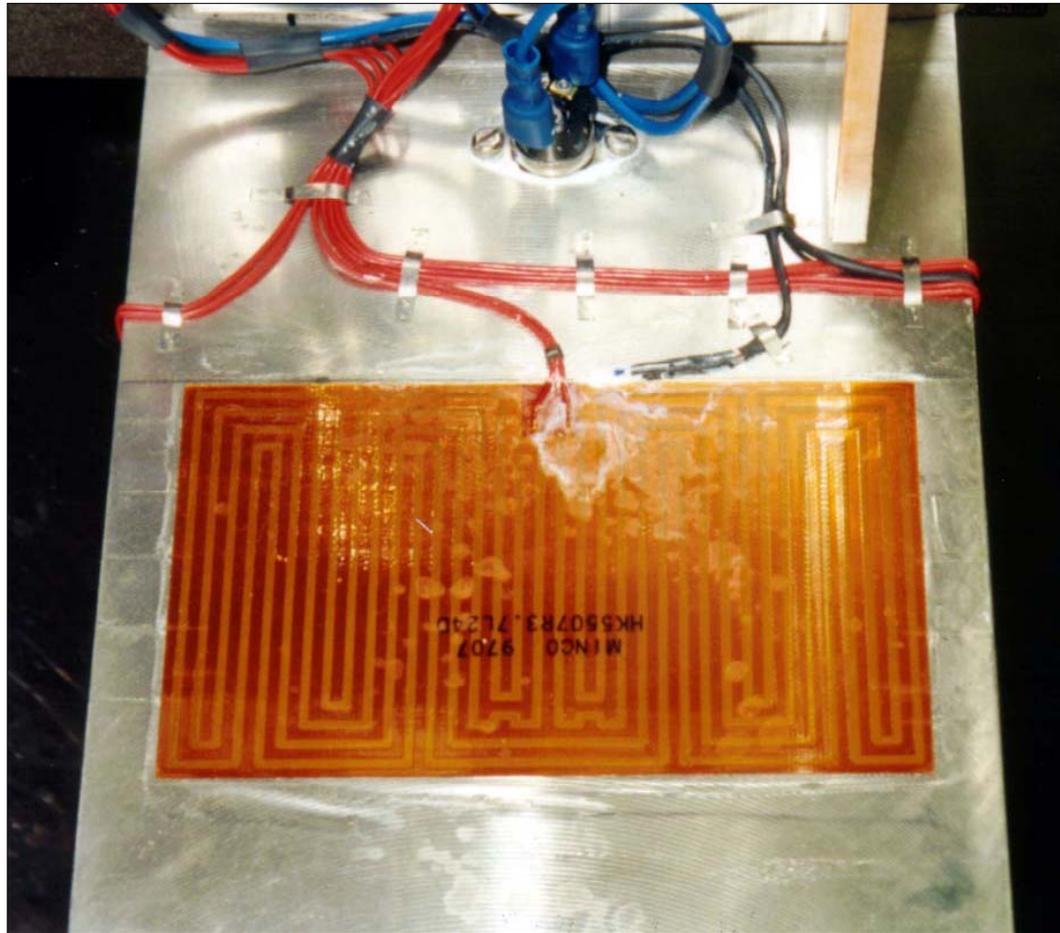
- 5 Component Design
- Maraging Steel
- NF,AF,PM Accuracy 0.1% (50-100% range)
- 0.05% (0-50% range)
- Thermal shields fitted to finished balance



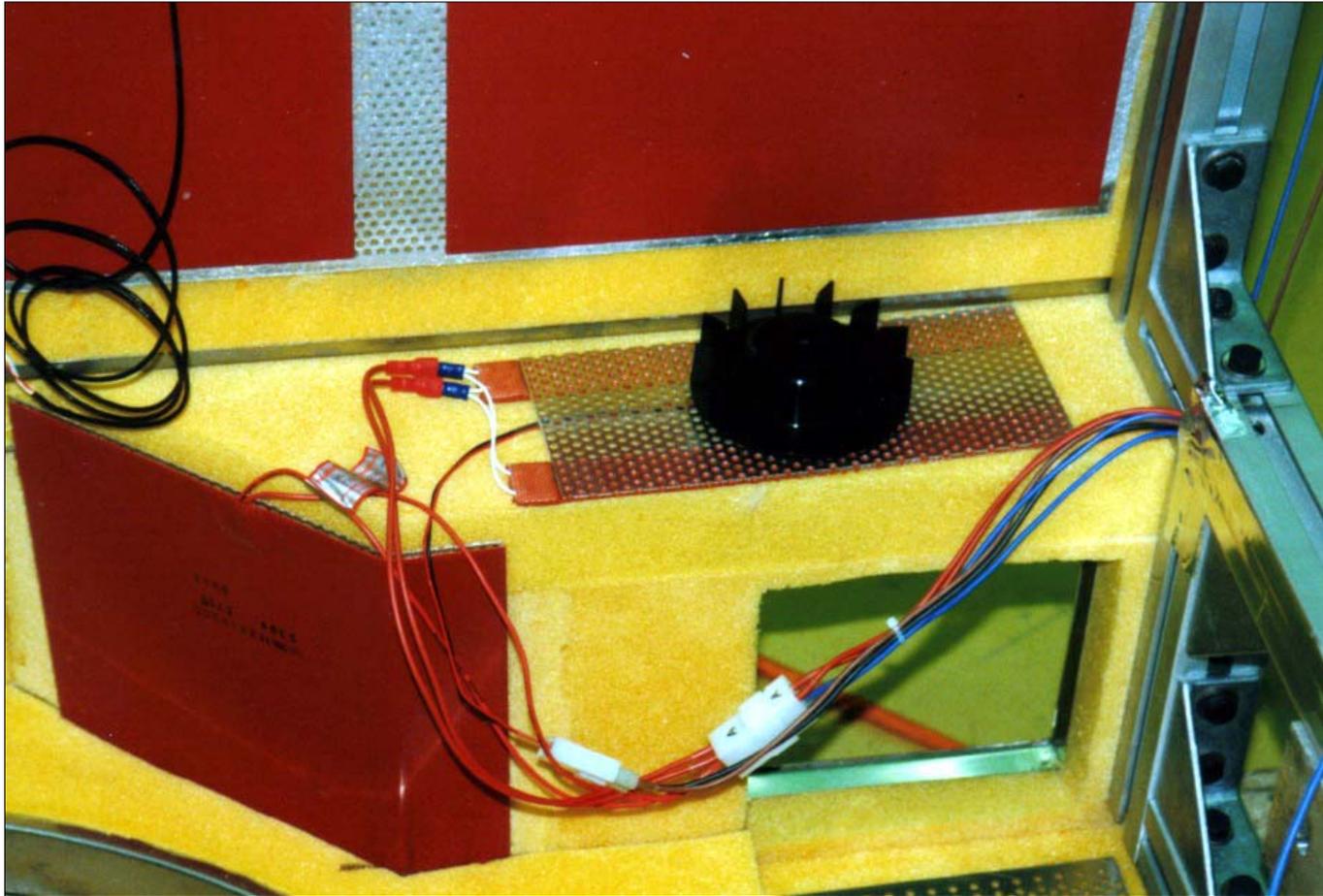
Heating Concepts

- Multi-zone design
- Create “cosy” atmosphere for balance
- Direct heating at interfaces
- Direct heating on inside walls
- Mix and control gas Temperature inside enclosure
- Control balance temperature on live and earth sides

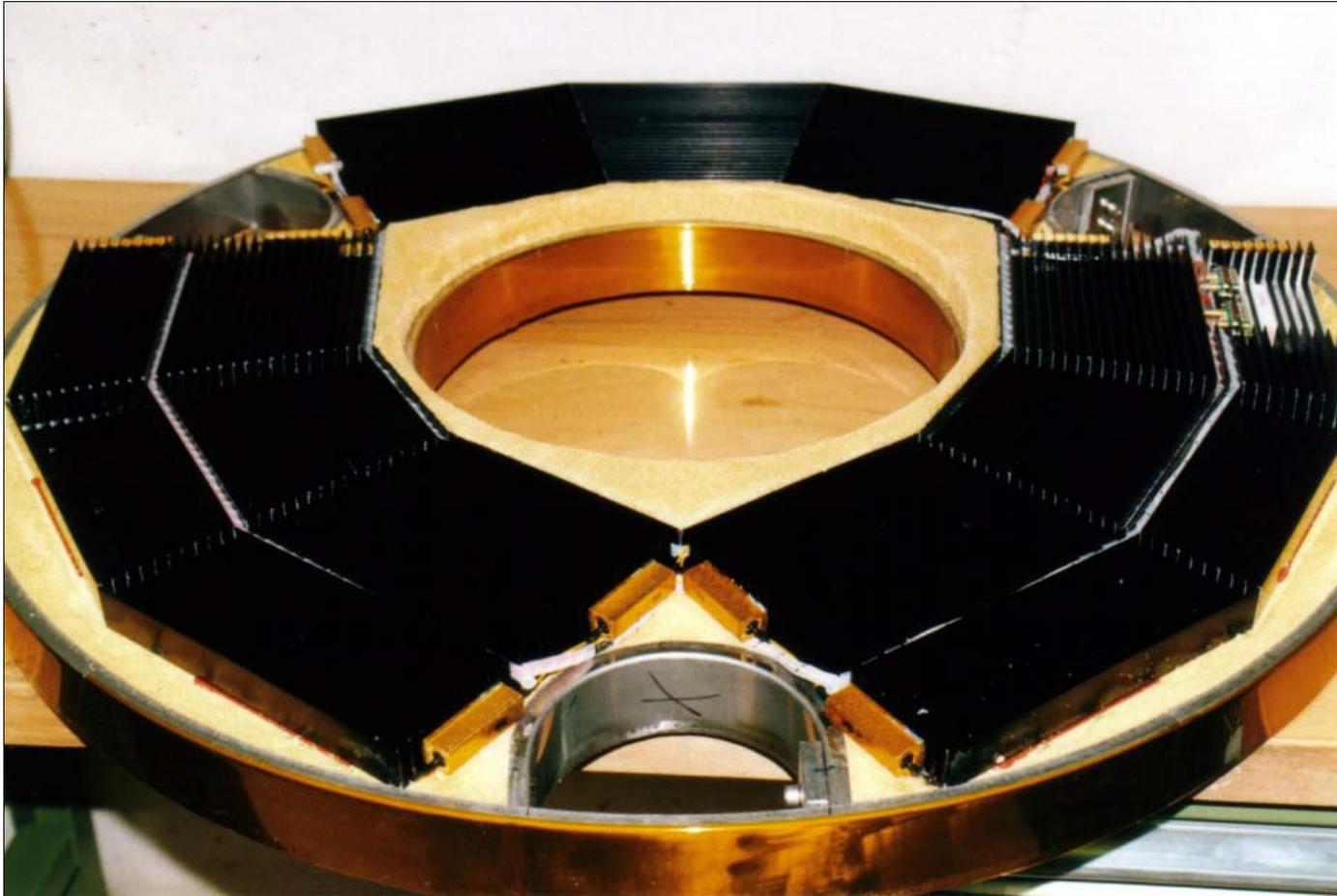
Direct Heating at Interfaces



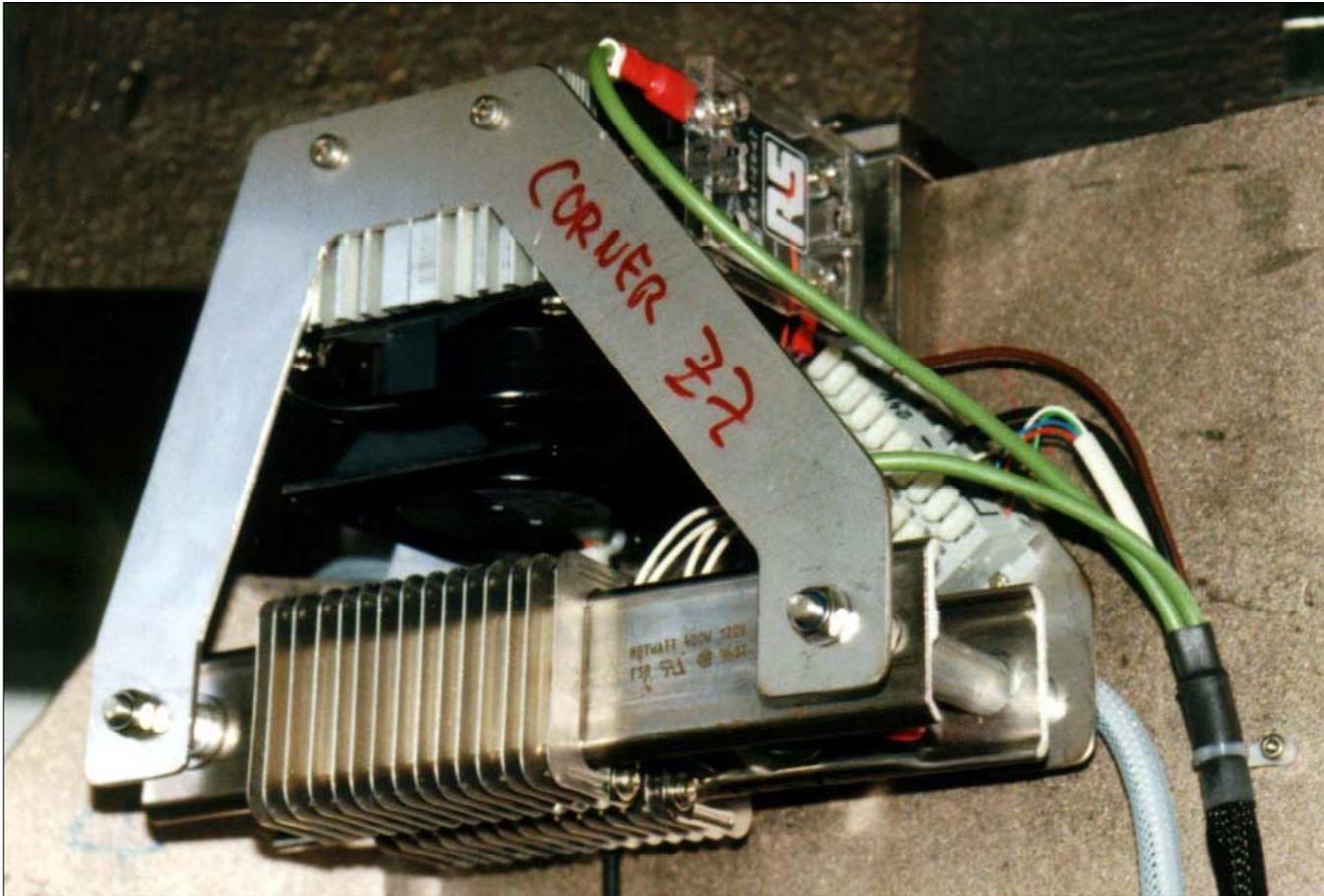
Direct Heating and Stirring Fans



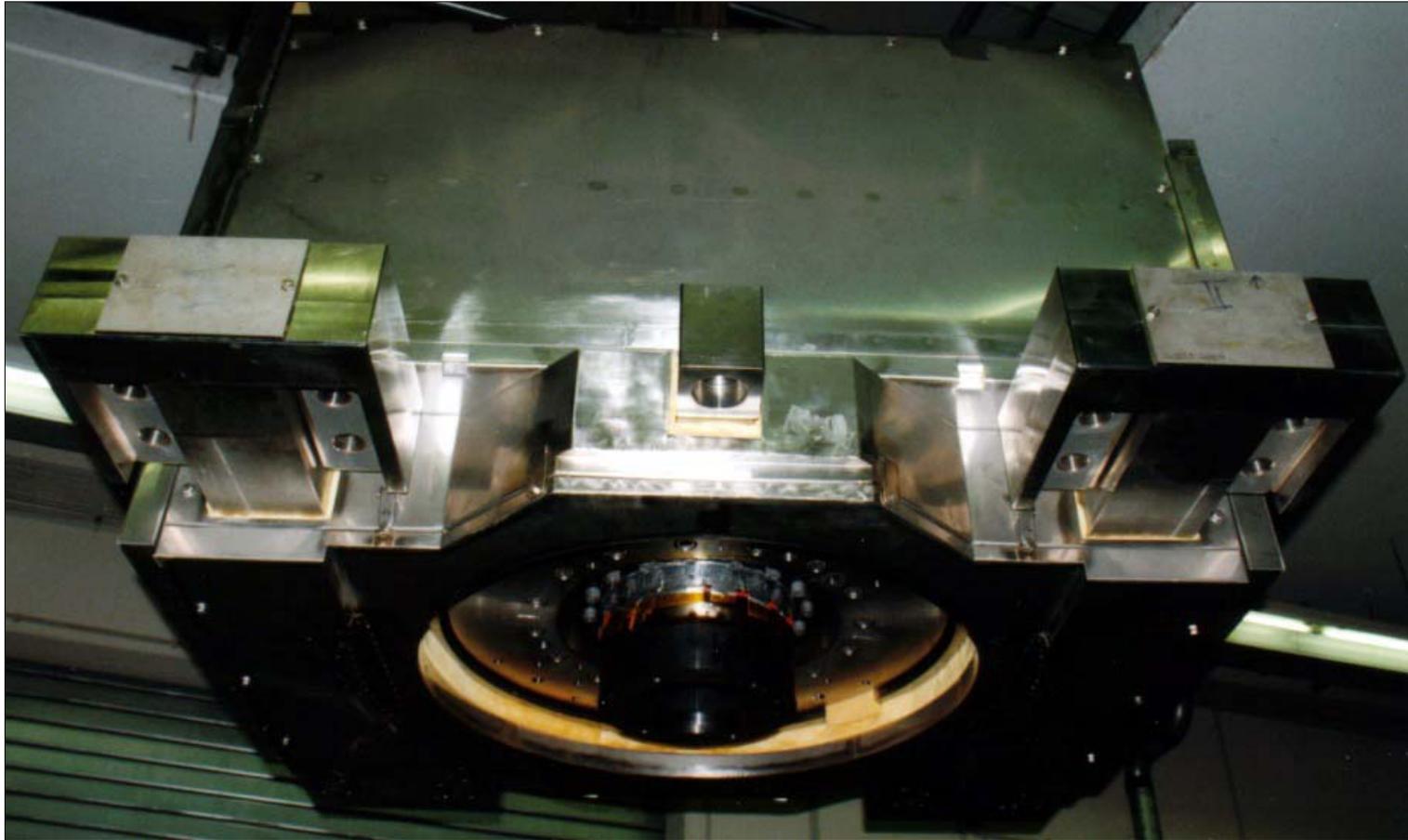
Lower Panel Heating



Circulation and Heating



Thermal Enclosure External



Turntable Workshop Trials

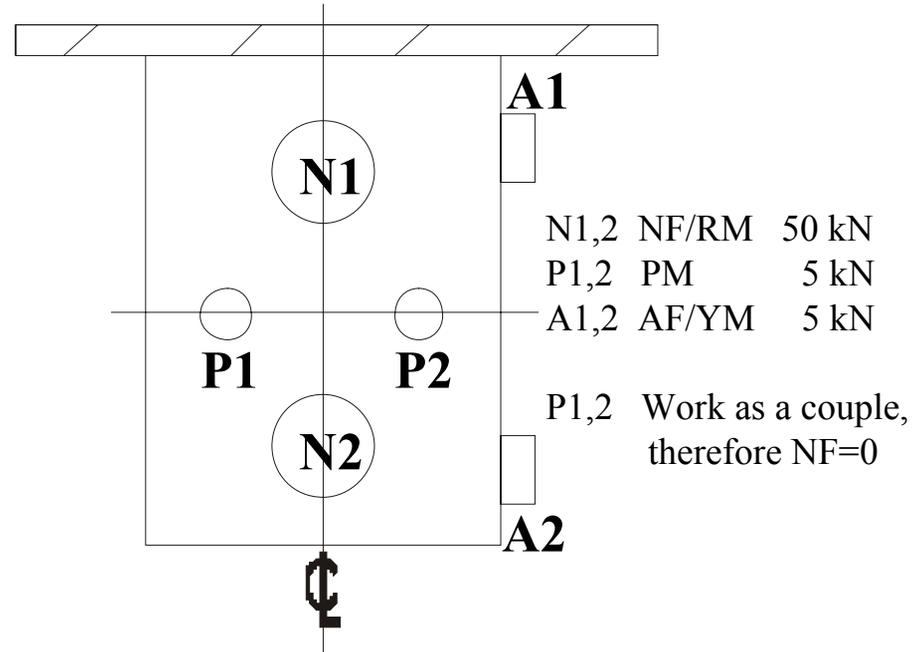
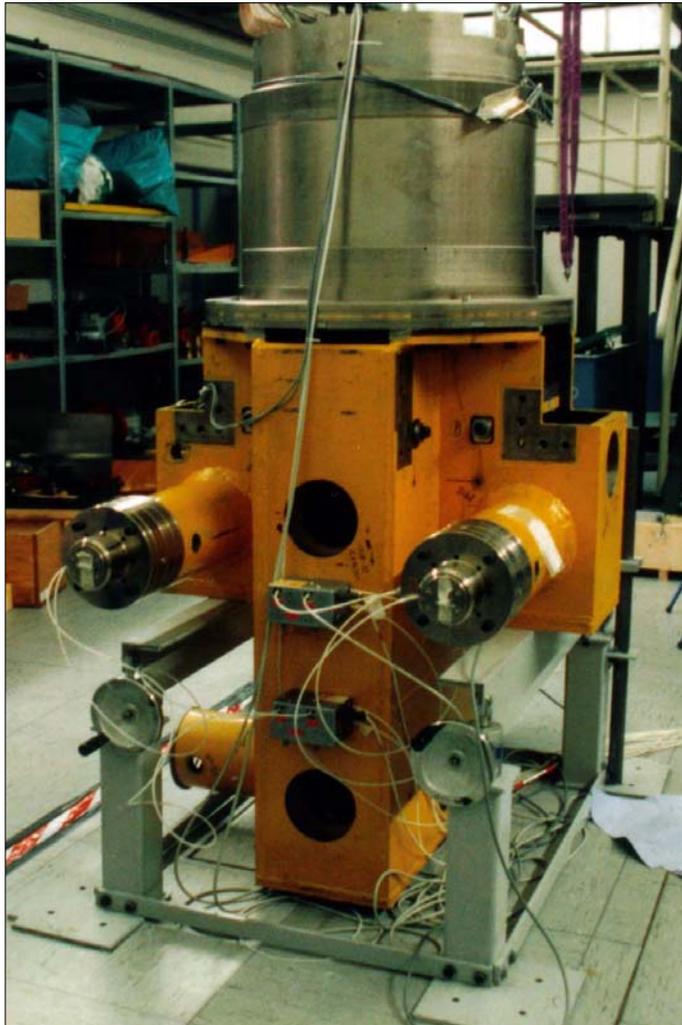


- Mechanical alignment
- Angular calibration
- Control system integration
- Endurance testing at maximum torque

Drive System Performance

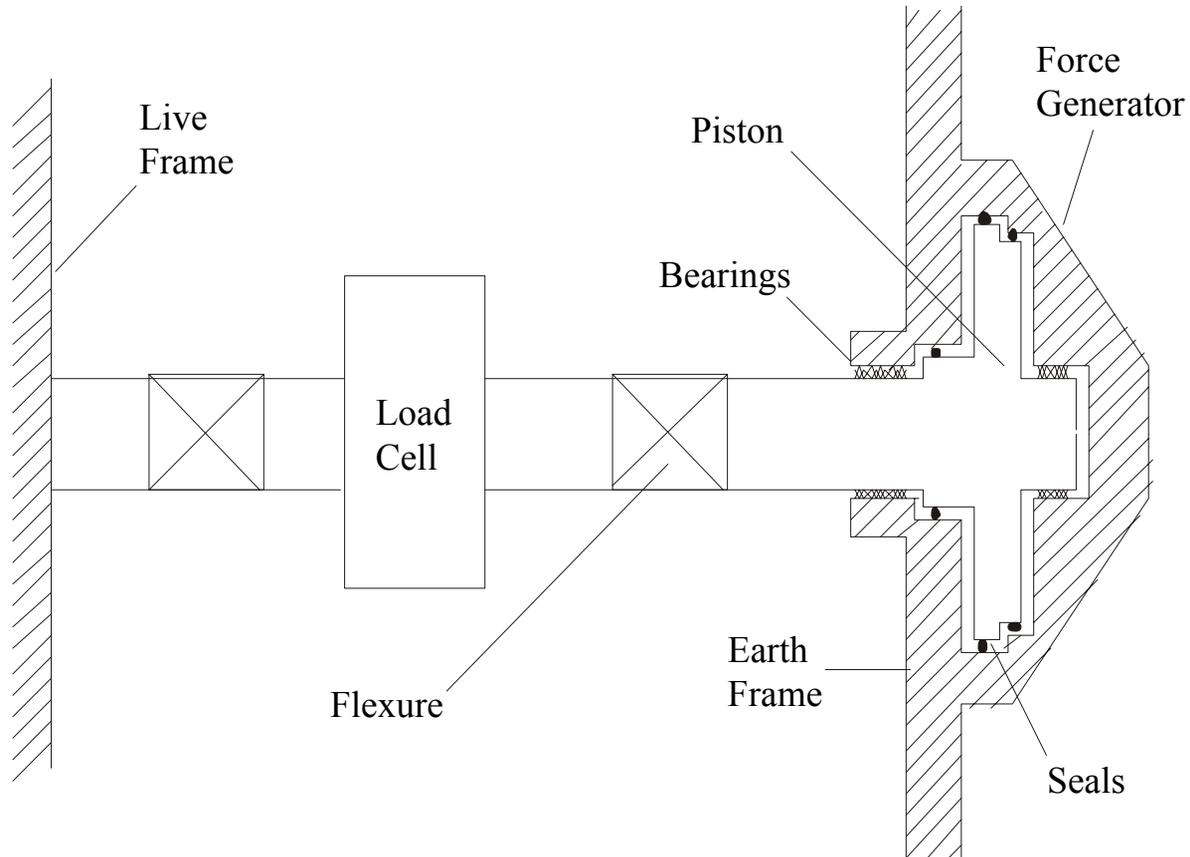
- Drive torque > 11 kN
- Incidence range - 45° to + 45°
- Incidence rate 0.05°/s to 1°/s
- Incidence acceleration up to 0.5°/s
- Minimum increment 0.01°
- Movement control Continuous and pitch & pause
- Positional accuracy $\pm 0.005^\circ$

Half Model Balance Calibration



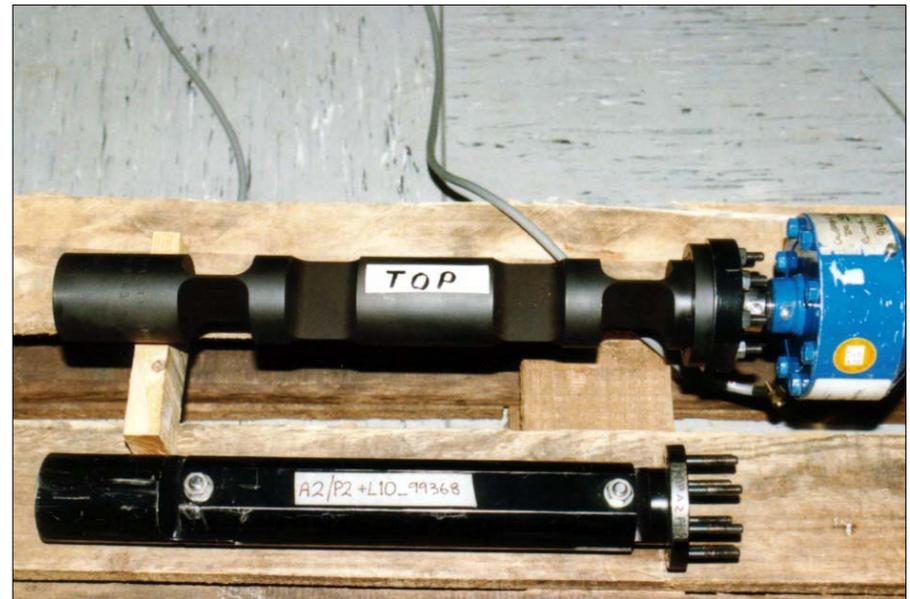
- Pneumatic semi-automatic system controlled by PC
- Load cells used as master calibration devices within individual load trains
- Combined loading of three components possible

Calibration Load Train

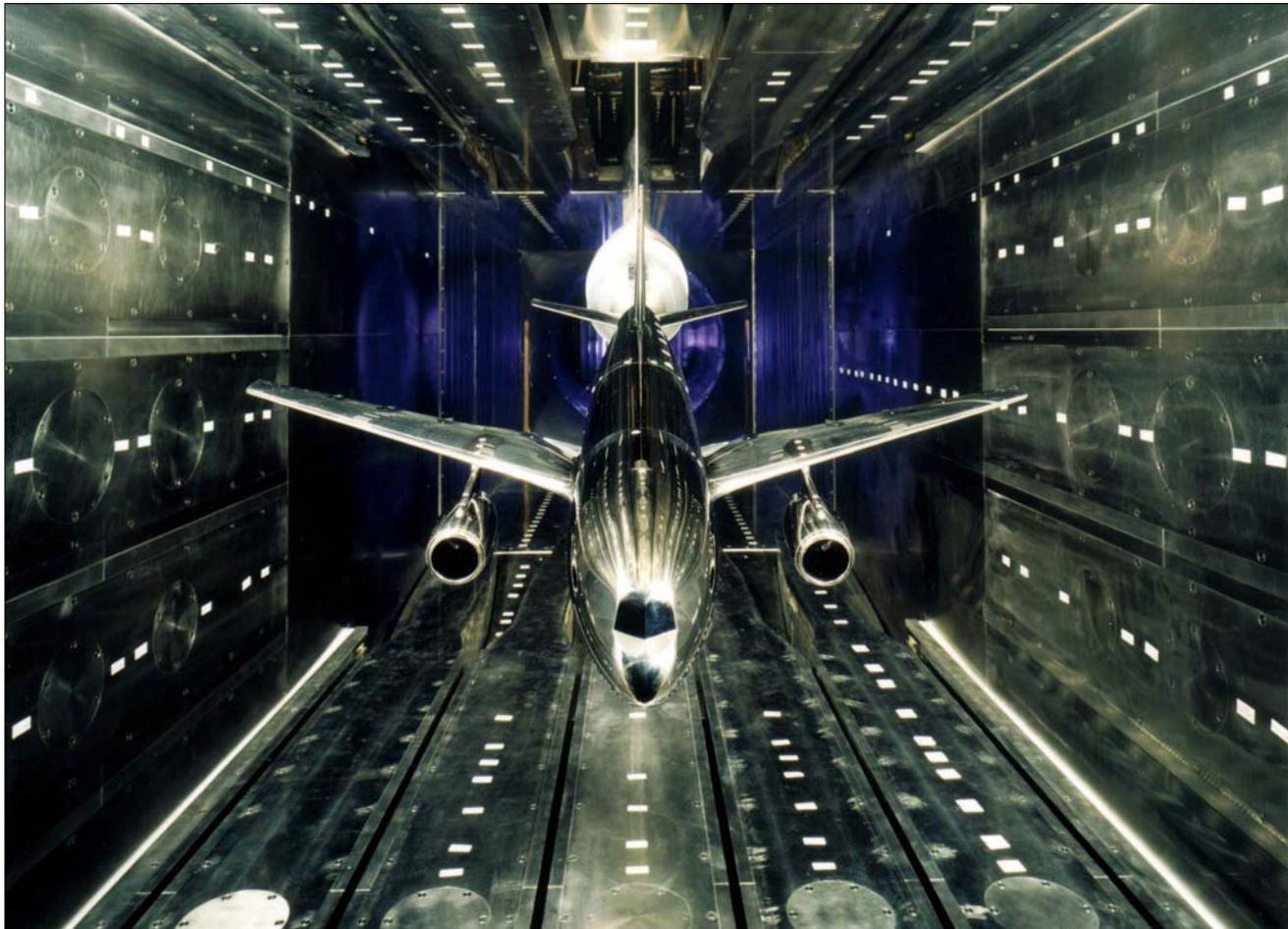


Force Train Development

- Original force trains capable of +/- loadings
- Original trains provide good performance for single component loadings
- Flexure friction corrupts combined loadings
- New trains capable of pull loadings only



Full Model Test Section

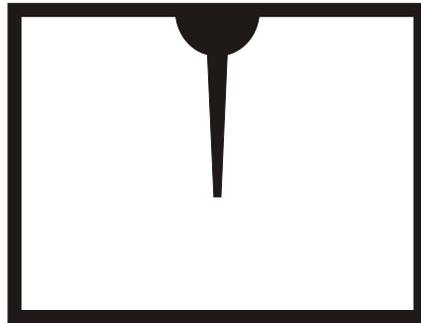




Full Model Test Section

Wall Configuration Options

Configuration 1



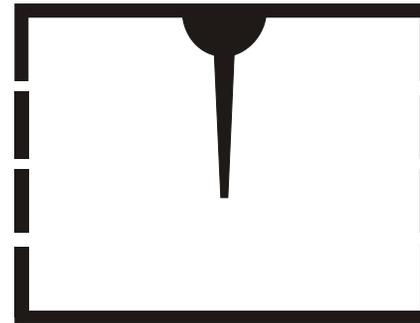
Configuration 2



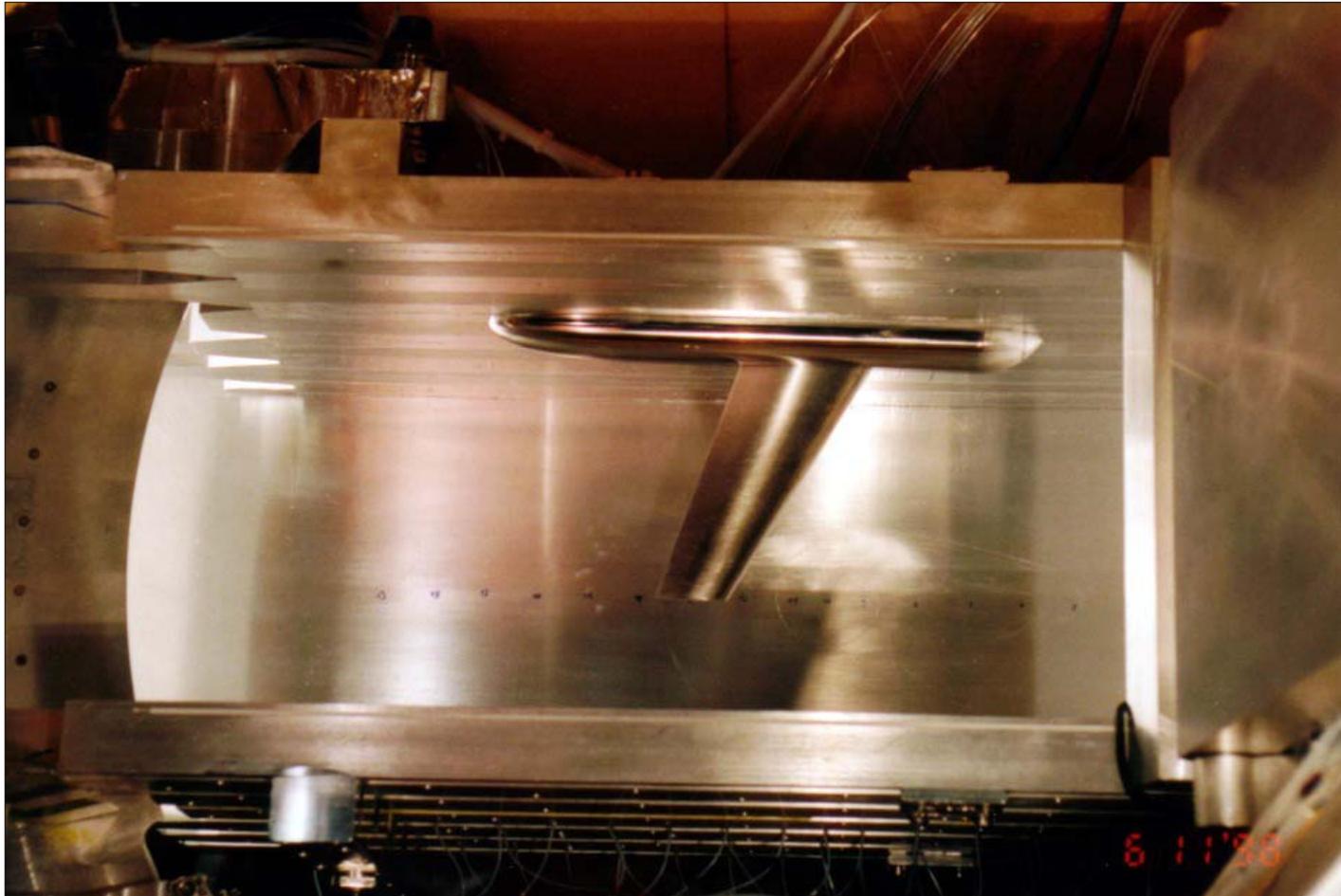
Configuration 3



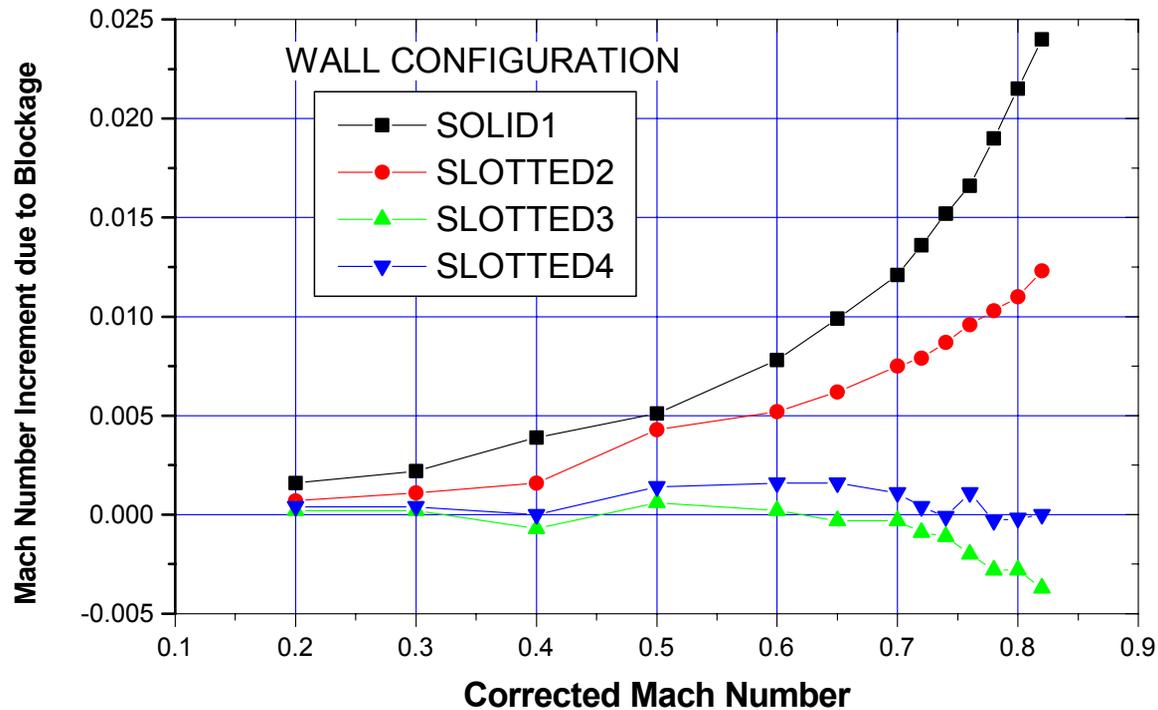
Configuration 4



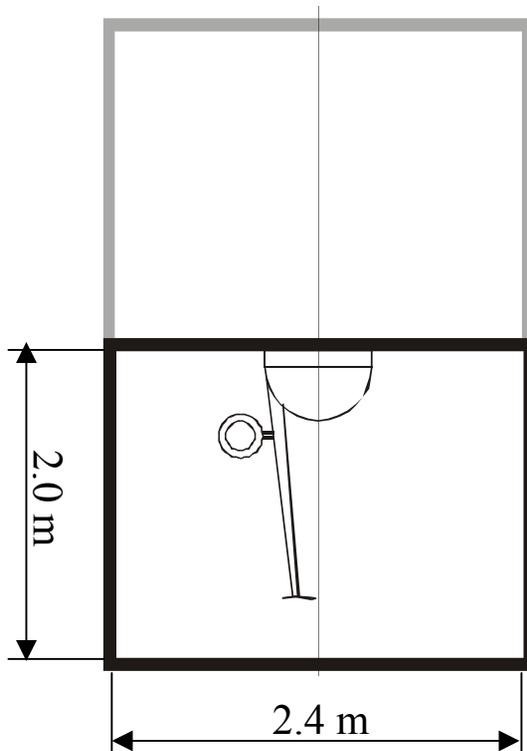
Half Model in PETW Test Section



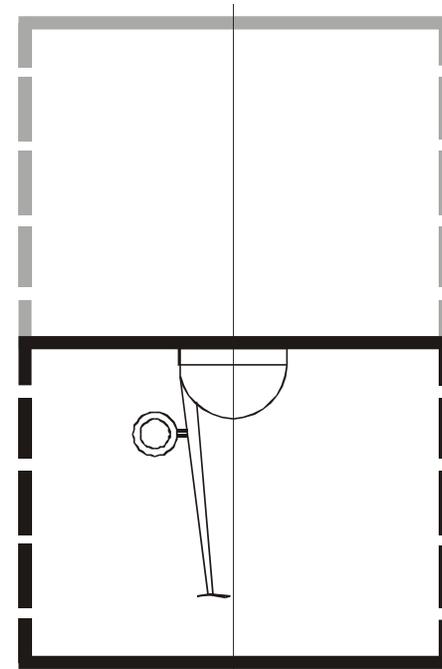
Effect of Wall Configuration



Test Section Configurations

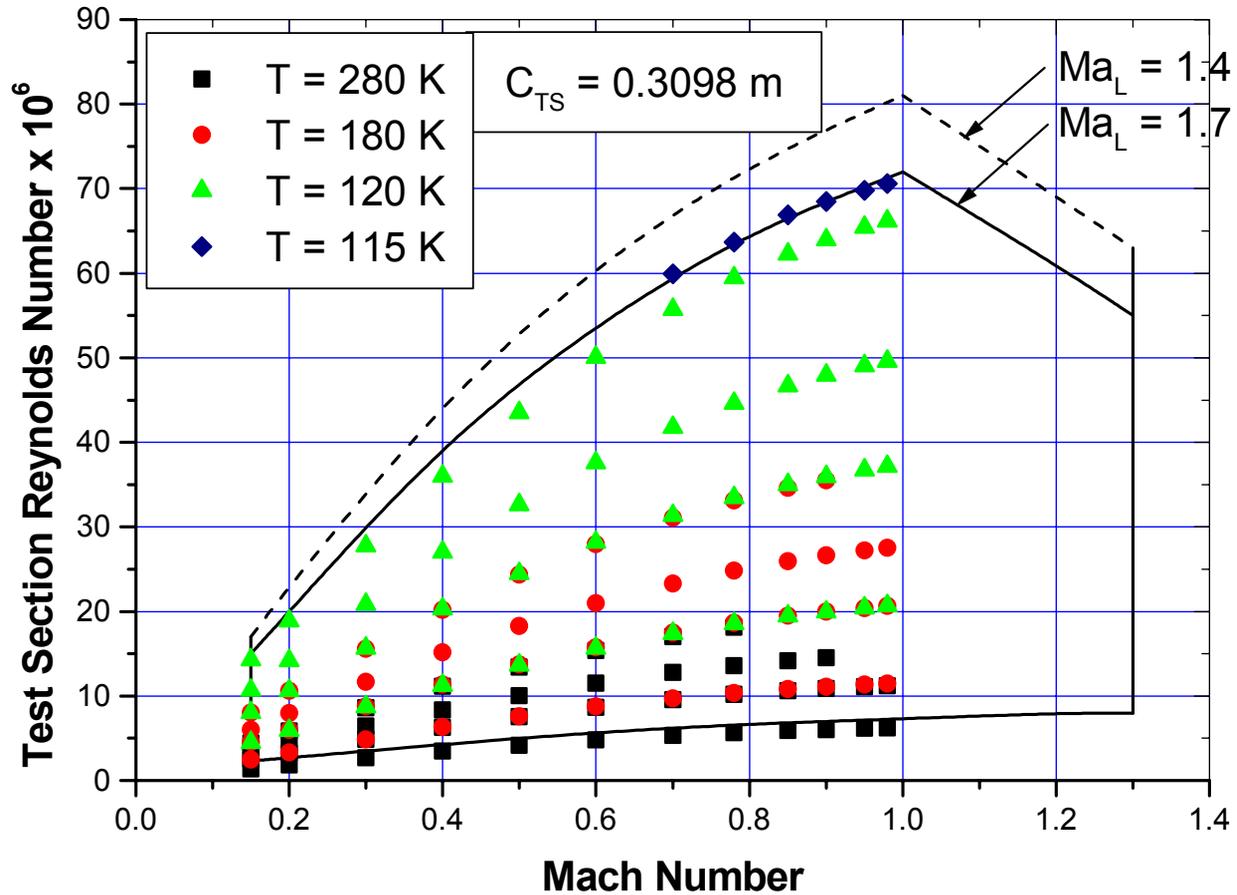


Solid Test Section



Slotted Test Section

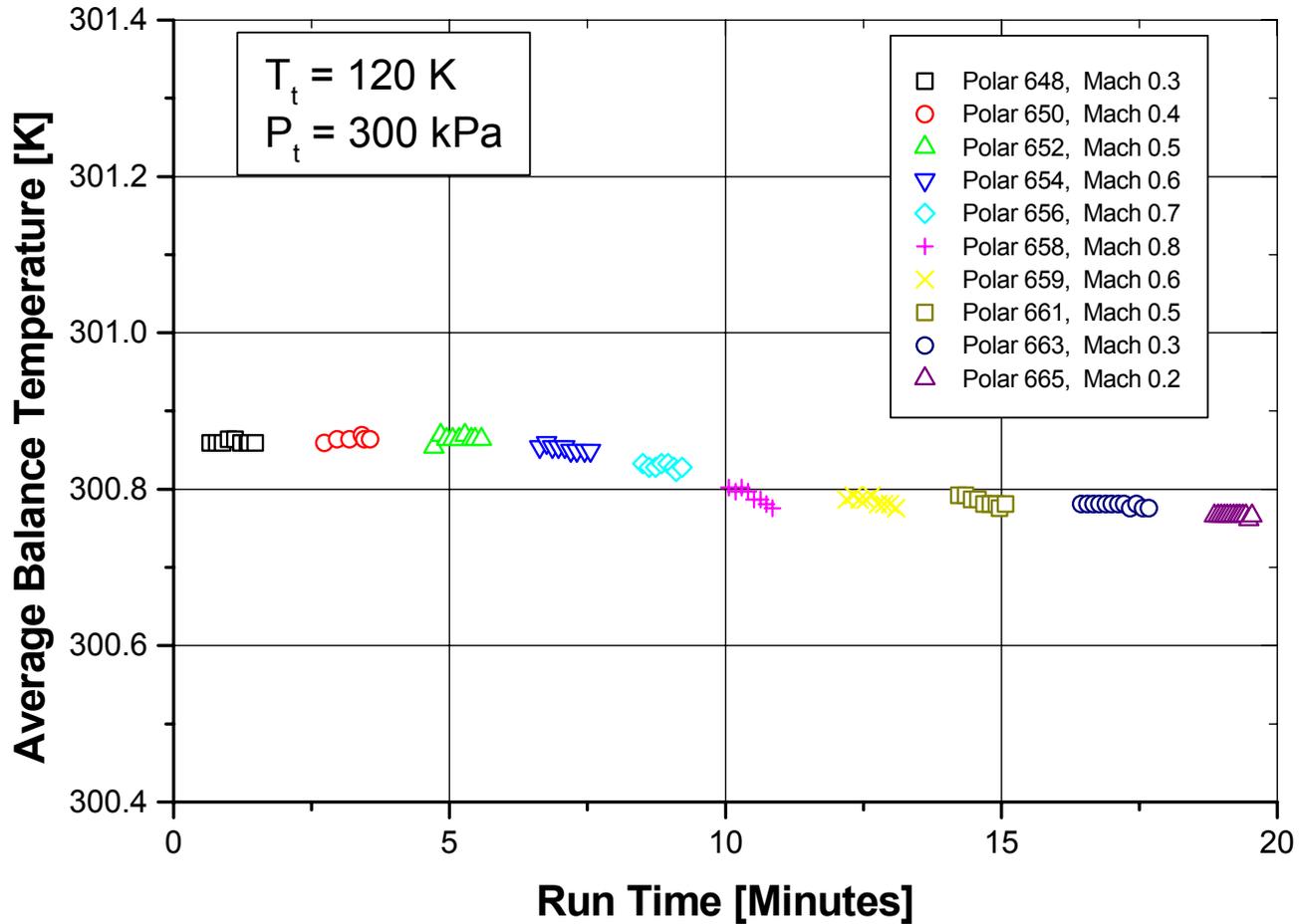
Test Section Calibration Conditions



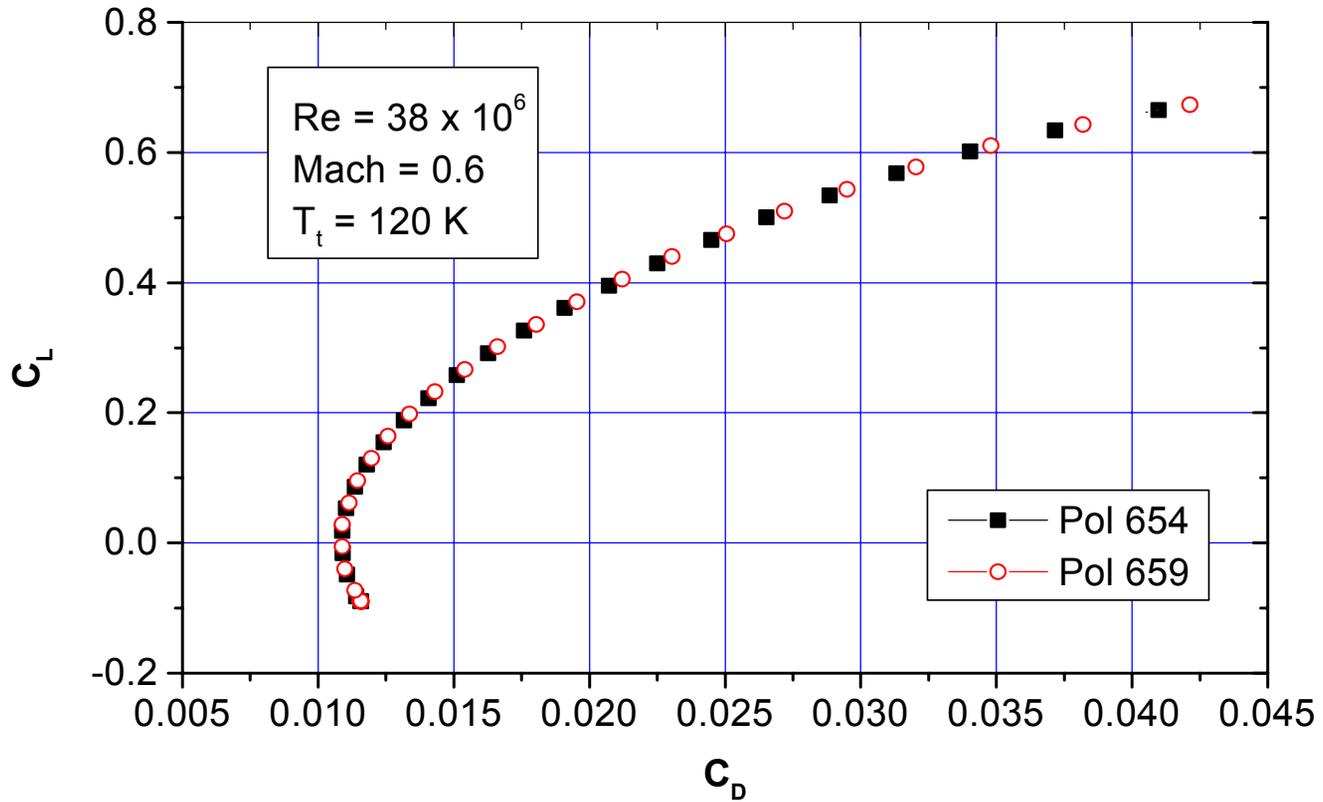
CHM in the ETW Test Section



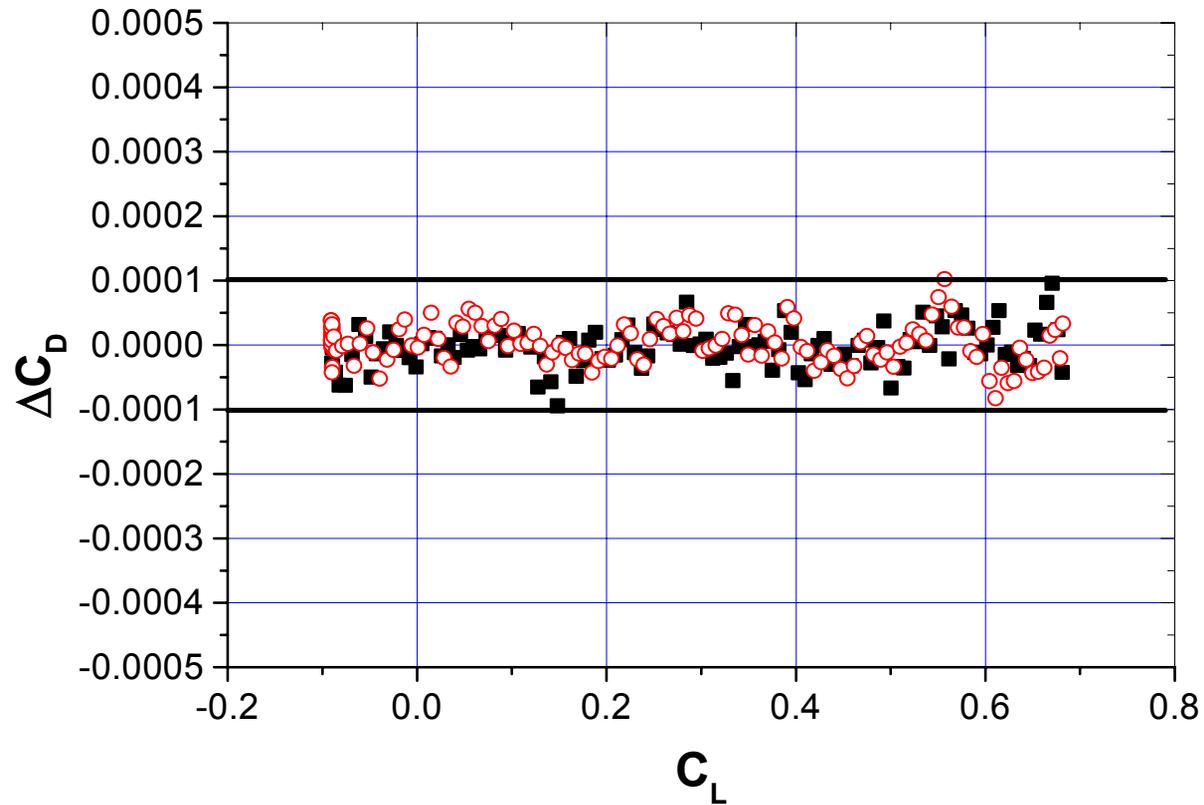
Balance Temperature Stability

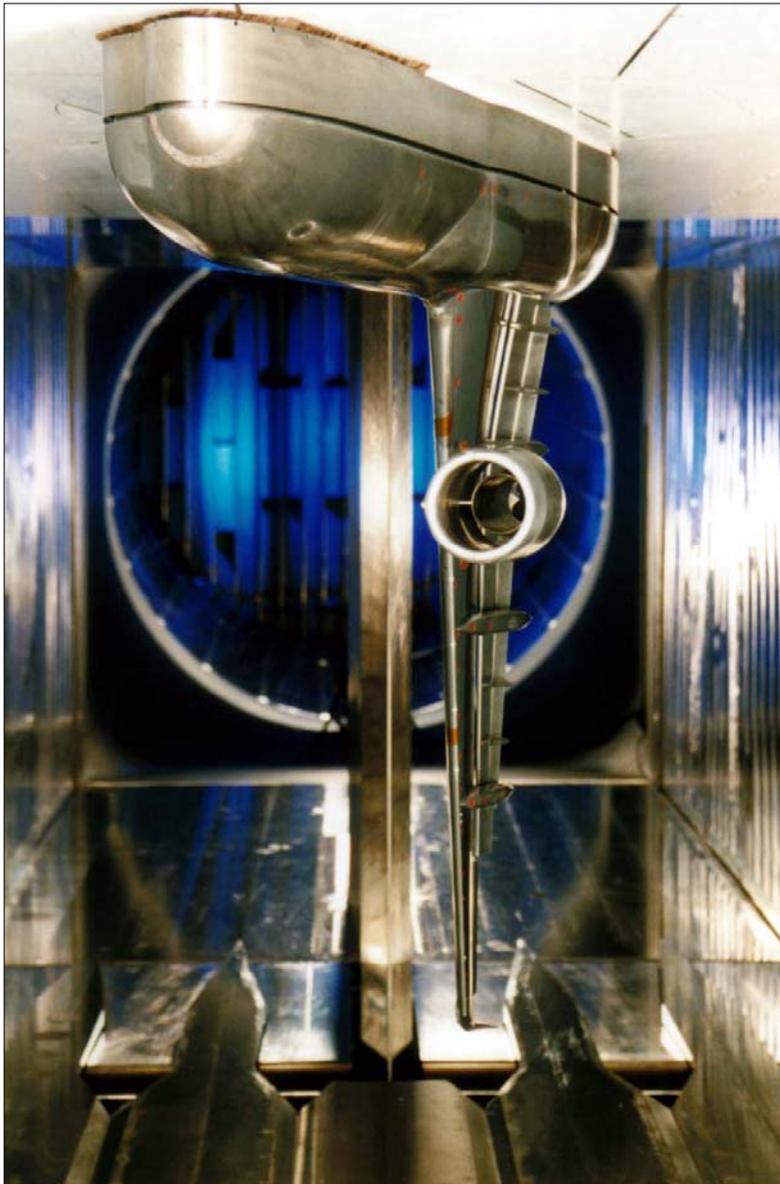


Short Term Repeatability I



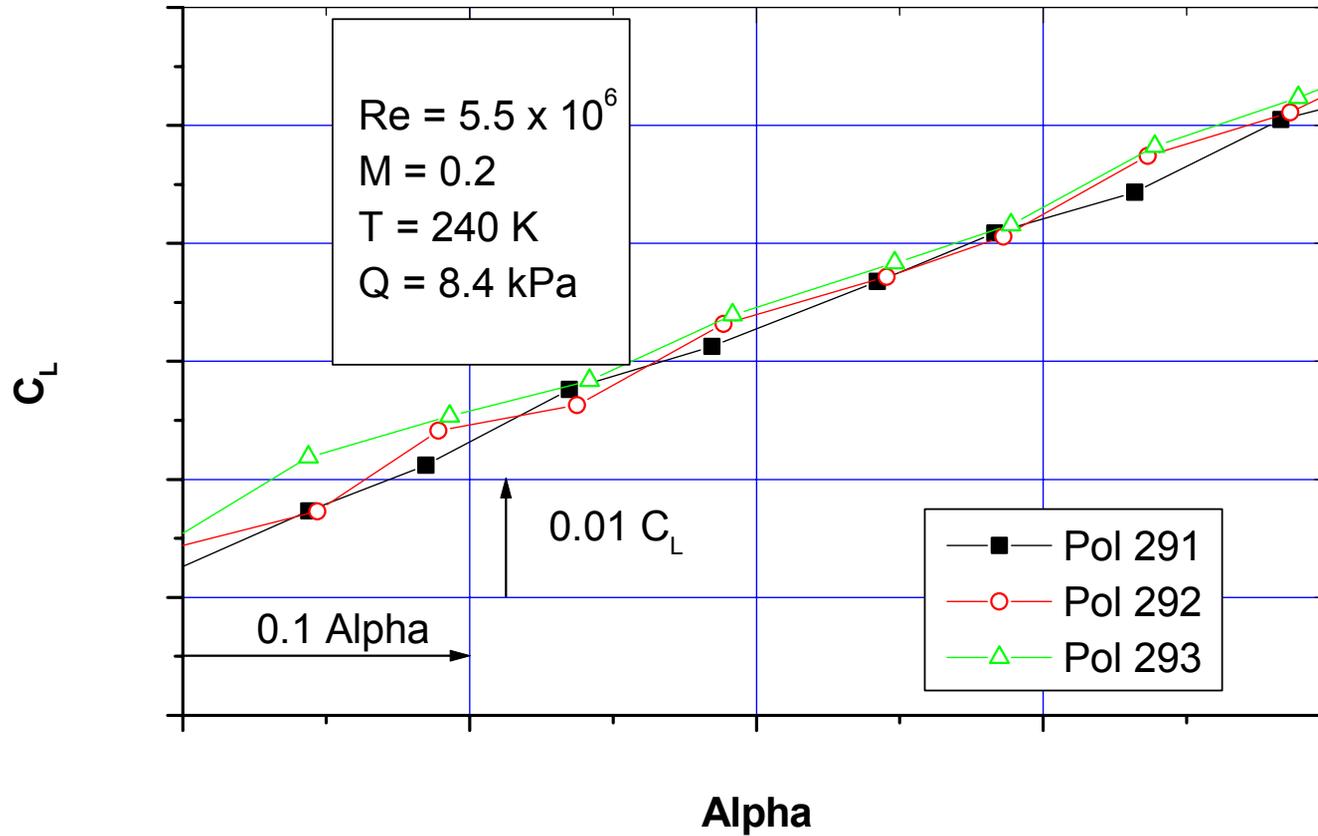
Short Term Repeatability II



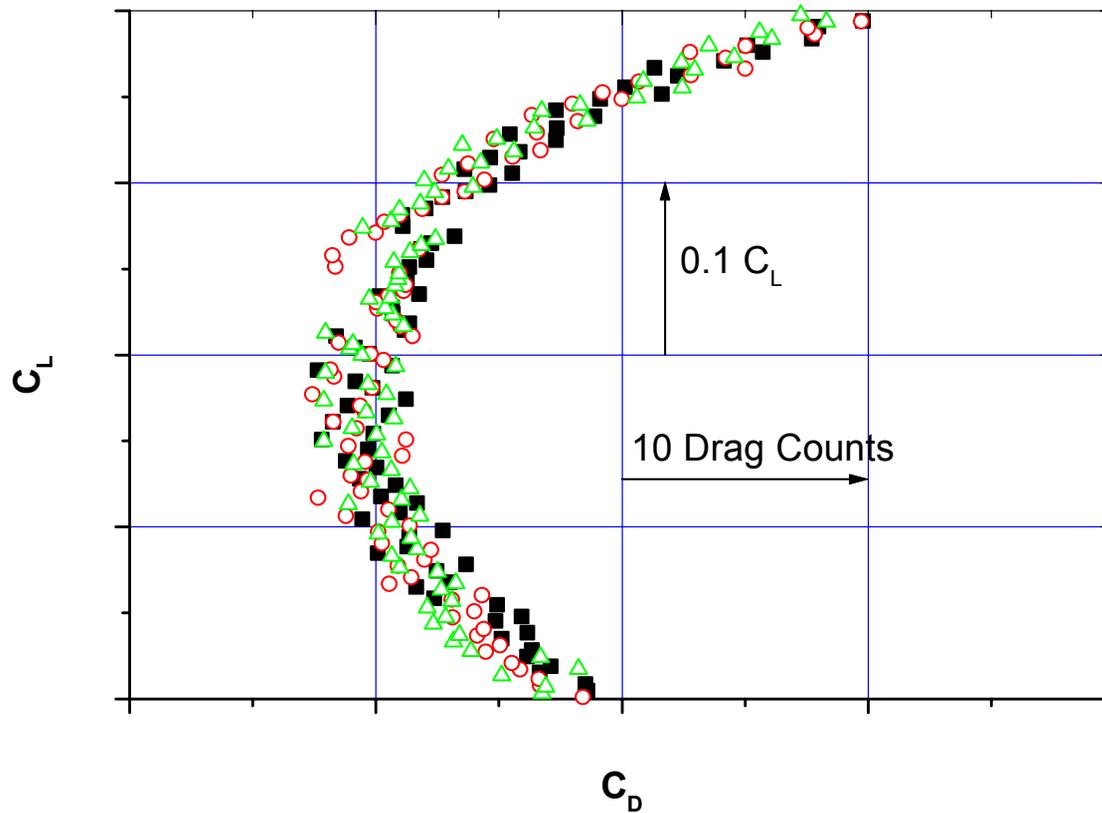


Validation Testing with the K3DY Half Model

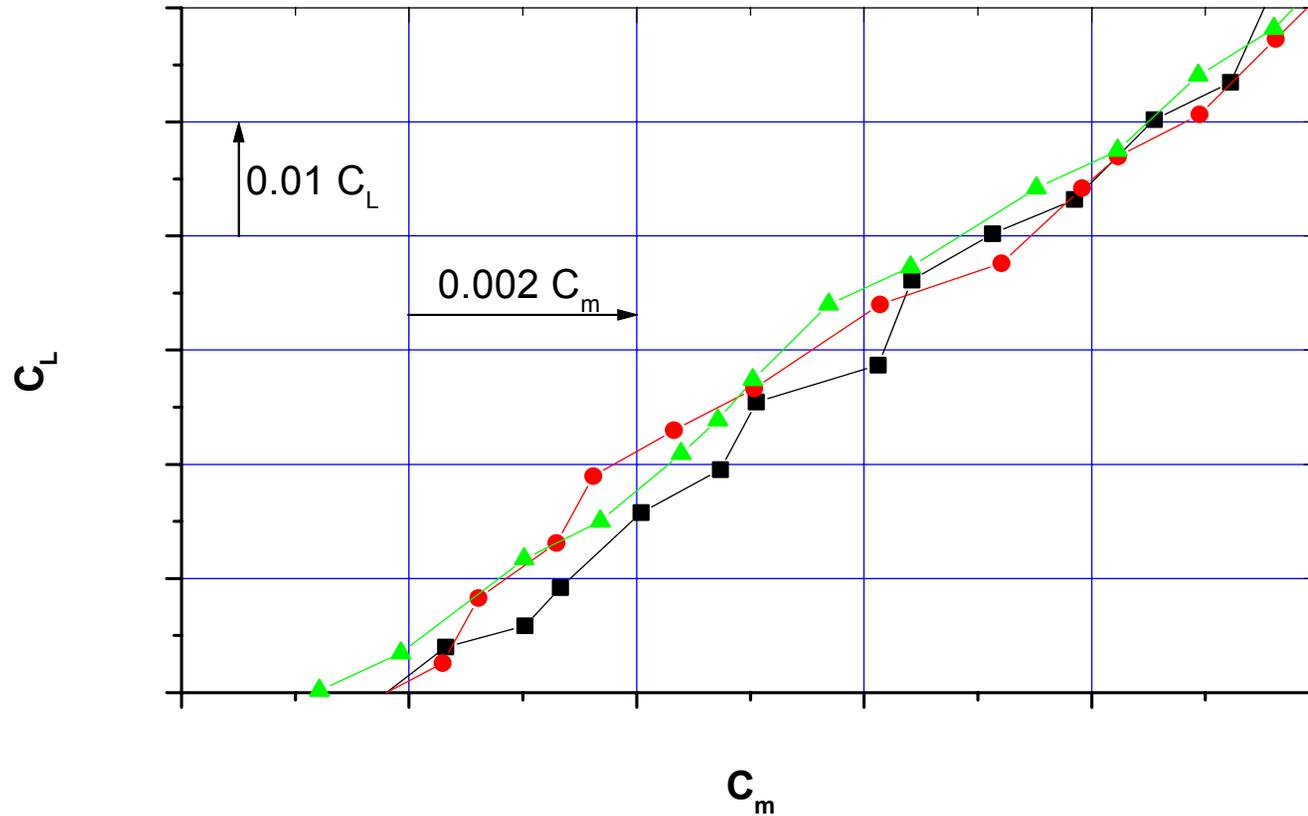
Low Speed Repeatability I



Low Speed Repeatability II



Low Speed Repeatability III



Test Section Systems

