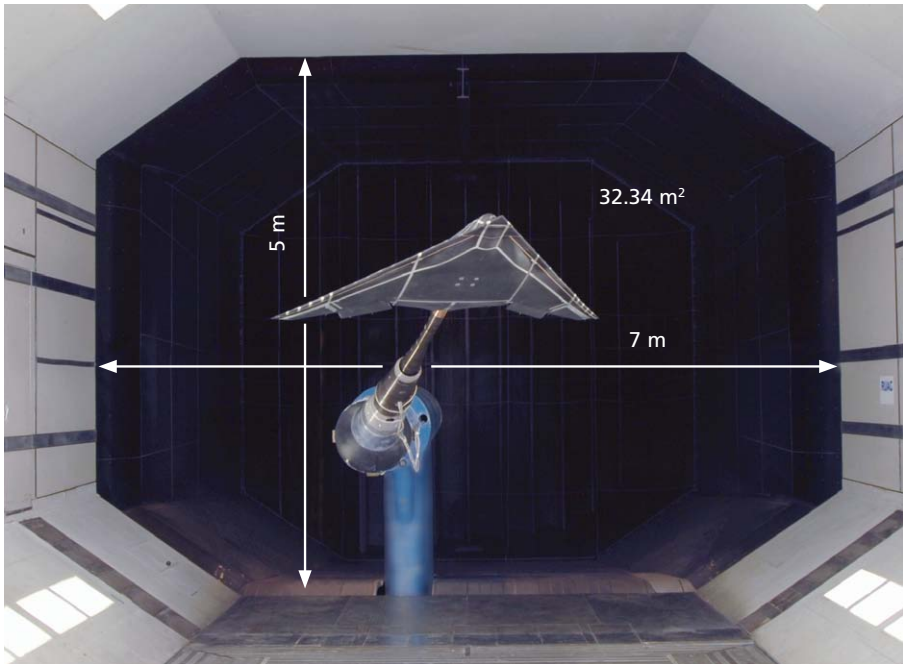
RUAG

Center Aerodynamics
Large Wind Tunnel Emmen

Characteristics of the Large Wind Tunnel

With its 7- by 5-meter test section, the Large Subsonic Wind Tunnel in Emmen (LWTE) is one of the largest in Europe. It is suited for a wide variety of tests including aircraft development, automotive research, rain tests, building and boat aerodynamics. Continuous improvement guarantees the fulfillment of ever increasing requirements on modern wind tunnel testing. The tunnel is of the atmospheric, closed single return type with a test section area of 32.34 m². The airflow is produced by two counter-rotating 8-bladed fans of 8.5 meter diameter which are located in the return part of the tunnel.

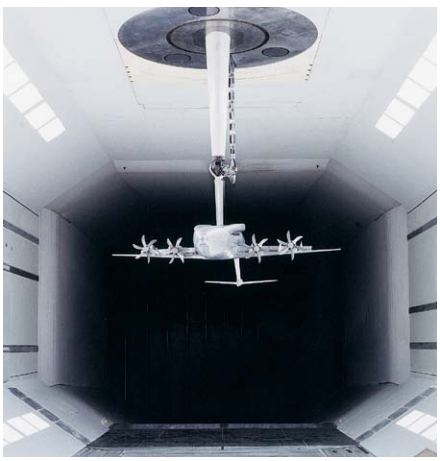


Maximum speed, meters per second	68
Reynolds number, per meter	0 to 4.5 x 10^6
Test section size (width x height), meter	7 x 5
Test section length, meter	15

Model Supports

In addition to the standard aircraft model support installations as shown below, more specific setups are available depending on customer requirements.

90° Rear-/Geared Sting	
Pitch range:	-18° to +90°
Pitch rate:	±0.05°/s to ±2°/s
Yaw range:	±30°
Yaw rate:	±0.05°/s to ±2°/s
Roll angle:	to be man. adjusted
Provision to simulate engine inlet flow	



Center Strut	
Pitch range:	45°
Pitch rate:	±0.05°/s to ±3°/s
Yaw range:	±180°
Yaw rate:	±0.1°/s to ±1.5°/s
Provision for pitch range increase from -10° to +90°	

Three Strut Support	
Pitch range:	-10° to +35°
Pitch rate:	±0.05°/s to ±3°/s
Yaw range:	±30°
Yaw rate:	±0.1°/s to ±1.5°/s

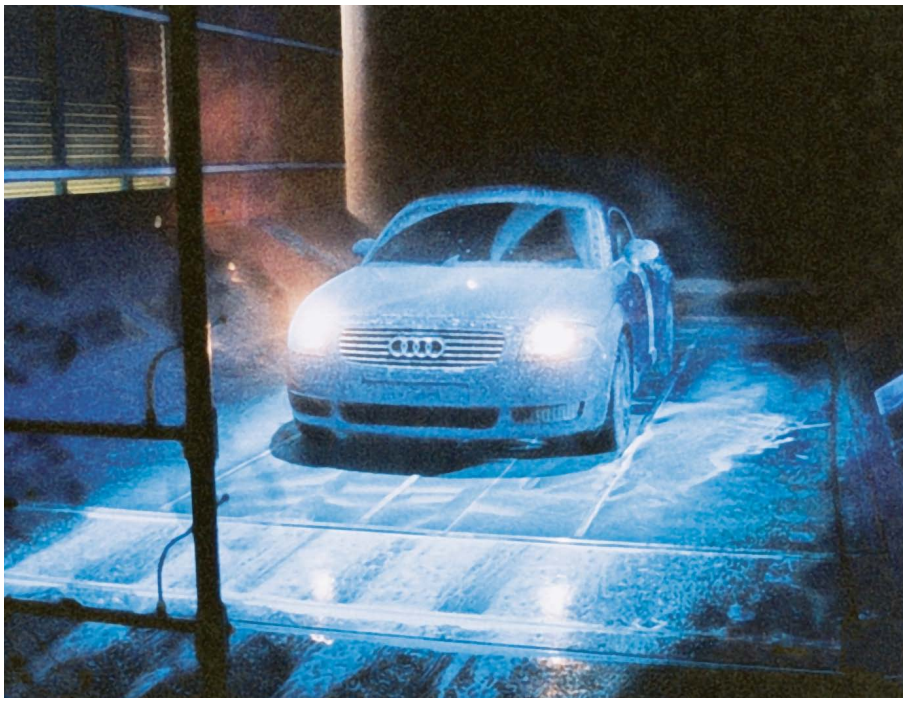
Engine Simulation

For the investigation of isolated propellers or multi-engined aircraft, compact high power hydraulic engines are used. An oil supply system capable of delivering 4 x 200 kW engine power is available for turbo prop modeling. The single or counter rotating engine configuration can be outfitted with rotating two or six component balances to accurately measure propeller forces. For jet engine inlet simulation an external air suction system is available.

Turn Table
Turning capacity through 360° (full scale cars ±15°)
External 6 component balance
Optional boundary layer floor
Support for half model installations
Support for full scale 6 component car testing

Rain Test

To improve the flow of splash-water over the car body in rainy conditions and to test the functionality of windshield wipers, water mixed with a fluorescent dye can be injected into the test section. The test object is illuminated with multiple UV lamps and the flow is documented with video or still cameras. Different types of rain conditions can be simulated.



Data Acquisition and Processing

For some years now, RUAG Aerospace has been relying on the accurate MGCplus technology of Hottinger Baldwin Messtechnik (HBM) for data acquisition in its wind tunnels. By choosing dedicated amplifier types and selective signal conditioning, the demands for accuracy and dynamic sampling rates can be met with a wide variety of suitable sensor types. For static measurements, the sampling rate is typically 100 Hz for each of the 144 channels and the integration time is in the order of a few seconds. If time-dependent resolution is required, the sampling rate can be increased up to 2'400 Hz.

An on-site calibration system, tracable to national standards, is used to comply with the periodic calibration requirements based on ISO 9001.

The processing and evaluation of the acquired data is performed on a Linux server. Specific test software on the company's own master computer controls the operation of the model support and the data acquisition. It performs motion commands, calculations and graphic routines (i.e. wind tunnel corrections, generation of dimensionless coefficients according to the customer requirements). The customers have access to the data in the control room or also by remote access from their own facility.

Special Test Techniques

A team of scientists is available to organize and conduct also more complex aerodynamic measurements such as ground effect investigations, wake flow measurements, pressure sensitive paint and PIV tests. Next to classical wind tunnel measurements with internal or external balances, flow visualization techniques at the facility include smoke, titanium dioxide oil flow and minitufts.

Test Confidentiality and Operating Hours

The test facility and the organizational structure fulfill the strictest security requirements. Working hours are adjusted to the customer's needs.

RUAG Aviation

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