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RUAG Aviation is a future oriented company focusing on the latest technology trends – to ensure being one «step ahead».

Modern infrastructure and equipment for aerodynamic research and industrial development activities form the basis for fulfilling the customers' needs in both the aerospace and automotive field. The mainstay of our services is centered on the operation of two continuously driven wind tunnels: the Large Subsonic Wind Tunnel Emmen (LWTE) and the Automotive Wind Tunnel Emmen (AWTE). Highest precision and efficient measuring process is our philosophy.

Through cooperation with universities, research institutes and industrial partners we aim to transfer findings of academic research to the aviation industry.

Thanks to the widespread competences in the fields of aerodynamics, development, instrumentation and system engineering, RUAG Aviation's services are well received by the aviation and automotive industry.
Aviation Development

Are you developing a new aircraft?
Are you looking to modifying or optimising an existing aircraft?
Are you interested in validating your CFD simulations?

RUAG Aviation’s wind tunnels in Emmen, Switzerland, are the ideal facilities for you to achieve your goals. Depending on your needs, RUAG will support you with model design, manufacture and instrumentation, wind tunnel testing, test strategy optimisation and data processing. RUAG’s engineers commit to an efficient project realisation, from concept and preliminary design to delivery of wind tunnel results.
Large Wind Tunnel Emmen (LWTE)

We adapt to your needs.

The 7 m by 5 m test section puts the RUAG LWTE amongst the largest wind tunnels in Europe. The maximum speed of this closed, single return, atmospheric tunnel is 68 m/s, or Mach 0.2. Jet, propeller and rotorcraft wind tunnels models, as well as a wide variety of other test setups are easily accommodated.

Continuous improvements and modern measurement equipment allow the facility to keep pace with the ever increasing customer requirements.

Direct optical access to the test section for flow visualisations, and real time viewing of the collected data in a selection of graphical and numerical tools, allows fast test programme decisions and a high productivity rate.

<table>
<thead>
<tr>
<th>LWTE Characteristics</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>maximum speed</td>
<td>68 m/s</td>
<td>132 kts</td>
</tr>
<tr>
<td>Mach</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>Reynolds Number</td>
<td>4.5E6/m</td>
<td>1.4E6/ft</td>
</tr>
<tr>
<td>width</td>
<td>7 m</td>
<td>23 ft</td>
</tr>
<tr>
<td>height</td>
<td>5 m</td>
<td>16.5 ft</td>
</tr>
<tr>
<td>length</td>
<td>15 m</td>
<td>49 ft</td>
</tr>
</tbody>
</table>
Model Supports

We excel at providing our customers with more.

In the LWTE, the primary structure for holding models is situated above the test section. The models, therefore, are usually mounted from the ceiling of the tunnel. The main configurations are the mono-strut and 3-strut supports. Alternatively, a rear sting set-up is also available (which may also be used as a traverse). All model supports are controlled by a common control system making handling and synchronized motion of manipulators very easy.

Mono-Strut
The mono-strut is the most commonly used support configuration in the LWTE for aerospace testing and is suitable for most airplane configurations in ventral and dorsal setup. It allows precise pitch and yaw motions of the model. The vertical position of the model is manually adjusted by inserts.

The support structure is non-metric. The model internal 6-component balance therefore directly measures the forces and moments on the aircraft. No error-prone aerodynamic tare measurements are necessary.

<table>
<thead>
<tr>
<th>Angle of attack range:</th>
<th>$-10^\circ &lt; \alpha &lt; 30^\circ$</th>
<th>Typical values; range can be shifted to suit customer needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sideslip range:</td>
<td>$-30^\circ &lt; \beta &lt; 30^\circ$</td>
<td></td>
</tr>
</tbody>
</table>

Mono-strut support in ventral (left) and dorsal (right) configuration
3-Strut
If the flow around the fuselage is of prime interest, the interference effects caused by the mono-strut going directly into the fuselage may not be acceptable. This would be one instance when the 3-strut support could be used. In this set-up the model is attached to an external balance above the test section: two struts attach to pivots on wings and the rear strut is used to control the pitch angle of the model. Depending on the model design, both a normal or inverted model installation (dorsal or ventral) are possible.

Angle of attack range: $-10^\circ<\alpha<30^\circ$
Typical values; range can be shifted to suit customer needs
Sideslip range: $-30^\circ<\beta<30^\circ$

3-strut support

Rear sting
The rear sting set-up is mostly used for fighter type jet aircraft and allows pitch, yaw and height control. The sting enters the model at the rear (often through the jet nozzle) and is attached to the model internal balance. Different sizes and geometries of stings are available. With the use of the geared sting, angles of attack of up to $110^\circ$ can be reached.

Geared rear sting  Rear manipulator with dorsal strut for ground effect testing
Powered Aircraft Test

Propulsion simulation, the key to identifying sources of aerodynamic interferences.

Aerodynamic interference between the aircraft's power plant and the airframe is of specific interest in many low-speed wind tunnel tests. RUAG offers a large selection of propulsion simulators for both propeller and turbofan powered aircraft.

RUAG’s hydraulic power technology enables the coverage of a wide range of power and size requirements using customised solutions.
Jet Aircraft

We validate the values for pressure recovery and intake distortion.

Reliable engine intake performance must be guaranteed throughout the entire flight envelope. RUAG supports test requirements for optimising pressure recovery characteristics and the detailed analysis of the intake flow distortion.

Suction capacities of up to 5 kg/s are available. Dedicated instrumentation includes rakes equipped with total pressure probes, both static and dynamic, flow angularity measurements and temperature probes to acquire flow characteristics inside the intake duct.
Propeller Aircraft

Excellent control and measurement for powered wind tunnel testing.

RUAG Aviation’s LWTE (Large Wind Tunnel Emmen) is used extensively for the development of propeller aircraft, from single engine, high performance trainers, to multi-engine transport aircraft. On your behalf, RUAG has successfully navigated the challenges posed by powered wind tunnel testing of conventional as well as counter-rotating open rotor (CROR) and multi-engine airplane configurations. For realistic simulations of propulsion systems in wind tunnel models, comparatively high power densities are required from the motors. The scaled nacelle geometry and the necessities of the instrumentation put additional requirements on power system installations.
RUAG relies on hydraulic motor technology for driving the propellers and fans on wind tunnel models. Robust engines provide abundant power, precise RPM control, thermal stability and, essentially, unlimited continuous operation. Further advantages feature reasonable investment in infrastructure and model hardware, low operating costs and high productivity.

Customers can rely on extensive expertise in the development and operation of customised hydraulic motors and their associated control and measurement systems for wind tunnel model applications.
Full-Scale Propeller Investigation

Determine propeller performance under realistic conditions within the comfort and controllability of a laboratory environment.

RUAG tests full-scale propellers, measuring up to 3 m in diameter. Our hydraulic motor technology is scalable and the hydraulic power plant can provide a total of approximately 1 MW in four separately controllable oil streams. A drop-shaped aerodynamic fairing encases the motor plus the RUAG 6-component balance, which measures all six aerodynamic load components on the propeller.

The assembly is attached to the upper strut and can be yawed to test sideslip conditions. Additional instrumentation is used to accurately control the rpm and monitor the dynamics of the system, thus ensuring safe operation throughout the test envelope.
Advanced Measurement Techniques

We closely collaborate with the specialists for new measurement technologies.

In addition to the conventional measurements, a number of advanced test techniques are available. RUAG’s focus centres on efficient implementation and test performance by the full utilisation of synergies and expert knowledge.

Research institutes and companies with proven expertise in their respective fields are the cornerstones of our collaborative technology network. RUAG LWTE customers can be confident that they are being provided with the latest and best advanced measurement techniques. Our subcontracted partners have detailed knowledge of our facility, understand our customers’ requirements, field the most modern equipment, provide honed crews and guarantee efficient test performance with high quality results at best possible cost.

Available advanced measurement techniques include particle image velocimetry (PIV), acoustic measurements, optical position and deformation measurements, IR-thermography for transition detection, and pressure/temperature sensitive paint measurements (PSP).
Particle Image Velocimetry (PIV)
Optical flow field measurement systems such as PIV are non-intrusive and offer high spatial and temporal resolution. RUAG can provide 2D and 3D PIV measurement solutions that allow for easy optical access to the region of interest. The high-resolution, in terms of both time and space, provides a wide range of possibilities for further data analyses and comparisons.

Aeroacoustics
The aeroacoustics field is continually gaining in importance. Knowledge of the location and magnitude of noise sources early within the development of a new aircraft is of key importance. RUAG’s aeroacoustics capabilities allow identification and quantification of noise sources during a standard wind tunnel test with minimum extra effort.

A phased microphone array with 144 microphones produces highly accurate noise source maps in minimal time. Extensive tests have been conducted on both powered and unpowered models and post processing analysis confirms that relevant acoustic data can be reliably gathered for both types of models.
The best performance is based on the best preparation.

The aerodynamic performance of both race and production cars is validated and improved through comprehensive testing in RUAG Aviation’s wind tunnels.

Using precise scale models for maximum data accuracy, the aerodynamic package is optimised through the evaluation of real-world forces and effects within a controlled environment.

The capabilities of both our Large Wind Tunnel Emmen (LWTE), for full-scale cars and scaled trucks, and our Automotive Wind Tunnel Emmen (AWTE), for racing and production car models, allow us to host a full range of vehicle shapes in all development stages.
RUAG is a groundbreaking, technology innovator with a pragmatic sense for efficiency.

The 2.45 by 1.55 m² Automotive Wind Tunnel Emmen (AWTE) and its infrastructure are especially suited for automotive testing and models up to 50% scale. The single return tunnel has a moving floor that measures 3.8 m in length by 1.8 m in width. The maximum speed of both the wind tunnel and the belt system is 60 m/sec. Standard features include a multi-axis model manipulator and real-time viewing of the collected data through a selection of numerical and graphical outputs. For the investigation of dynamic motion effects, a model shaker is available.

Forces and moments are measured by internal, high precision RUAG 6-component balances. Such RUAG developed balances are in use in the leading automotive wind tunnels around the world.
**AWTE Characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum speed</td>
<td>60 m/s</td>
<td>134 mph</td>
</tr>
<tr>
<td>Reynolds Number</td>
<td>4E6/m</td>
<td>1.2E6/ft</td>
</tr>
<tr>
<td>width</td>
<td>2.45 m</td>
<td>8 ft</td>
</tr>
<tr>
<td>height</td>
<td>1.55 m</td>
<td>5 ft</td>
</tr>
<tr>
<td>moving belt dimensions (length × width)</td>
<td>3.8 m × 1.8 m</td>
<td>49 ft</td>
</tr>
</tbody>
</table>

**Flow Quality**

The increasingly demanding requirements of modern car development call for an excellent flow quality to guarantee representative results. Special attention must be given to the spatial uniformity in velocity and pressure throughout the test section and especially close to the belt.

![Velocity plot as a function of height above the belt](https://via.placeholder.com/150)
Full-Scale Soiling/Rain Test

Improving driving safety - at RUAG it starts with making rain visible.

The Large Wind Tunnel Emmen (LWTE) accepts full-scale cars in its test section for performing water management tests. Water mixed with a fluorescent dye is injected upstream of the car. Rain intensity and droplet size is adjustable according to customer requirements. The test object is illuminated with multiple UV lamps and the distribution and flow of the water droplets are documented on UHD video or still camera pictures. The effectiveness and functionality of windshield and headlamp wipers are analysed, and soiling of the side windows, and within the rearview mirror’s line of sight, is documented.
Race Car Development

An excellent aerodynamic package will keep your race on track.

The RUAG team at the Automotive Wind Tunnel (AWTE) serves various race series including Le Mans LMP, Formula 3, WTCC, Formula Student and others. As recognised experts in our field, we support competitors in the racing world in their development of the aerodynamic package. Your timing is fast and ours is efficient while providing the most accurate results both reliably and promptly.

RUAG's aerodynamics department enjoys a solid reputation within the racing community for our ability to achieve high correlation with track data in the shortest possible time. Various states of model complexity can be handled, such as coordinated main body motions and wheel arms axes, wheel steering motions, air pressure system for exhaust simulation, engine cooler modelling and a model shaker for fully individualised dynamic motion testing.
Production Car Development

Rely on RUAG to help you achieve your fleet production goals.

The RUAG Automotive Wind Tunnel Emmen (AWTE) and its infrastructure are especially suited for automotive testing with models up to 50% scale. Explore and develop various concept configurations to extract the required performance, validate your CFD, achieve excellent and reliable handling characteristics and evaluate real-world forces and effects.

Modeling tools, clay, polystyrene foam and scanning devices are available for model design work.
Truck Testing

We can adjust to your sizing specifications.

A 7 m by 5 m test section makes the RUAG LWTE one of the largest in Europe for a wide range of body geometries.

Half scale truck and trailer models are ideally sized regarding tunnel blockage and side-wind test requirements for the LWTE. Multi axel vehicles including trailers are installed on the external underfloor balance using multiple wheel pads as contact points. An automated turntable enables the investigation of side force effects. Model blockage effects are taken into account and measurement values are directly corrected by acquiring the surrounding pressure signature at the test section walls.
Dynamic Test Techniques

Accurately simulating the real-world conditions in the RUAG AWTE.

Transient aerodynamic effects influence vehicle performance and handling. RUAG’s advanced dynamic motion testing techniques, developed in the Automotive Wind Tunnel Emmen (AWTE), allows the testing and measurement of forces under real-world, unsteady conditions.

Optimum driving performance requires keeping the distribution of force on the front and rear wheels, remaining within specified limits at all times. RUAG’s dynamic model motion generator allows our customers to simultaneously measure drag, front and rear axle lift, side force, and rolling and yawing moment by means of a 6-component balance, while the model moves dynamically through defined motions.
The freely programmable model shaker, together with the associated data processing procedure, allows the studying of time resolved pressure readings and inertia-free aerodynamic loads on the moving body. This information offers new and otherwise not easily quantifiable insights into aerodynamic performance and drivability issues for race as well as production cars.

Comparison of static and dynamic data for a simplified closed wheel race car as a function of ride heights
Reliable measurement through innovative design, meticulous implementation, careful calibration, and professional operation.

RUAG Aviation’s instrumentation specialists are actively engaged in serving you promptly and efficiently. This means that all our experience, engineering skills and workmanship flow timely into your measurement needs.

Focusing on your requirements and using our experience in the diverse fields of testing and measuring, we strive to achieve overall project results within a minimum timeframe, while our customers can be confident they are receiving the latest technologies and the best support.

RUAG’s reputation for innovation and testing efficiency is well known. On behalf of our customers, we have developed highly accurate, dynamic measurement technologies and techniques, and we are recognised as the market leader for wind tunnel balances with our proprietary 6-component balances.

Well established know-how in measurement technology and control systems from wind tunnel testing is the basis for customized test bench solutions.

Sensors
State-of-the-art instrumentation ensures precision and reliability:
– Design, manufacture, calibration and verification of multi-component load cells (force/moment sensors),
– selection and application of sensors, e.g. strain gauges, temperature and pressure sensors, and
– complete assembly of instrumentation in-house and on-site is what we can offer to enhance your product platform.
Aerodynamics | Measurements and Instrumentation

6-Component Block-type Balances

Balances, the ultimate Wind Tunnel Sensor you have to rely on

RUAG’s balance portfolio consists of two families. Each family has a number of differently sized sensors which cover a wider range of force and moment loads. In addition, all balances are equipped with temperature sensors on both the metric and non-metric parts to allow for correcting temperature effects.

Series 7xx is designed and optimised for stiffness and is used in high and dynamic load applications. Extensive theoretical, computational and experimental development led to novel design features which assist with

– considerably high accuracy level
– coping with the high cycle loads in a dynamic test environment
– small interferences between load components
– keeping local and overall deformations to an absolute minimum
– high safety factor by limiting local stress concentrations in critical areas
A purposely built, calibration laboratory, equipped with calibration rig and highly accurate instrumentation, calibrates each balance before it is delivered and used in your facilities.

**Customized Wind Tunnel Balances**

Due to their compact design, balances are mostly installed within the model. Model internal mounting allows a more precise determination of the moments since the balance reference point is close to the model reference point. The balances are also equally applicable for model external installation.

In addition to the above-mentioned family, RUAG provides customised solutions such as multicomponent rotating shaft balances (including data transmission), wing and wheel balances for car models, and local balances for aircraft models.

**Refurbishments**

RUAG’s balance experts will also refurbish, repair and recalibrate damaged older balances, either of its own design or from third party providers.

**Rentals**

All of RUAG’s balances are also available for rental – a possible option for short projects within a tight timescale.
Special Strain Gauge Balances

Determine forces and moments with RUAG’s trusted, precision instrumentation.

Our experience and pursuit of state-of-the-art technology in wind tunnel testing uniquely qualifies us to engineer, design and build strain gauge balances. These balances are the basis of accurate data in various wind tunnels worldwide, as well as for the RUAG in-house research labs and wind tunnels.

Next to the standard block type 6-component balances, RUAG Aviation designs balances for high and low load cases under static and dynamic conditions. Beside the well-known, 6-component balances, wheel load and component balances, e.g. to derive hinge moments of flaps, are also within our repertoire. The design, fabrication, instrumentation and calibration are done in-house. This allows us to respond quickly to special customer requirements.
6-component propeller and rotor balances
RUAG has considerable experience in designing and manufacturing strain
gauge based Rotating Shaft Balances (RSB). Depending on customer
requirements and available space, either a 6- or a 2- (thrust and torque)
component balance can be chosen.

Local balances
For a number of measurement requirements, standard balances cannot be
used. RUAG designs and provides customised solutions for these applications,
which optimally fulfil the measurement task. Hinge moment balances for
control surfaces, flaps and air brakes, or sensors for load measurements on
external stores, and landing gear doors are just a few examples.
RUAG’s experience in test benches and measurement systems helps you to concentrate on your own product or service.

Our services
We provide solutions covering all aspects of testing procedures: design, implementation, commissioning, operation and maintenance of test benches and control systems.

Measurement techniques and control systems
Tailored to your requirements, our range of measurement solutions and control systems are engineered to deliver maximum performance in your specific application.

– Systems and sensors:
  ▪ Concept definition
  ▪ Reverse Engineering
  ▪ Analysis
  ▪ Calibration
– LabVIEW software for real-time monitoring and automation
– Determination of measurement uncertainties
Benefits
- Highly experienced team, ready on call
- On-time delivery
- Cost-efficiency
- State-of-the-art equipment
- Extensive resources from a single source

Advantages
Our wide range of resources form a one-stop shop solution, reducing testing time and improving on-time delivery.

Our resources include:
- Data Acquisition (HW/SW)
- Motion Control (HW/SW)
- Electronics/electrics/mechanics/hydraulics/pneumatics
- LabVIEW: Certified Developer/Certified Associate Developer
- Certification according to ISO9001-2000 regulation
- Proven standard processes

Realised projects
- Wind tunnel model manipulators and control systems integrating various actuator types
- Test benches for linear actuators and landing gear shock absorbers
- Test bench with shaker for inclinometers
- Test bench for controlling pressure containers and pressure sensors
- Calibration of unit motors for optical positioning systems (using stepper motor control)
- LabVIEW migration and consultancy
Models & Hydraulics

We are your partner of choice for model manufacture and hydraulics.

RUAG Aviation’s aerodynamics department is synonymous for wind tunnel research, innovation, performance and testing.

RUAG’s experience, proven capabilities and reputation for reliability make us the partner of choice for everything in and around wind tunnels.
Wind Tunnel Models

Your visions plus our expertise build the best possible models.

RUAG Aviation’s aerodynamics department is your partner of choice for the development and manufacture of wind tunnel models. Firmly supported by our decades’ worth of proven experience in wind tunnel testing, we know how to create a wind tunnel model which will best serve your needs. Our own design office, equipped with CATIA CAD workstations, guarantees a high level of flexibility and enables us to respond quickly to customer specific requirements. RUAG’s model building capabilities are in demand and we have accumulated an impressive list of credentials.

Exclusive experience in the LWTE allows us to engineer wind tunnel model concepts which succeed in achieving a high level of testing efficiency. The focus is on accurate and repeatable configuration changes which will save the customer a significant amount of wind tunnel occupancy time, and thus expense. In a powered model, the integration of hydraulic piping, a main balance crossing system, engines, propeller and propeller balances, and engine related sensors creates additional challenges. RUAG experts will build your wind tunnel model – with or without engine simulation for subsonic or transonic investigations.
Hydraulic Engines

Hydraulic power systems for wind tunnel models – our speciality.

Hydraulics is used for actuators and to simulate the propulsion for powered wind tunnel models. In this context, a number of technologies were developed such as subtly controllable hydraulic power supplies, balance crossings, and compact high-power, high-rpm hydraulic motors. Hydraulics is a clean technology with a number of advantages over electric or pneumatic alternatives:
- Intrinsic heat removal, thus unlimited run times
- High power density
- No low temperatures due to gas expansion
- Inexpensive technology

Although developed for use in wind tunnels, these motors and associated systems are suitable for a wide range of other applications, where high power densities, high rpm and accurate control are required.
- restricted volume (high power density)
- high rpm levels
- high torque levels
- coaxial drive system
- forces and moments to be measured
Hydraulic Motors
The motors are based on in-house gear motor technology, readily scalable to the required power levels and dimensions. They are unique, compared to competitive designs, with respect to power density (rpm and torque) and available options: hollow shaft, specific inlet/outlet topologies (lateral or coaxial), instrumentation, locking mechanism, selectable direction of rotation, to name a few. The designs allow the simple set-up of counter-rotating configurations, by two back-to-back mounted hydraulic motors.

RUAG Aviation combines these motors with in-house developed, rotating 6-component balances, telemetry and instrumented carbon model propellers to form a full, power simulation package for wind tunnel models.

The current portfolio is constantly growing, driven by specific model requirements.
Hydraulic Balance Crossings

We have critical balance crossing systems under our control.

Operating an hydraulic motor on the metric side of the high precision balance (with the hydraulic power supply on the non-metric side) requires the routing of high pressure oil, at large flow rates, over the sensitive balance, in what is usually a very constrained space inside the model. Interference effects from the crossing system on the balance must be kept minimal and/or correctable. The influence of heat flux is reduced by thermal management of both balance and oil temperature levels. Residual influences of pressure, flow rate and temperature are corrected in the data reduction process.
We place safety first with our innovations on the power supply control system.

The RUAG Aviation wind tunnel facility is equipped with four, 420 bar/360 litres per minute hydraulic pumps. The control system for the 1 MW unit is an in-house developed LabVIEW application which enables an accuracy control of better than +/-10 rpm on the motors installed in the model. The rpm command values can be coupled with wind tunnel speed to prevent overloading of the propeller blades. Safety features, such as rpm and pressure plausibility checks, protect personnel and equipment. Oil temperatures are finely controlled by a massive heat exchanger and heaters to minimise thermal interference effects on instrumentation. A network of pressure, return, and tank lines allow the flexible and safe distribution of high pressure oil to the wind tunnels and test benches.

A similar hydraulic power supply has been delivered by RUAG Aviation for use in a high speed wind tunnel.
We control the art of simulating realistic conditions and measurements so there are no surprises.

Reduced initial expenditure makes Computational Fluid Dynamics (CFD) ideal for preliminary configuration studies. In conjunction with experimental data validation, CFD also enables detailed flow analysis which may not be entirely addressed by wind tunnel testing.

RUAG Aviation’s aerodynamics team uses synergies between numerical and experimental methods, reducing your development time and validating the engineering results. In collaboration with RUAG’s subsidiary CFS Engineering, a wide range of applications are covered using numerical simulations, from very low speeds (HVAC) up to hypersonics (space re-entry vehicles), steady state calculations and time-resolved simulations, including dynamic fluid structure interaction (FSI).

**Software**

There is no single silver bullet in numerical flow simulation. To generate accurate results across the different aerodynamic regimes, different solvers have to be utilised, each having its own strengths and weaknesses. This leads to a mix of structured and unstructured solvers, based on Navier-Stokes as well as Lattice Boltzmann approaches:

- NSMB (in-house code developed by CFSE, RANS, structured)
- OpenFOAM (open source, RANS, unstructured)
- SU2 (open source, RANS, unstructured)
- XFlow (commercial, LBM)
Join RUAG in our virtual wind tunnels and beyond for the investigation of your aircraft’s lift configurations.

Typical low-speed CFD applications can include trains, turbofan simulators, propeller aircraft, helicopters and all sorts of aircraft in high-lift configuration (take-off/landing). High-lift configurations with dynamic and unsteady flow characteristics are often minutely simulated and additionally measured in the RUAG wind tunnels allowing direct comparison and validation of CFD to experimental results.
Internal Flow Simulation

RUAG’s simulation experience can make the difference to your competitor.

Computational Fluid Dynamics can be used to predict the flow characteristics of gases and fluids within almost any bounded volume across a diverse range of industrial fields.

A considerable part of RUAG’s internal flow simulation focusses on the optimisation of piped and ducted flow characteristics, such as for the layout and improvement of wind tunnel airline layouts or ducted, respectively ultra-high bypass, turbofan engines.
High-Speed Flow Simulation

RUAG goes beyond the sound barrier.

Transonic, supersonic and hypersonic speeds are covered with our optimised, high speed CFD methods. RUAG’s aerodynamics team is ready for all applications ranging from business jets and fighter aircraft, over orbital launchers and its separating payload fairings, small arms projectiles, up to space re-entry vehicles on foreign planets atmospheres.
HVAC – Heat, Ventilation and Air-Conditioning

Identifying comfort zones is our business.

Passenger comfort plays an important role in today’s aircraft design. OEMs and operators alike are challenged to optimise their performance in this respect. The ambient mix of heating, ventilation and air-conditioning is fast becoming a critical aspect of passenger well-being.

RUAG Aviation’s aerodynamics team implements CFD models to calibrate and optimise air flow patterns and velocities for the design of cabin interiors. These are complex simulations where all possible variables are analysed, singularly and in conjunction with each other: natural airflow convection, forced airflow convection, solar radiation, interior furnishings, passenger body temperatures and external temperatures, both on the ground and in the air.
Aerodynamic News

RUAG is your resource for trending developments in the aerodynamics field. We invite you to tap into our knowledge base and the latest innovations...

www.aerodynamics.ch

Keep up with RUAG Aviation’s aerodynamics team and our partners as we pursue the latest in measurement techniques, work on interesting projects and come up with impressive and innovative solutions.

Our “Aerodynamic News” showcases these achievements with in-depth articles, detailed technical graphics and video links. The most recent issues are available on our website.

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– Full-scale propeller investigations – From powered wind tunnel models to full-scale propellers
– ETH Zurich wins Formula Student competition – The success of the RUAG supported AMZ team