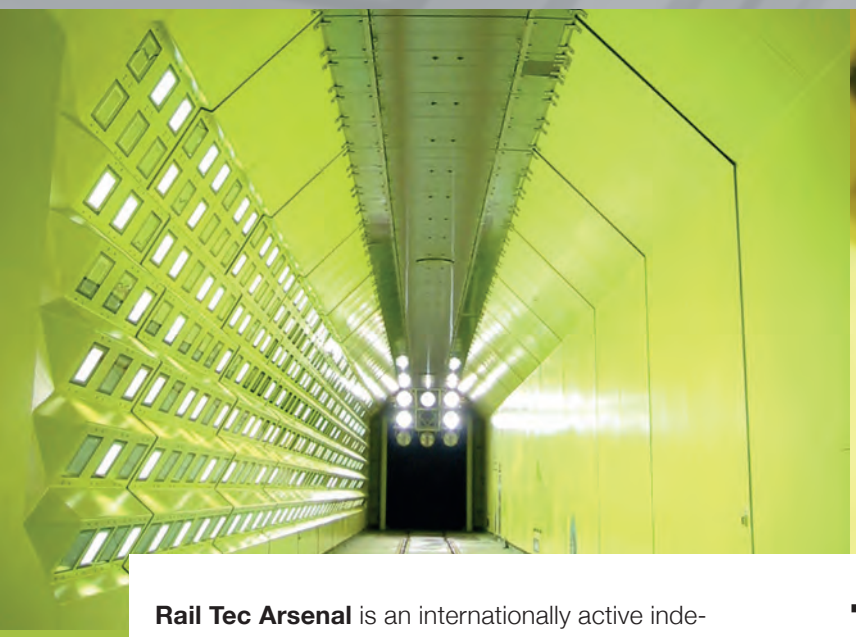
Wind Tunnel

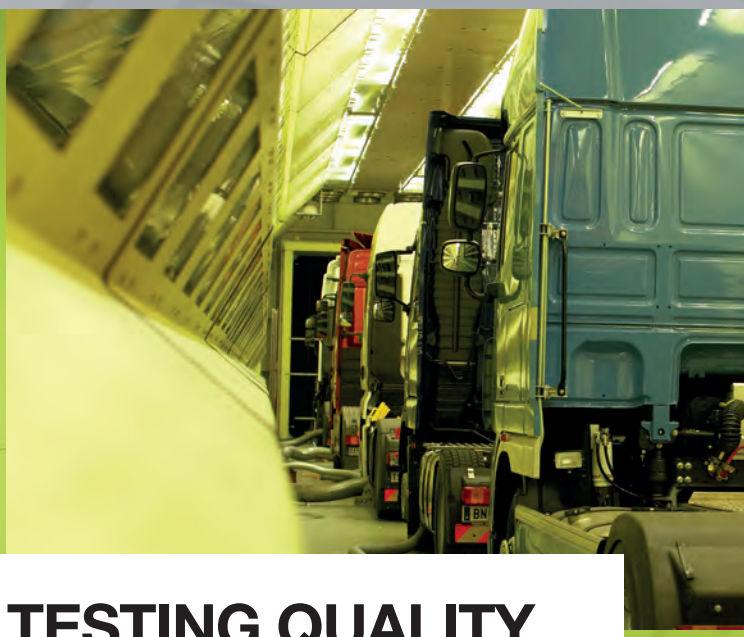
Climatic Wind Tunnel **Vienna**

Quality in any weather

RAIL TEC ARSENAL

Rail Tec Arsenal
MORE THAN JUST A TEST CHAMBER





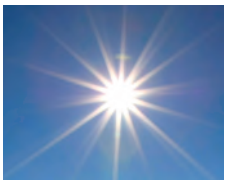
Rail Tec Arsenal is an internationally active independent **research and testing institute** for rail and road vehicles, aircraft and technical systems that are exposed to extreme climatic conditions. RTA operates two modern climatic wind tunnels designed to optimise **thermal comfort** as well as **energy efficiency** in public transport vehicles and to investigate and improve the **availability** and **safety** of systems in industrially sensitive areas.

The Vienna Climatic Wind Tunnel operated by RTA offers the opportunity to analyse the impact of a variety of weather conditions on vehicles and components under realistic operating conditions. **Any kind of weather** can be reproduced at the push of a button – from **extreme solar radiation** to **snow**, **rain**, **fog** and **ice**. In combination with wind, load and drive cycle simulation, it is possible to create extremely **realistic test scenarios.** Performing repeated tests under **reproducible** conditions allows different improvements to be analysed and compared, which in turn simplifies the development process.

Even though the facility has been specially designed for climatic tests on **rail vehicles**, it also offers optimal testing conditions for **road vehicles**, particularly buses and trucks. The tests outlined below are essential to creating a quality assurance process which ensures that vehicles on the road are safe, comfortable, and reliable. **Highly qualified RTA staff** also offer consulting services for the development of individual testing scenarios. Technical challenges arising during test performance are solved in close cooperation with the customer.

TESTING QUALITY
FOR ROAD VEHICLES

Life is motion, and motion is **mobility**. As cars are suitable for both passenger and goods transport, they are, and will remain, essential to meeting the constantly increasing demand for mobility. However, vehicles are also required to meet increasingly stringent accuracy, **convenience, safety, comfort** and **reliability** criteria, while at the same time minimising their **impact on the environment**.



Nowadays, extensive **quality assurance testing** for vehicles is essential, both before and during serial production. Test drives on the roads and under laboratory conditions in a variety of testing facilities provide the required proof of compliance. However, field testing can be extremely time consuming, as consistent environmental conditions are generally subject to the seasons, or not available when required. Modern vehicle development processes are subject to enormous time pressures, making quality assurance testing in the Climatic Wind Tunnel essential.

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AVAILABLE SIMULATION
DIFFERENT FORMS OF PRECIPITATION

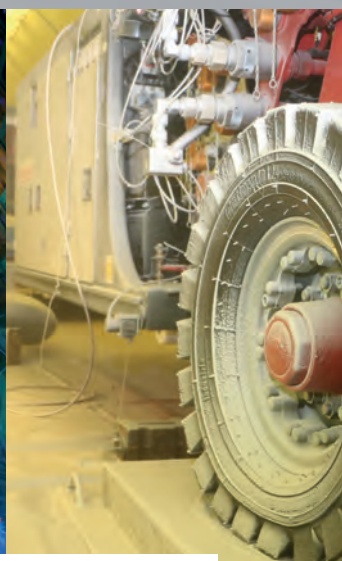
Ingress of snow and rainwater into air intakes (air-conditioning unit/engine) for different front trim panels, air ducts or separation systems. Icing of the intercooler ducts caused by high humidity and freezing temperatures combined with low engine load.

Visibility through the windscreen or side mirror with a focus on the effectiveness of the wiper system under rain or snow conditions also at high windspeeds. Poor visibility caused by condensation can be simulated using a specific combination of environmental parameters (temperature/humidity).

Proper functioning of driver assistance systems (adaptive cruise control, blind spot assist system/camera, traffic sign recognition system, etc.) can be impaired by snow, rain, fog or soiling.

Soiling tests for improved road safety: Windscreen and side mirror visibility may be impaired by splash and spray from wet pavements when driving in dense traffic. Such soiling can be made visible by spraying the vehicle front with a fluorescent liquid and illuminating it with a black-light lamp. This allows manufacturers to optimise vehicle front designs, wind deflectors or mirror shapes.

Available Services
MORE THAN JUST A TEST CHAMBER



THERMAL COMFORT

Fig. 1: heating mats simulate passengers

Examining thermal comfort in the vehicle interior is an essential part of the climatic tests. The tests are based on the **applicable standards**, such as VDV 236 and other quality and test regulations, and cover both **climatic** as well as **passenger simulations**. E.g. the typical operation of a service bus with regular stops, including drive cycles, can be simulated on a chassis dynamometer under real-world conditions.

- **Determining the heat-up and cool-down times** for vehicles parked over an extended period.
- Monitoring the **control behaviour of the air-conditioning system** undervarying ambient conditions, from heating to cooling mode through to high-pressure shutdown of the air-conditioning compressor.

Fig. 2: comfort meter

DRIVE SYSTEM FUNCTIONALITY

External climatic conditions exert extreme stresses on drive systems which are simultaneously required to meet stringent reliability standards.

- **Starting behaviour** of parked vehicles at extreme ambient temperatures; the tests include various engine components, e.g., fuel or engine preheating system, and heat build-up in the engine compartment.
- **Proper functioning of exhaust gas treatment systems** (AdBlue injection systems);
- **Alternative drive systems**, such as hydrogen, electric battery or gas, present a huge challenge to the industry, especially when operating under extreme ambient conditions:
  - Engine management (energy distribution to system components)
  - Battery cooling system (sun, heat, engine load)
  - Thermal insulation of the battery in cold conditions

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ALTERNATING **CLIMATE TESTS**

Driving through tunnels may lead to dangerous situations, particularly in mountainous regions during winter. **Abrupt changes in climatic conditions** can very quickly give rise to condensation, e.g., on the windscreen and mirror. The alternating climate tests are conducted by rapidly moving the vehicle from winter in the climatic wind tunnel to the warm and humid tunnel conditions in the adjacent soak room.

FACILITY & TEST **EQUIPMENT**

In addition to the two climatic wind tunnels, RTA also offers its customers the following facilities and/or resources:

- Numerous **sensors for measuring** temperature, humidity, air velocity, pressure, and electrical power; (no measurement equipment for exhaust gas and fuel consumption analysis);
- Refueling system for **special fuels** (e.g. winter diesel, kerosin);
- 2 **preparation halls** with working pits and ceiling cranes for setup and adjustment work;
- Temperature **soak room** for testing, setup and adjustment work, climate change tests;
- **Climate chamber** for pre-heating individual materials (e.g., AdBlue, oils, fuels) to critical temperature limits;
- **Passenger simulation:** latent and sensible load continuously adjustable in accordance with standard requirements (heating mats, heater, humidifiers);
- Numerous systems for generating different kinds of **precipitation** such as rain, fog, wet and dry snow, freezing rain, freezing drizzle:
  - Stationary ceiling mounted rain and icing system (adjustable rain intensity)
  - Spray rig covering entire tunnel cross-section (adjustable droplet size, water content)
  - 3 mobile rain bars (adjustable droplet size, rain intensity)
  - Numerous mobile (snow) nozzles (variable droplet size, rain intensity, snow density);
- **Chassis dynamometer** for road load simulation with a powerful exhaust extraction.

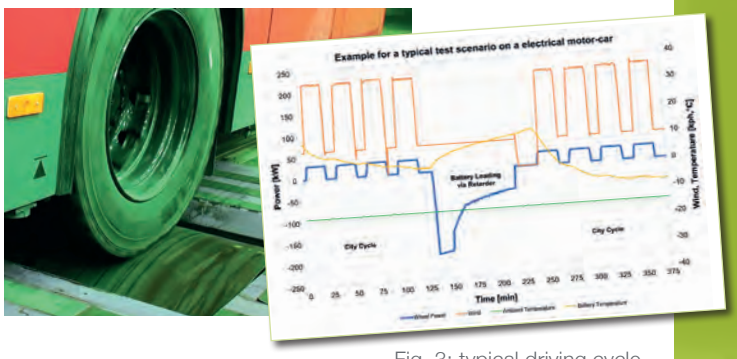
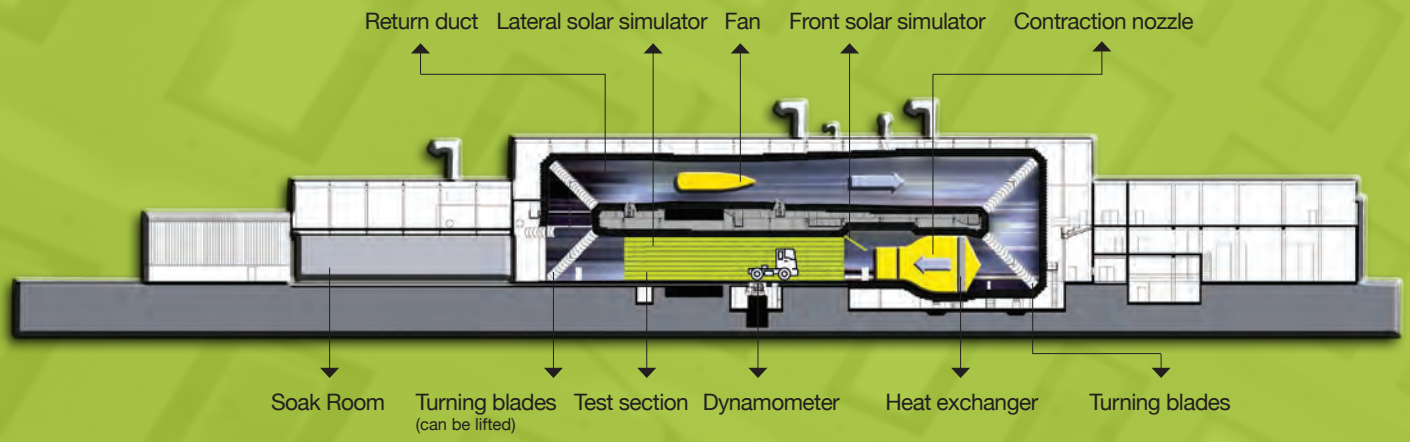


Fig. 3: typical driving cycle

Technical Data
CLIMATIC WIND TUNNELS



DESCRIPTION	SMALL CWT	LARGE CWT
Test section width height cross sectional area	 4.9 m to 5.1 m 5.9 m to 6.0 m 27.2 m² to 28.7 m²	 4.9 m to 5.6 m 5.9 m to 6.2 m 27.2 m² to 32.2 m²
Contraction nozzle dimensions width / height / area	3.5 m / 4.6 m / 16.1 m²	
Test section length	33.8 m	100.0 m
Dimensions of lateral solar simulator (length / height)	30.0 m / 4.3 m	60.0 m / 4.3 m
Solar intensity of lateral solar simulator[3] at fixed 30° angle of incidence operating temperature > -10 °C	200 W/m² to 1,000 W/m²	
Maximum temperature range	-45°C to +60°C	
Maximum wind speed	120 km/h	300 km/h[1] 200 km/h[2]
Maximum temperature gradient in the temperature range -20 °C to +60 °C	10 K/h	
Relative humidity at temperatures > +10 °C	7% to 98%	
Braking and load simulation	chassis dynamometer with one driven axle	no dynamometer for motor cars available
Maximum power	250 kW motoring power 300 kW absorbing power	
Maximum speed	160 km/h	
Load simulation	4,000 to 20,000 kg	
Power supply for battery charger	3 x 400 V 50 Hz 20 – 200 V DC CCE connectors 16A to 125A	350 kVA 500 A max 200 A max

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QUALITY **CERTIFICATION**

Ensuring quality in all weather conditions requires internal quality assurance. RTA is certified according to the following standards:

- Accreditation according to **EN ISO/IEC 17025**
- **ISO 9001** and **ISO 45001**
- RTA is a **member of the TISAX network** and has a certificate to perform prototype testing.

www.rta.eu

IMPRESSUM

RTA Rail Tec Arsenal
Fahrzeugversuchsanlage GmbH

1210 Wien
Paukerwerkstrasse 3
Austria
Tel.: +43 1 256 80 81-0
contact@rta.eu
www.rta.eu

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Gregor Richter, Uwe Sorgalla
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[1] High speed: reduced dimensions of contraction nozzle
[2] restrictions at low temperatures, e.g. at -20°C
[3] additional front solar simulator available with different incidence angels (depending on wind speed)

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