TOYOTA GAZOO Racing EUROPE

VEHICLE AND COMPONENT TEST FACILITIES
SPECIFICATION CATALOGUE

WELCOME

TO THE HOME OF HIGH PERFORMANCE

TOYOTA GAZOO RACING EUROPE (TGR-E) is a unique high-performance development, testing and manufacturing facility located in Cologne, Germany.

High performance, precision and diversity are core principles at TGR-E and our technical specialists have in-depth engineering experience across various sectors.

TGR-E has honed its competences in top-level competition, from our world championship-winning rally cars, revolutionary Le Mans prototypes, securing the WEC manufacturer's and driver's championship in 2014, to record-breaking electric vehicles via the pinnacle of motorsport, Formula 1.

Whatever the requirements and however extensive the project, TGR-E can create a tailor-made solution to deliver prototype development, specialist testing or enhancement of existing components.

Constructed to the highest standards with no compromise on quality or functionality, the spacious 30,000m^2 facility and its highly-skilled staff of around 250 offer a remarkable range of machines, facilities and expertise.

TGR-E has developed into a one-stop shop for specialised services focusing not only on automotive clients but also those from other sectors where precision and performance are essential.

TGR-E's range of services encompasses the complete development cycle, with seamless interaction between systems and facilities to ensure speed, efficiency and, most importantly, quality.

Our complete range of processes and systems is far too lengthy to list in detail but one look at the highlights and it is clear that TGR-E truly is the home of high performance, with everything under one roof.

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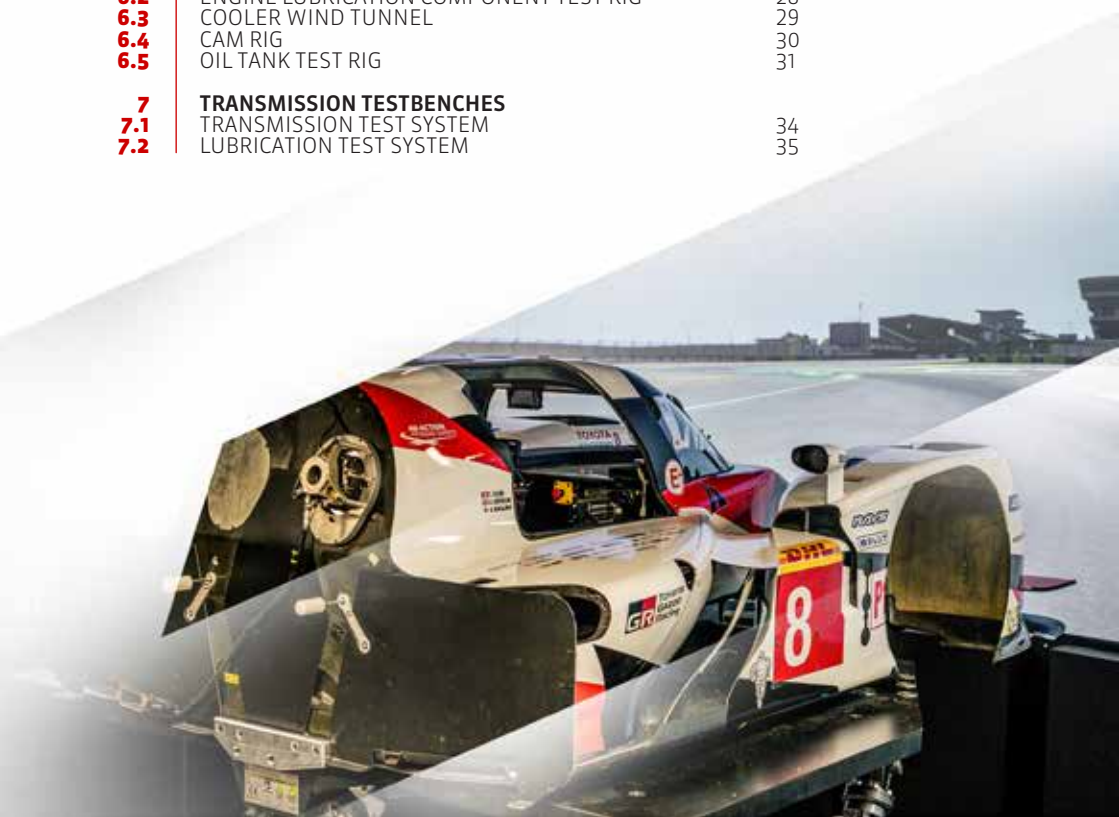


WIND TUNNELS

THE ULTIMATE AERO EXPERIMENT

TGR-E's two near-identical wind tunnels were built to the highest specification and are equipped with endless stainless steel belt rolling roads. Both tunnels are fitted with permanent Robotic Particle Image Velocimetry (PIV) to visualise flow structures in X, Y and Z planes and Measurement Probe Arm (MPA) for local measurements of pressure field. Real time, high speed control and data acquisition for model and wind tunnel systems ensure maximum efficiency (time reduction) and accuracy. Live wind tunnel data analysis software available and customisable based on customer's formulae.

APPLICATIONS:

- Full scale race or road car testing with Active Ride Height System
- Model scale testing with continuous motion wheels-on approach
- WLTP Certified testing
- Motorbike testing including lean angle and active ride height with dummy or human rider
- Aircraft models or components
- Flexibility to test a wide range of models and aerodynamic components
- Thermal measurements
- Fully equipped and confidential workshop areas




SPECIFICATIONS	
Airline	Length: 67.2m / Width 24.5m
Test section	Width: 4.1m / Height: 3.7m / Length: 15m
Max. Wind Speed	70m/s
Rolling Road	Max. Speed 70m/s Width 2.4m / Length 7m
Vertical Wheel Force Measurement (load range)	Model scale 30 – 300N Full scale 500 – 7000N
Main balance load range	Drag 1800N Side Force 1400N Lift 5200N Roll moment 1100Nm Pitch moment 2600Nm Yaw moment 1100Nm Accuracy +/- 0.04% FS Repeatability +/- 0.02% FS
Model motion system load range	Drag 1500N Side force +/- 750N Lift 5200N Roll moment +/- 200Nm Pitch moment +/- 2600Nm Yaw moment +/- 250Nm

DRIVING SIMULATOR

SIMULATION & EVALUATION

The TGR-E driving simulator is a dedicated engineering tool, accurately reproducing the driving experience in a virtual environment. The driving simulator offers consistent and repeatable track conditions, ideal for vehicle development and determining setup directions. With professional drivers in the loop and highly repeatable conditions, the Simulator is both suitable for objective and subjective evaluation. Precise track features are accurately reproduced due to the LIDAR scanned track surfaces purposely developed for simulator use. A six-degrees-of-freedom motion platform simulates driving sensations and an electric feedback motor creates realistic steering torque. State of the art rendering computers offer visuals with high resolution and high refresh rates. Live telemetry and advanced data logging systems can supply the interactive pit crew with rapid information to efficiently support and run simulator sessions.

TGR-E has vehicle models of various types and the flexible software platform allows bespoke models to be created and easily integrated based on existing data and/or customer requirements (i.e. using Simulink, S-Functions, Dymola/ FMUs, IPG CarMaker, etc.). TGR-E also offers in house developed vehicle models, which can be adapted to suit a wide variety of customer requirements: passenger cars, hyper cars and race cars.

APPLICATIONS:

- Performance testing of aerodynamic changes based on wind tunnel results
- Performance and feel testing of mechanical set-up changes
- Set-up evaluation
- Driver training
- Driver behaviour analysis

TRACK LIST:

- Algarve International Circuit (Portimao)
- Aragon
- Autodromo Hermanos Rodriguez (Mexico)
- Autodromo Nazionale Monza
- Bahrain International Circuit
- Bettenfeld (German City)
- Circuit of the Americas (Austin)
- Circuit de la Sarthe (Le Mans)
- Circuit de Spa-Francorchamps
- Fuji Speedway
- Hockenheimring
- Nürburgring GP Circuit
- Nürburgring Nordschleife
- Paul Ricard
- Sebring
- Shanghai International Circuit
- Silverstone Circuit
- Vehicle Dynamics Proving Ground
- Large road course including motorway, split μ road surface, country road and town environment

SPECIFICATIONS	
Screen	220° fixed
Projectors	5
Refresh Rate	100Hz
Resolution	1,400 x 1,050dpi
Latency	~40 milliseconds
PLATFORM	
Lateral Travel	~40milliseconds
Longitudinal Travel	±0.6m
Vertical Travel	±0.6m
Yaw	±38°
Roll	±27°
Pitch	±27°
Latency	~50milliseconds

CHASSIS TEST BENCHES

A UNIQUE TESTING FACILITY

MTS 329 ROAD SIMULATOR

Six degrees of freedom at each vehicle spindle gives control over vertical, lateral, longitudinal, brake torque, camber and steer forces. An additional four actuators can simulate downforce. In floating body mode, up to 28 control channels deliver accurate full-vehicle stress distribution analysis of manoeuvring events. Fixed body mode, using up to 26 control channels, allows double axle suspension testing, including braking and cornering simulation. Additional features include steering robot, heat application to specified components, four Swift wheel force transducers and an additional 38 recording channels. K&C test combined with highest resolution optical measurement system provides highly accurate results for forces and moments applied at wheel center.

APPLICATIONS:

- Full-car stress distribution simulation
- Front or rear suspension and sub-system testing, including steering
- Front or rear axle fatigue simulation
- K&C analysis
- Elasto-kinematic analysis of components, such as suspension
- Component and assembly proofing for various purposes
- Optical measurement studies of suspension or other component deformation

SPECIFICATIONS		
Channels		29
Operating Frequency		50 Hz
VERTICAL INPUT (FRONT)	**Dynamic Spindle Force/Moment**	75 kN
	Spindle Displacement	300mm
	Spindle Velocity	6 m/s
VERTICAL INPUT (REAR)	**Dynamic Spindle Force/Moment**	63 kN
	Spindle Displacement	300mm
	Spindle Velocity	7 m/s
LONGITUDINAL INPUT	**Dynamic Spindle Force/Moment (front)**	30 kN
	Dynamic Spindle Force/Moment (rear)	22 kN
	Spindle Displacement	300mm
	Spindle Velocity	2.5 m/s
LATERAL INPUT (FRONT)	**Dynamic Spindle Force/Moment**	30 kN
	Spindle Displacement	200mm
	Spindle Velocity	2.5 m/s
LATERAL INPUT (REAR)	**Dynamic Spindle Force/Moment**	22 kN
	Spindle Displacement	200mm
	Spindle Velocity	2 m/s
STEER INPUT (FRONT)	**Dynamic Spindle Force/Moment**	6.9 kNm
	Spindle Displacement	44°
	Spindle Velocity	400°/s
STEER INPUT (REAR)	**Dynamic Spindle Force/Moment**	3.8 kNm
	Spindle Displacement	16°
	Spindle Velocity	400°/s
CAMBER INPUT	**Dynamic Spindle Force/Moment**	7kNm
	Spindle Displacement (front)	30°
	Spindle Displacement (rear)	16°
	Spindle Velocity	400°/s
BRAKE/ DRIVE INPUT (FRONT)	**Dynamic Spindle Force/Moment**	6.2 kNm
	Spindle Displacement	30°
	Spindle Velocity	400°/s
BRAKE/ DRIVE INPUT (REAR)	**Dynamic Spindle Force/Moment**	7 kNm
	Spindle Displacement	35°
	Spindle Velocity	700°/s
PERFORMANCE	**Max. length of Force introduction rod**	+/- 300mm (+/- 12 in)
	Max. power on the bar	36 kN (8kip)
	Frequency response	50 Hz
	Vertical positioning of the bar	400mm (15,7 in)
	Oil flow	126 l / min (33gpm)
	Recommended input air pressure	7 bar (100psi)
MTS RESTRAIN SYSTEM (FRONT AND REAR)	**max. displacement restrain rods**	±300mm
	max. force restrain rods	36 kN
	max. test frequency	50 Hz

SEVEN POST RIG

Our seven-post rig adapts to most vehicles and is a valuable development and proving tool for original equipment manufacturers and high-performance car developers. Our baseline configuration, featuring one frontal downforce actuator and two at the rear, is ideal for optimising the vertical dynamics of cars generating large amounts of downforce.

For road vehicles also a four-post mode is available (i.e. comfort rating).

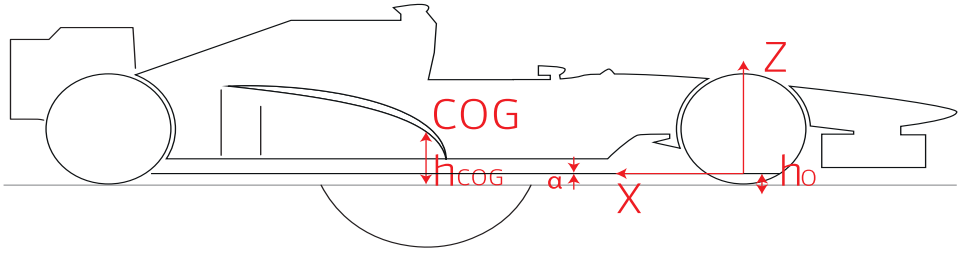
APPLICATIONS:

- Track data replay with excellent correlation to the track
- Set-up optimisation for races (prior and during event)
- Analysis of resonance frequencies in roll pitch and heave
- Vibration measurements using synthetic or track inputs
- Complete car suspension friction measurements
- Noise, vibration, harshness (NVH) investigations
- System checks on on active suspension systems, e.g. ride height control systems

SPECIFICATIONS	
Max. Wheel Pan Force	29kN
Max. Dynamic Wheel Pan Stroke	±125mm
Max. Downforce Actuator Force (down)	15.6kN
Max. Downforce Actuator Force (up)	8.9kN
Actuator Stroke	±125mm
Max. Vertical Wheel Pan Acceleration	20-30g
Peak Velocity of Wheel Pan @ 10Hz	4.5m/s
MAX. WHEEL PAN DISPLACEMENT @	
7Hz	200mm
10Hz	100mm
20Hz	12mm
30Hz	10mm
50Hz	3mm
100Hz	1.5mm

CENTRE OF GRAVITY RIG

A specially-developed rig to determine, to a very precise level, the centre of gravity of a vehicle and the moment of inertia around the three main axes. Various complete cars can be mounted in exact road/track specification, up to a maximum weight of approximately 2,300kg.



APPLICATIONS:

- Centre of gravity investigations
- Moment of inertia investigations

ACCURACY (Based on Formula 1 car)	
CoG Height Over Road Surface	±0.5mm
Repeatability	±0.1mm
XCOG in Car Coordinates	±1mm
YCOG in Car Coordinates	±1mm
ZCOG in Car Coordinates	±1mm
IX Inertia Around X-Axis	±1 kg m2
IY	±1 kg m2
IZ	±1 kg m2

POWER STEERING TEST RIG

This dynamic test rig delivers realistic simulation of all suspension, turning and driving torque forces. A variety of different power steering solutions can be tested for durability and performance. For exceptional realism, simulated car or recorded track data can be used to test specific scenarios.

APPLICATIONS:

- Durability testing
- Linear spool valve set-up
- Hydraulic power steering set-up and optimisation

SPECIFICATIONS	
Track Width	1000-1400mm
Recession/Precession	±220mm
Vertical Displacement	±50mm
Vertical Acceleration	25g
Lateral Displacement	±60mm
Lateral Force	±10kN
Steer Input Velocity	2000°/s
Steer Input Torque	±70Nm

SHAKER

This medium force, LDS-manufactured shaker, model V850 is an air-cooled electro-dynamic shaker produced for vibration testing of items, making it ideal for automotive uses. This tool can be used in either vertical or horizontal orientation, depending on requirements, and works in conjunction with our climatic chamber.

VERTICAL ORIENTATION	
Positive Displacement Limit Peak	25.4mm
Negative Displacement Limit Peak	25.4mm
Max. Velocity Peak	2m/s
Max. Acceleration Peak	60gn
Min. Drive Frequency	5Hz
Max. Drive Frequency	3000Hz
Max. Drive Peak	2V
Sine Force Peak	22.2kN
Effective Mass of Moving Element	24.52kg
Plate Working Area (diameter)	400mm
HORIZONTAL ORIENTATION	
Positive Displacement Limit Peak	23.5mm
Negative Displacement Limit Peak	23.5mm
Max. Velocity Peak	2m/s
Max. Acceleration Peak	37gn
Min. Drive Frequency	5Hz
Max. Drive Frequency	2000Hz
Max. Drive Peak	2V
Sine Force Peak	22.2kN
Effective Mass of Moving Element	61.01kg
Plate Working Area	600 x 600mm

CLIMATIC CHAMBER

The Vötsch Industrietechnik VCV 4120-5 climatic chamber is an optional addition to our shaker, allowing the simulation of mechanical and thermal loads in a dynamic environment.

APPLICATIONS:

- Stress and durability testing at a range of temperatures
- Stress and durability testing in different humidity environments.

TEMPERATURE TESTS	
Chamber Volume	1200l
Temperature Range	-40°C to 180°C
Temperature Fluctuation	±0.1 to ±0.8K
Deviation in Space	±0.5 to 2K
Temperature Gradient	1 to 4K
Temperature Change Rate	5.5K/min (cooling and heating)
Heat Compensation at 20°C	5000W
Heat Compensation at -20°C	2000W
Calibrated Values	23°C and 80°C
CLIMATIC TESTS	
Temperature Range for Relative Humidity	10-95°C
Temperature Fluctuation	±0.1 to ±0.3K
Deviation in Space	±0.5 to 1K
Temperature Gradient	1 to 2
Humidity Range	10-95%
Humidity Fluctuation	±1 to ±3%
Dew Point Range	4°C to 94°C
Heat Compensation	500W
Calibrated Values	23°C/50% and 95°C/50%

MATERIAL TEST SYSTEMS

TGR-E has three MTS 810 uniaxial material test systems. The units use servo-hydraulic frames and can be customised to address a whole range of material testing demands. These test systems are suitable for large specimens and can accommodate various materials, including alloys and composites. TGR-E's range of material test systems includes MTS 318.10, 318.25 and 318.50 models.

APPLICATIONS:

- Fatigue analysis
- Damper and suspension testing
- Side-intrusion or chassis safety testing
- Material tests for toughness and fatigue
- Sine wave simulation up to 3m/s

SPECIFICATIONS	318.10	318.50	318.25
Actuator	50kN	500kN	100kN
Vertical Test Space	1308mm	2108mm	1625mm
Working Height	889mm	889mm	889mm
Column Spacing	533mm	762mm	635mm
Column Diameter	64mm	102mm	76mm
Base Width	864mm	1245mm	1003mm
Base Depth	610mm	914mm	762mm
Diagonal Clearance	2718mm	3835mm	3251mm
Overall Height	2540mm	3581mm	3023mm
Stiffness	2.6 x 108 N/m	7.5 x 108 N/m	4.3 x 108 N/m

DAMPER DYNO

This MTS-manufactured 850 Series damper test system features high-performance hydraulic actuators. Three load cells are available for simultaneous testing and all deliver accurate results for static or dynamic testing.

APPLICATIONS:

- Damper and component evaluation
- Durability testing
- Performance testing

SPECIFICATIONS	
Actuator	Series 850
Actuator Stroke	+- 125 mm
Load Cells	2 x 10kN 1 x 25kN
Mounting Threads	M12 x 1,25mm
Vertical Test Space	1397mm
Column Spacing	533mm
Base Width	1067mm
Base Depth	1143mm
Overall Height	3150 mm

COMPONENT TESTING AREA

In this specific area of TGR-E's chassis testbench department, we offer various component durability and reliability tests. With our customizable and modular test equipment, we combine wide range of actuators and sensors for mechanical component tests.

OPTICAL MEASUREMENT SYSTEMS

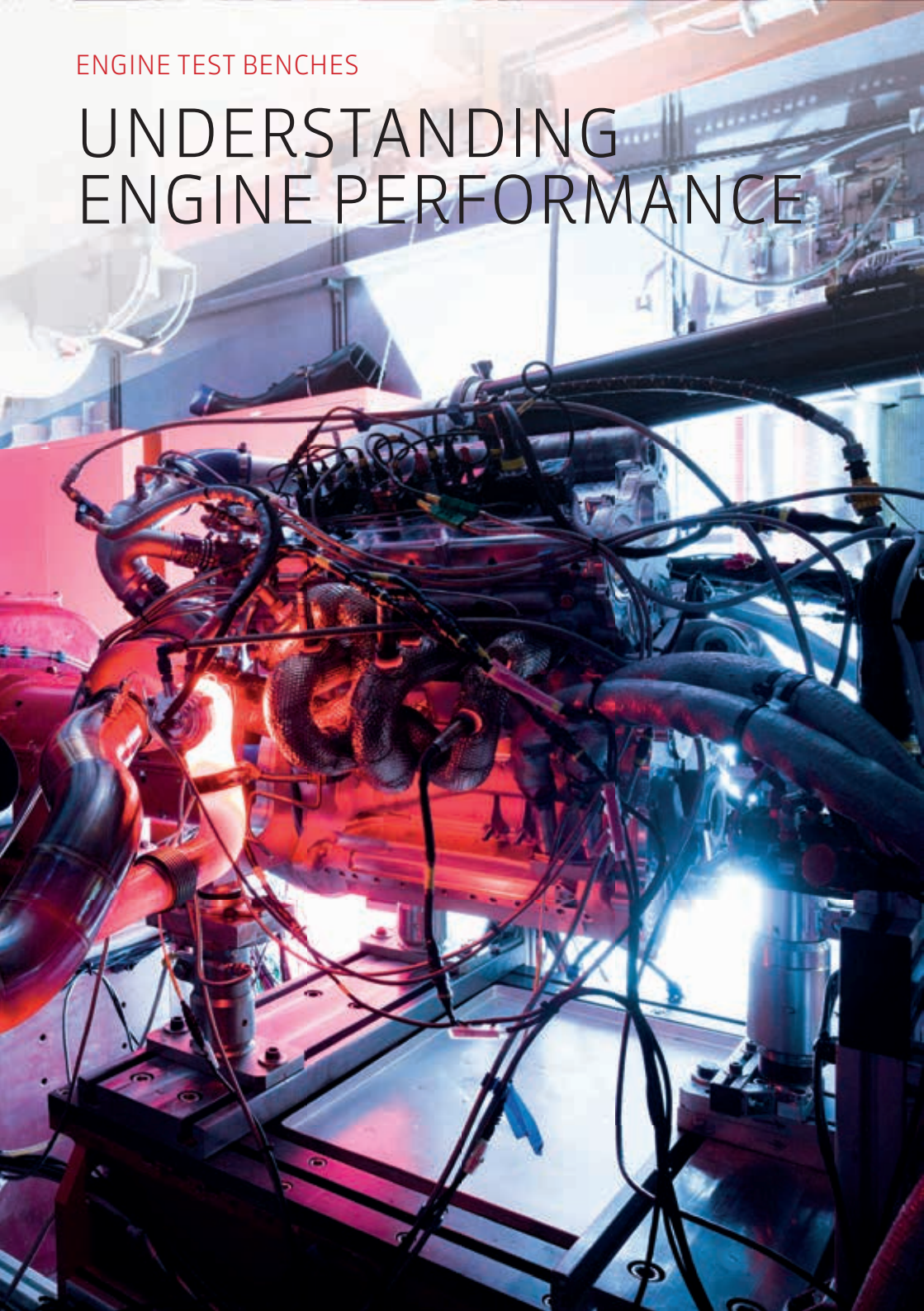
TGR-E possesses several systems designed for highly accurate optical measurement of large or small objects. TriTop is an optical coordinate measuring machine which includes deformation module. ATOS is a very accurate three-dimensional digitizer for creating CAD drawings of small or large parts via reverse engineering. ARAMIS is an optical three-dimensional deformation analysis tool which indicates any tiny structural change on a part during use.

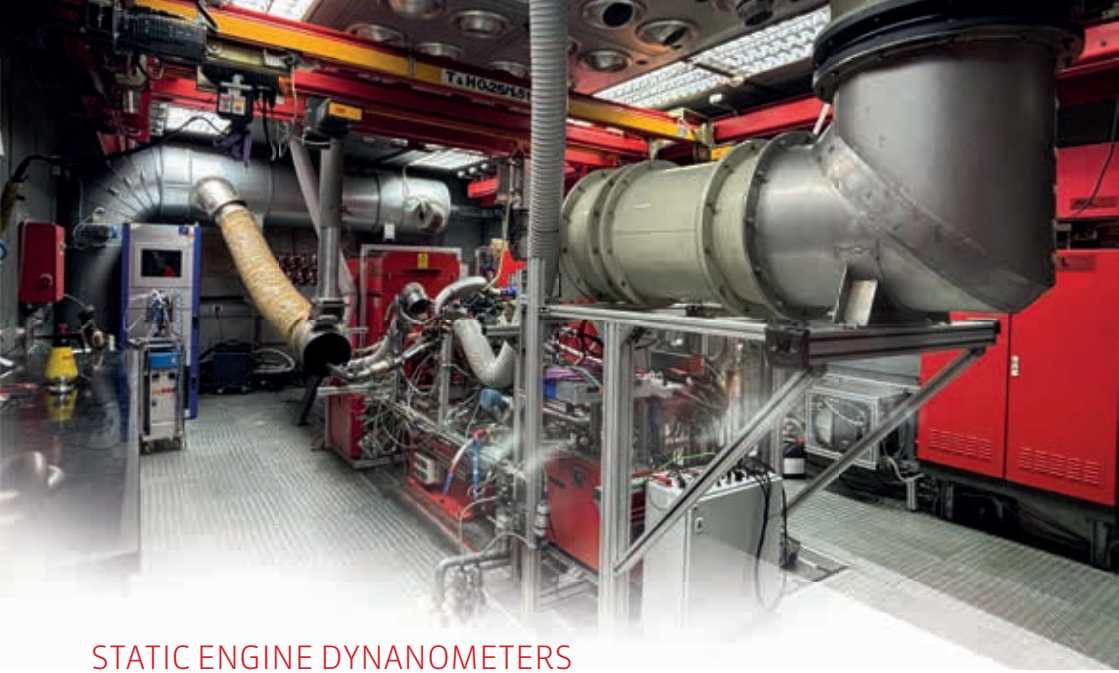
APPLICATIONS:

- Mobile coordinate measurement
- Static movement analysis
- Static deformation analysis
- Three-dimensional digitisation for CAD export
- Reverse engineering projects
- Three-dimensional surface coordinate mapping
- Three-dimensional displacement and velocity analysis
- Surface strain testing
- Strain rate analysis

ENGINE TEST BENCHES

UNDERSTANDING ENGINE PERFORMANCE





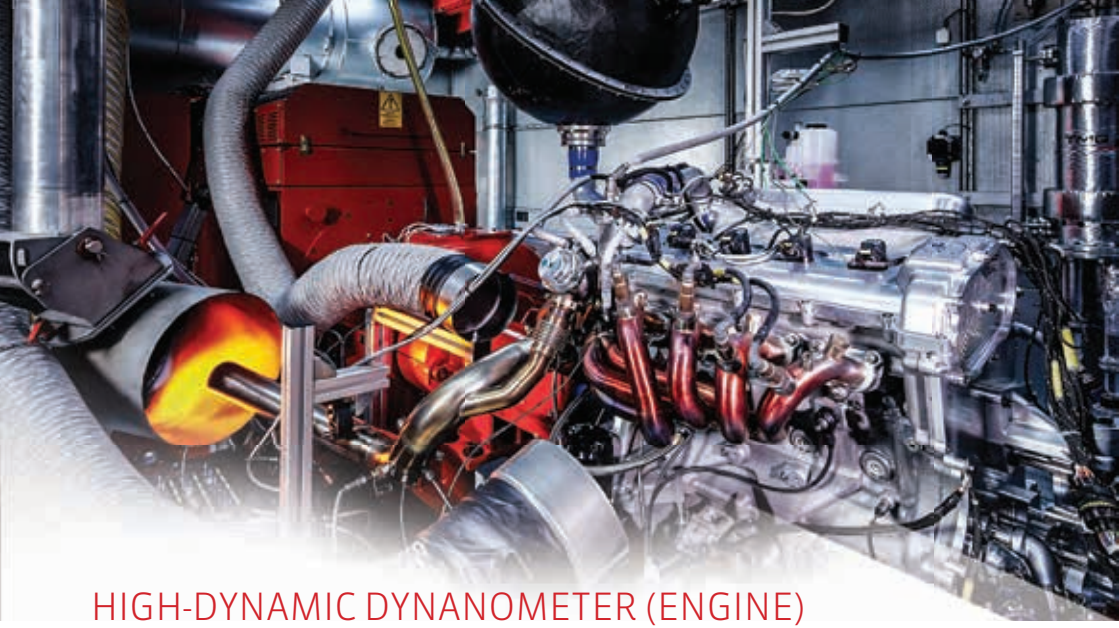
STATIC ENGINE DYNANOMETERS

TGR-E has three static dynamometers for engine-related test functions, each oeprating in a fully-conditioned environment for realistic results. Our dynamometers are located in secure private rooms with accompanying office space for monitoring and engineering support.

APPLICATIONS:

- Power and endurance testing
- Calibration and mapping (manual or automatic)
- Drivability and fuel efficiency tuning (static)
- Pressure indication of intake, combustion chamber, exhaust
- Emission measurement in static or dynamic mode with AVL i60
- Playback of profiles
- Testing of oil and various fuels incl. e-Fuel, biofuel

SPECIFICATIONS	
Max. Speed	22,000 rpm
Max. Power	660kW
Playback Frequency	100Hz
Measurement Accuracy	~0.1%
FULLY-CONDITIONED ENVIRONMENT	
Air	15°C to outdoor +40°C (combustion)
Humidity	50-95% at 20°C
Oil	30-150°C
Water	30-130°C
Fuel	10-60°C



HIGH-DYNAMIC DYNANOMETER (ENGINE)

This high-dynamic engine dynamometer is designed for investigation of all engine-related aspects and allows extremely high performance engines to be tested to their full potential. Additionally, the inertia of the dyno's electric motor is equal to that of a race car wheel for greater accuracy.

APPLICATIONS:

- High-performance efficiency and reliability investigations
- Ultimate power and torque analysis
- Exhaust reliability testing
- Hybrid or electric vehicle powertrain testing with battery simulator

SPECIFICATIONS	
Max. Speed	21,000rpm
Max. Power	800kW
Max. Acceleration	200,000rpm/s
Playback Frequency	1000Hz
Measurement Accuracy	~0.1%
Combustion air flow	Car speed controlled
FULLY-CONDITIONED ENVIRONMENT	
Air	15°C to outdoor +40°C (combustion)
Humidity	50-95% at 20°C
Oil	30-150°C
Water	30-130°C
Fuel	10-60°C

HIGH-DYNAMIC DYNANOMETER (POWERTRAIN)

In addition to its suite of static dynamometers, TGR-E has specialist dynamic test benches designed to individual customer requirements. The dynamic two-wheel-drive powertrain dynamometer allows in-depth testing of all powertrain-related items.

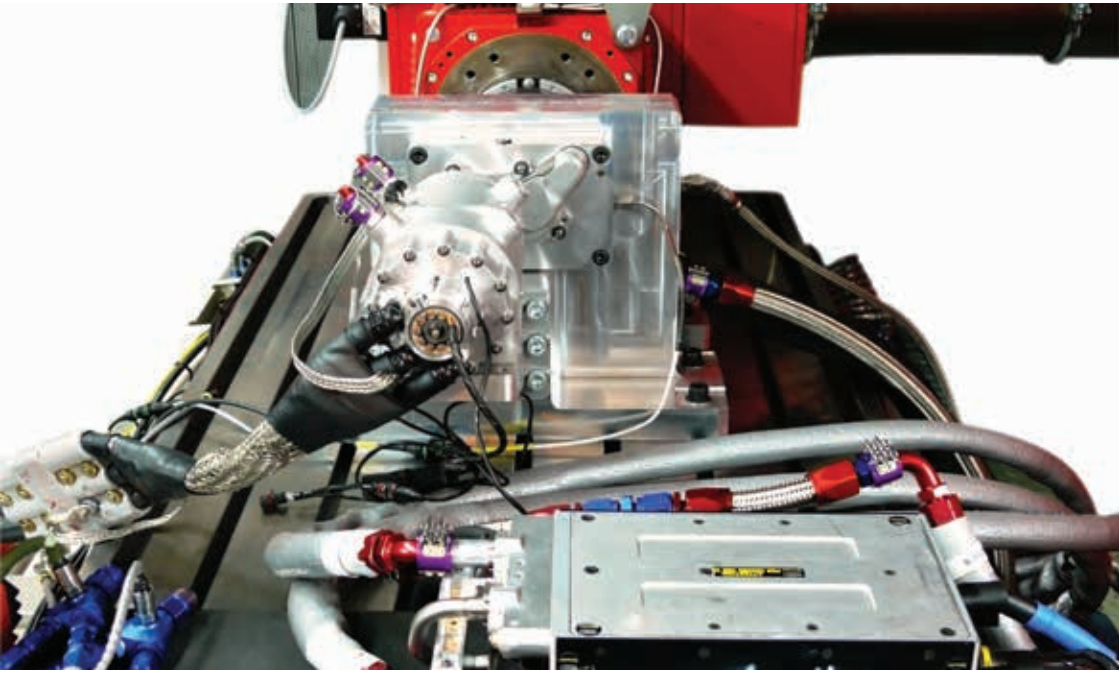
APPLICATIONS:

- Powertrain efficiency and reliability investigations
- Gearshift testing and development with high shift gradients
- ECU testing and development
- Hybrid or electric vehicle powertrain testing with battery simulator

SPECIFICATIONS	
Max. Speed	21,000rpm
Max. Wheel Speed	3,000rpm
Max. Power	800kW
Playback Frequency	1000Hz
Measurement Accuracy	~0.1%
Combustion air flow	Car speed controlled
FULLY-CONDITIONED ENVIRONMENT	
Air	15°C to outdoor +40°C (combustion)
Humidity	50-95% at 20°C
Oil	30-150°C
Water	30-130°C
Fuel	10-60°C

HIGH-DYNAMIC DYNANOMETER (POWERTRAIN)

As a pioneer of high-performance electric powertrains, TGR-E has developed an exclusive test bench for hybrid or E.V applications. A DC battery simulator provides power at user-defined voltage and current levels, as well as charging the battery and supply a current converter.



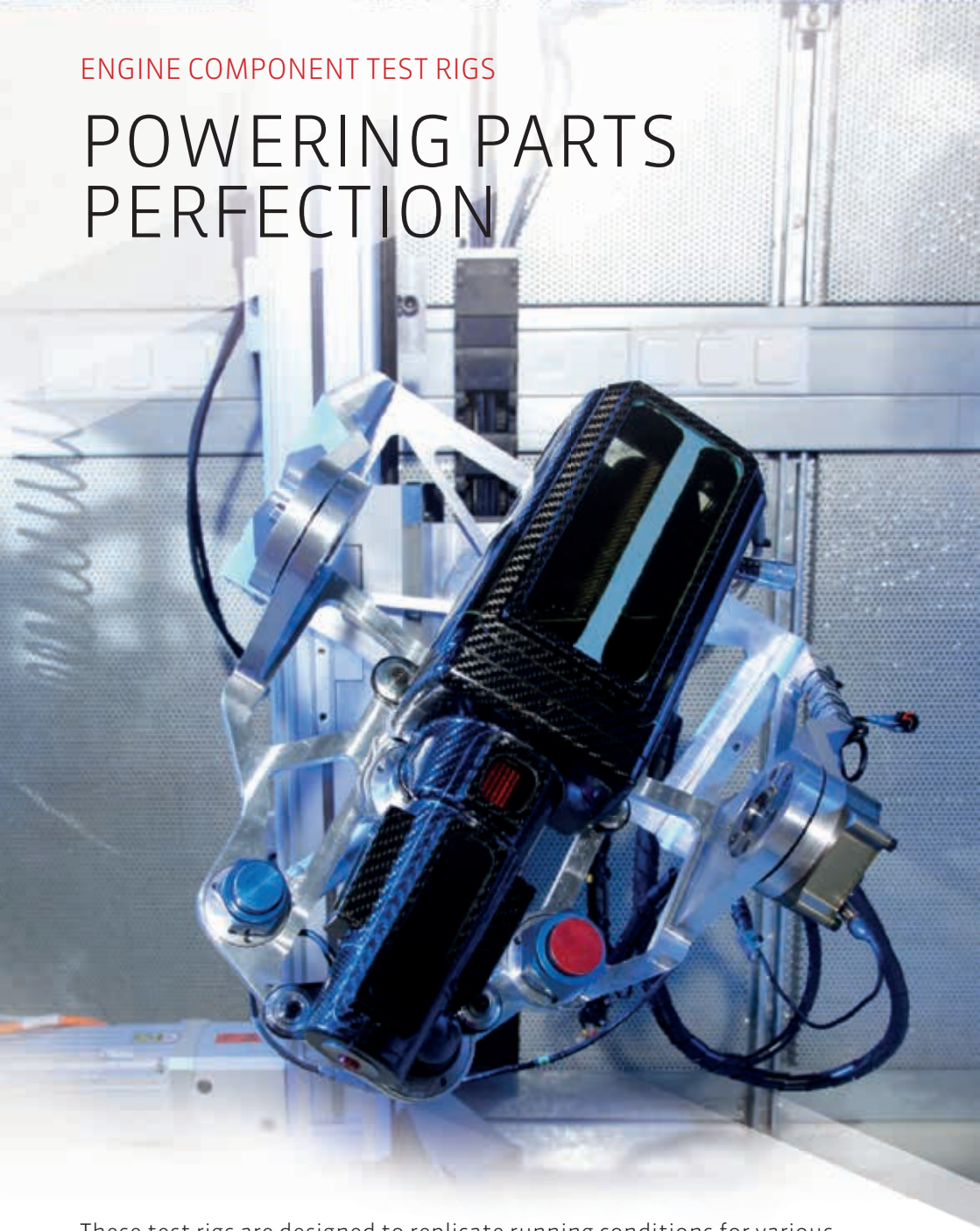
APPLICATIONS:

- Component testing in isolation
- Power electronic unit testing with customer battery models
- Motor generator unit testing
- Battery testing and simulation
- Energy, capacity and efficiency analysis
- Hot and cold cycles
- Lifetime analysis

SPECIFICATIONS	
Battery Output Voltage	800V
Battery Output Power	150kW
Battery Output Current	-800 to 800A

ENGINE COMPONENT TEST RIGS

POWERING PARTS PERFECTION



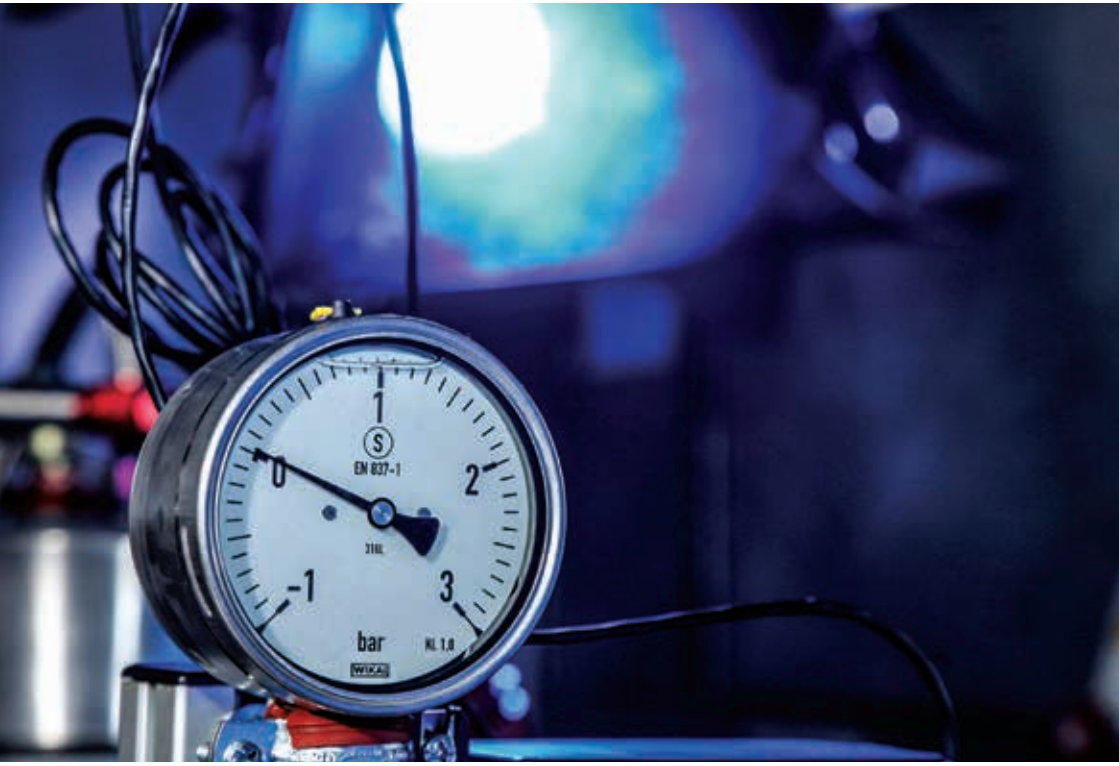
These test rigs are designed to replicate running conditions for various components and systems. They are fitted with various flow, density and pressure sensors to accurately determine fluid behaviour in-system.

COOLANT AND OIL CIRCUIT TEST RIG

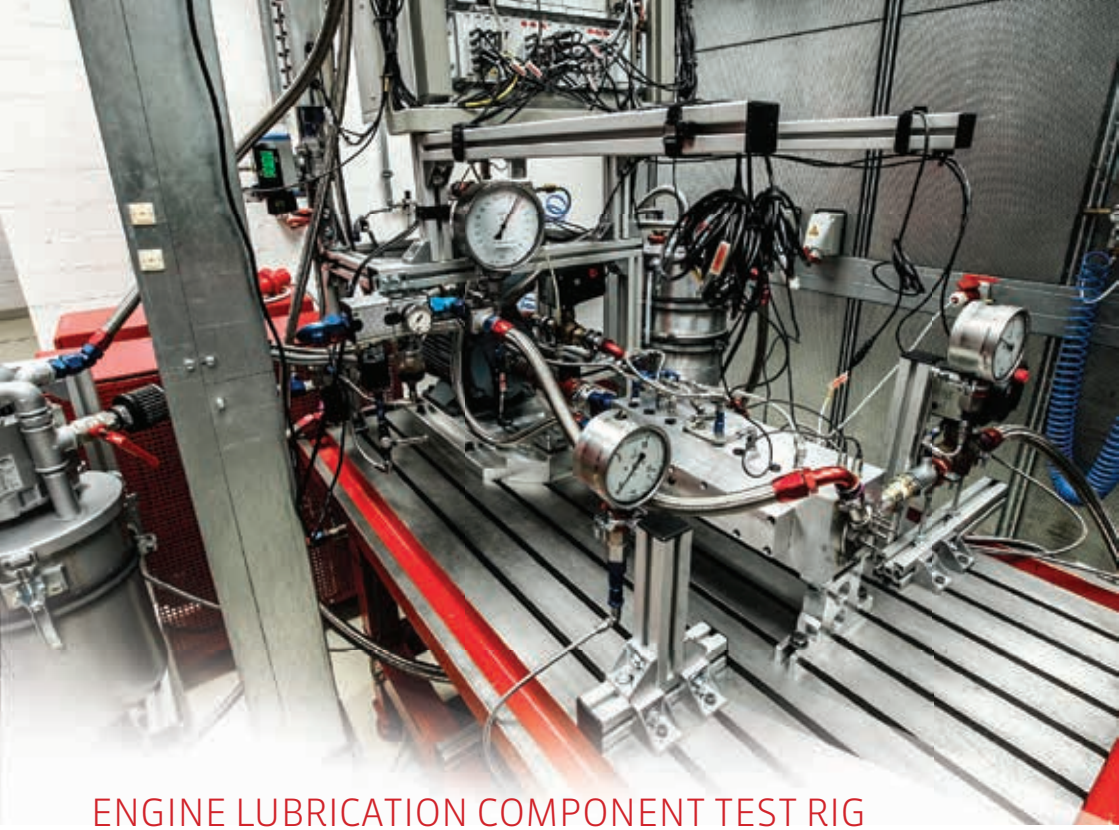
The coolant and oil circuit test rig is fitted with various flow, density and pressure sensors to accurately determine fluid behaviour in-system.

APPLICATIONS:

- Water pump characterisation for friction, hydraulic performance, drive power, efficiency, wear and reliability
- Engine water and oil circuit evaluation for friction, hydraulic performance, drive power, efficiency, wear and reliability



SPECIFICATIONS	
Max. Measurement Channels	40
Motor Power	30kW
Max. Speed	10,000rpm (20,000rpm w gearbox)



ENGINE LUBRICATION COMPONENT TEST RIG

The engine lubrication component test rig, suitable for oil and water testing, is a bespoke unit which allows ancillary engine components to be tested in isolation. It can be customised for various purposes and part sizes.

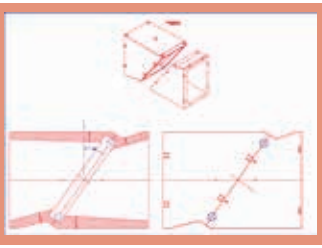
APPLICATIONS:

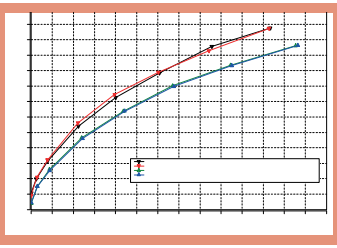
- Gear train lubrication, oil scavenging and air ventilation analysis
- Oil sump scraper evaluation
- Oil pressure pump development and optimisation for friction, hydraulic performance, drive power, efficiency, wear and reliability
- Scavenge pump development and optimisation for friction, hydraulic performance, drive power, efficiency, wear and reliability
- Scavenge pump gallery with centrifuge testing for oil quality (online or with FEV aeration tester) or system adjustment
- Piston cooling jet characterisation for flow versus pressure & spray picture
- Potential industries: aviation, industrial hydraulic

SPECIFICATIONS	
Max. Measurement Channels	40
Motor Power	15kW
Max. Speed	10,000rpm

COOLER WIND TUNNEL

Special Tasks:
Radiator core inclination effect (car situation)





APPLICATIONS:

Cooling performance (liquid/ air) measurement of radiator cores:

- Water radiator cores
- Oil radiator cores
- Different fin pitches
- Different core geometries (f.e. thickness)
- Different suppliers
- Special surface coatings
- Special applications (f.e. hydraulic radiator concepts)

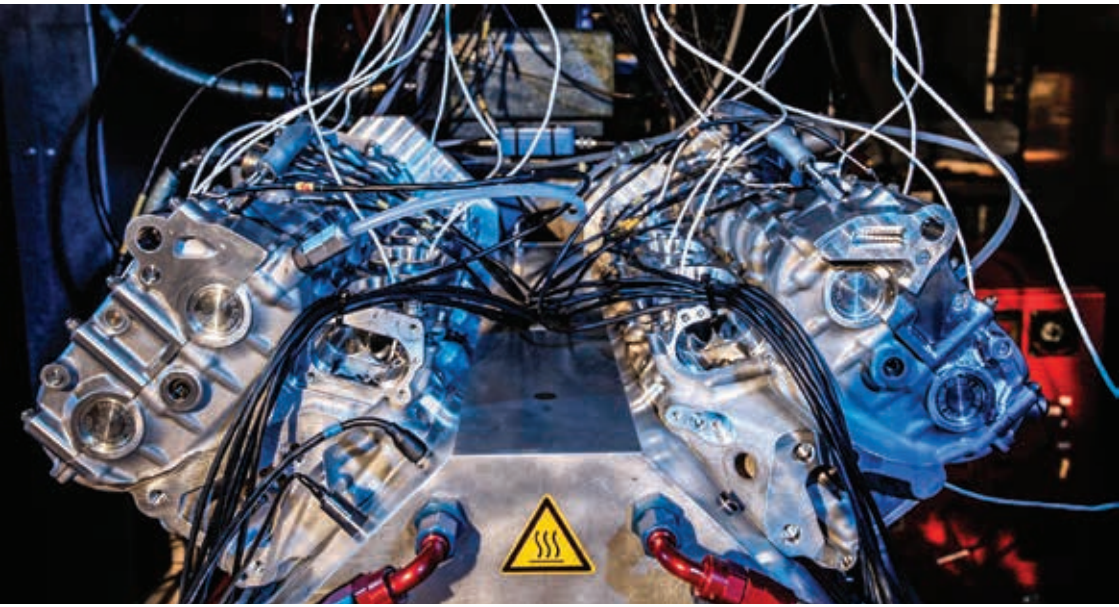
SPECIFICATIONS	
Water flow	0-250 L/min
Oil flow	0-70 L/min
Air flow rate	0-6000 m^3/h
Air velocity:	0, 1, 2, 4, 6, 8, 10, 12 m/s at hot condition
Conditioning unit for oil and water:	60kW max
Max test duct length	1500mm (if longer another test cell to be used)
Measurement channels	up to 40
Accuracy Flow/Pressure	±5% / ±1% from reading
Core size	400 x 263 mm (adaptable to bigger sizes)

CAM RIG

This specialised testing rig provides comprehensive analysis of valve train behaviour. A 110kW electric motor recreates realistic engine speeds, even for very high-performance units. An AVL IndiMaster high-dynamic data acquisition system ensures very accurate results, complimented by a Polytec six-channel laser system and high-speed cameras. Oil and water can be environmentally conditioned to increase realism.

APPLICATIONS:

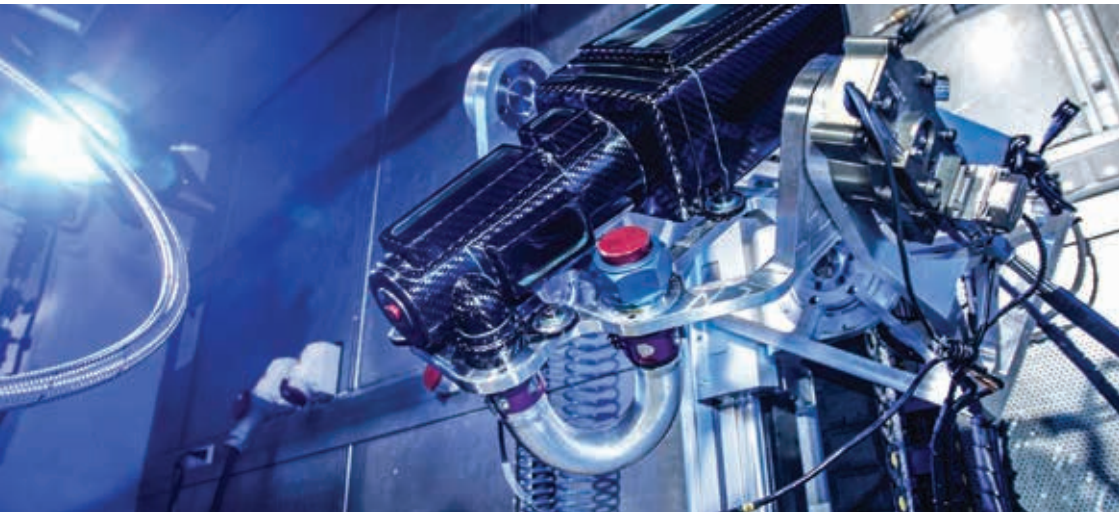
- Full valve and valve train motion anaylsis
- Friction, wear and lubrication optimisation and development
- Stress measurements on valve train components
- Valve spring measurement
- Pneumatic valve spring system measurement and applications
- Endurance testing with static or dynamic lap simulation patterns, including customer patterns



SPECIFICATIONS	
Channels	70
Motor Power	110kW
Max. Speed	22,000rpm
Max. Oil Temperature	140°C
Max. Water Temperature	140°C

OIL TANK TEST RIG

This dynamic oil tank 'rodeo' test rig is a bespoke TGR-E development designed to simulate lateral and vertical experienced by a car on the road, even in very demanding circumstances. Customer road/track data can be implemented.



APPLICATIONS:

- In-tank lubricant flow analysis
- Indication of minimum and maximum oil tank level for specific road/track purposes
- Spill-out quantity analysis
- Oil accumulation simulation
- Comparison of development steps based on defined customer test patterns
- Blow-by simulation
- Oil quality analysis (online or single point measurements with FEV aeration tester

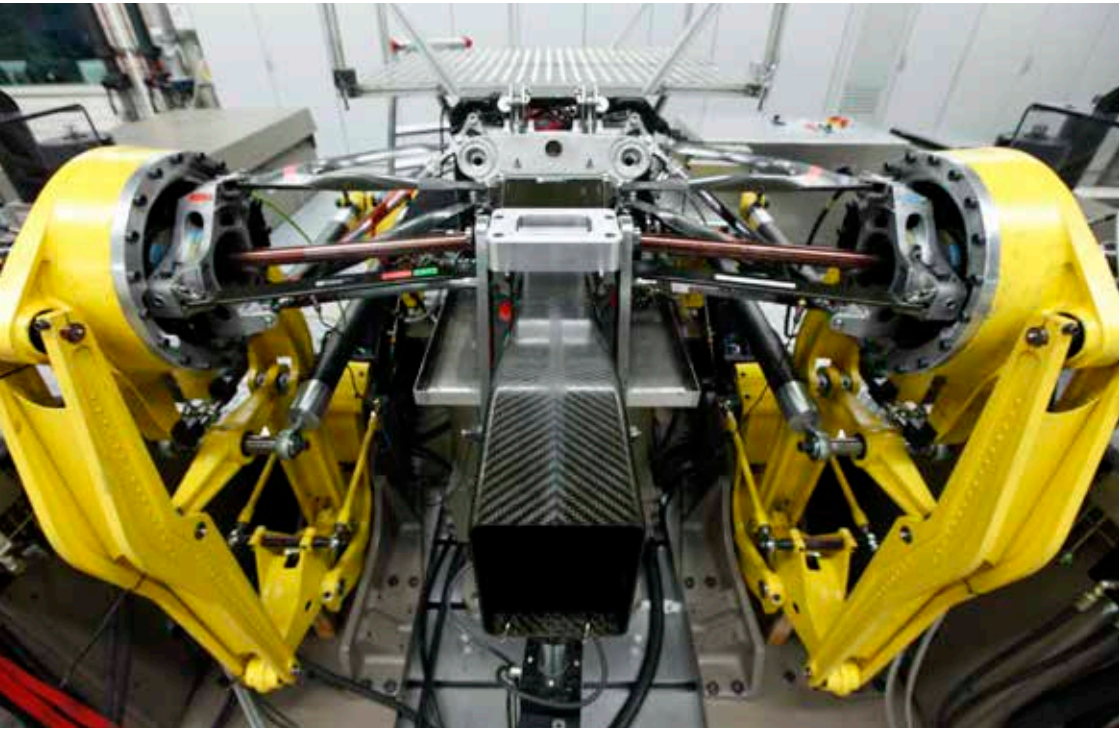
SPECIFICATIONS	
Max. Vertical Force	1500N
Max. Vertical Lift	800mm
Max. Vertical Speed	3m/s
Max. Vertical Acceleration	43m/s^2 (with 35kg load)
Max. Vertical G Force	4G (with 35kg load)
Vertical Positioning Tolerance	±0.2mm
Max. Axis Turn	±80°
Axis Turn Time (100% Left to 100% Right)	0.4sec

TRANSMISSION TEST BENCHES

DEVELOPING DRIVE

TRANSMISSION TEST SYSTEM

A unique hardware-in-the-loop tool for thorough transmission testing which simulates input and output forces on the gearbox whilst at the same time recreating 4 DOF suspension inputs per corner. Suitable for various transmission types including e-axles.



APPLICATIONS:

- Endurance tests with real-time lap simulation (Hardware in the loop)
- Launch and clutch development, including burnout simulation
- Complete rear-end testing, including uprights and hubs (performance and reliability)
- Compatibility with prototype gearboxes due to variable mounting plate
- Efficiency testing
- Adaptable for various test scenarios, including drive shaft testing
- High performance battery simulator for e-axle testing

TRANSMISSION TEST SYSTEM

OUTPUT DYNAMOMETER	
Continuous Power	450 kW
Maximum Speed	3,100 rpm
Base Speed	1,400 rpm
Continuous Torque at Maximum Speed	1,500 Nm
Peak Torque (1s) at Maximum Speed	2,000 Nm
Continuous Torque at Base Speed	2,700 Nm
Peak Torque (1s) at Base Speed	3,750 Nm
Inertia of Motor	0.6 $kg*m^2$
Motor Torque Control	3 ms
LATERAL INPUT (FRONT)	
Maximum Speed	9000 rpm
Continuous Power at Maximum Speed	635 kW
Peak Power at Maximum Speed	760 kW
Continuous Torque at various speeds	9000 rpm - 705Nm; 6500 rpm - 905 Nm; 1000 rpm - 1180Nm
Peak Torque at various speeds	9000 rpm - 800Nm; 6300 rpm - 1210 Nm
Inertia	0.1$kg*m^2$

ROAD SIMULATOR		
VERTICAL ACTUATOR	**Maximum Yoke Force**	+14 / 0 kN
	Maximum Yoke Displacement	± 60 mm
	Response	50 Hz
LATERAL ACTUATOR	**Maximum Yoke Force**	+14 / -7 kN
	Maximum Yoke Displacement	± 15 mm
	Response	50 Hz
DOWNFORCE ACTUATOR	**Maximum Yoke Force**	±20 kN
	Maximum Yoke Displacement	± 90 mm
	Response	50 Hz
LONGITUDINAL ACTUATOR	**Maximum Yoke Force**	+10 kN
	Maximum Yoke Displacement	±16.5 mm
	Response	50 Hz
BRAKE ACTUATOR	**Maximum Yoke Force**	+4/0 KNm
	Maximum Yoke Displacement	±5°
	Response	50 Hz

BATTERY SIMULATOR	
Voltage Range	12-920 Volt DC
Continuous Current	400 A
Peak Current (30secs)	800 A

LUBRICATION TEST SYSTEM

The forces experienced by transmission lubricants is recreated using real car data (Ax, Ay and Az acceleration data) which is recreated by the rig in rotation around two axes. This causes transmission oil distribution to be recreated accurately. A high-speed AC induction motor recreates the drive input from the engine. Oil can be conditioned to recreate different temperature scenarios. This delivers a very accurate analysis of lubricant behaviour in on-road conditions.

APPLICATIONS:

- Complete gearbox lubrication testing and analysis
- Replay of lap profiles (speed, acceleration)
- Specialised synthetic tests focusing on cornering and straightline details
- Spray bar set-up development
- Oil pump tests
- Cooler pressure drop testing

SPECIFICATIONS	
Continuous Power	63kW
Maximum Speed	20,000rpm
Torque	60Nm
Pitch Angle	-90° to 80°
Roll Angle	±60°

BY PLANE, TRAIN OR AUTOMOBILE: TGR-E IS AT THE HEART OF EUROPE

The Home of High Performance is just a short journey away, with TGR-E's prime location at the heart of Europe.

Cologne lies at a crossroads in Europe, with three major highways passing through the city and connecting to the main routes in Belgium, France, Holland and beyond to bring cities like Brussels (200km), Amsterdam (270km), Paris (500km) and Zurich (580km) within easy reach.

Even a journey across, or under, the Channel from Great Britain to TGR-E is straightforward, with regular ferry or Eurotunnel crossings from Calais just 400km away.

Cologne Bonn airport, the sixth largest passenger hub in Germany and its second biggest air freight terminal, is less than 25km from TGR-E while Düsseldorf at 65km and Frankfurt at 200km are also within easy reach.

For those who prefer the train, modern high-speed rail links connect Cologne to Brussels, Paris and Frankfurt faster than ever before while connections to most major European stations make a stop in the city.

WHAT MORE CAN WE SAY? CONTACT US NOW FOR MORE INFORMATION

With so many services on offer, a brochure can only give an overview. So for a detailed discussion on how to extract the full potential of your project or product simply call or email for a no-obligation consultation to understand exactly what we can offer.

As a multi-national company we have representatives speaking all major European languages and several more besides.

So get in touch by phone on **+49 2234 1823 0**, email **contact@tgr-europe.com** or check out **www.tgr-europe.com** to find out more.

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