AUTOMOTIVE

INFOCOM

MOBILITY, ENERGY & ENVIRONMENT

AERONAUTICS

SPACE

DEFENCE & SECURITY

Overview Test Facilities
Tests and Analyses

Industrieanlagen-Betriebsgesellschaft mbH
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D-85521 Ottobrunn

Overview Test Sites

IABG's Test Resources – Available Test Equipment

IABG has a wide range of test facilities and components at its disposal for structural tests.

- Testing Buildings

Ottobrunn	60,278 sq.ft, height up to 49 ft
Erding	53,820 sq.ft, height up to 89 ft
Dresden – Hall 1	53,820 sq.ft, height up to 76 ft
Dresden – Hall 2	19,375 sq.ft, height up to 56 ft

- Hydraulic Jacks

Total Number	more than 850
Nominal Load	1 – 1,800 lbf
Stroke	1 – 256 in.

- Hydraulic Power Supply Systems – stationary

Ottobrunn	988 US gpm at 4,060 psi
Dresden – Hall 1	1,585 US gpm at 4,060 psi
Dresden – Hall 2	555 US gpm at 4,060 psi

- Hydraulic Power Supply Systems – mobile

Erding	554 US gpm (2x 277 US gpm) at 4,060 psi

- Air Pressure Supply

Erding	94 ft^3/s (4x 23,5 ft^3/s) at 109 psi
Dresden – Hall 1	159 ft^3/s at 109 psi
Dresden – Hall 2	59 ft^3/s at 109 psi

- Overhead crane (lifting power)

Ottobrunn	16.5 US t & 22 US t
Erding	33 US t
Dresden – Hall 1	2x22 US t
Dresden – Hall 2	22 US t





Test infrastructure - Sites

Ottobrunn

- Base area — 60,278sq.ft
- Height — 49 ft
- Overhead crane (lifting power) — 16.5 US t & 22 US t

- Infrastructure
  - Hydraulics — 988 US gpm; 4,060 psi
  - Pneumatic (mobile) — currently on the site of Erding 94 ft^3/s (4x 23.5 ft^3/s);109 bar

Test infrastructure - Sites

Dresden – Halle 1

- Base area 53,820 sq.ft
- Height 89 ft
- Overhead crane (lifting power) 2x22 US t

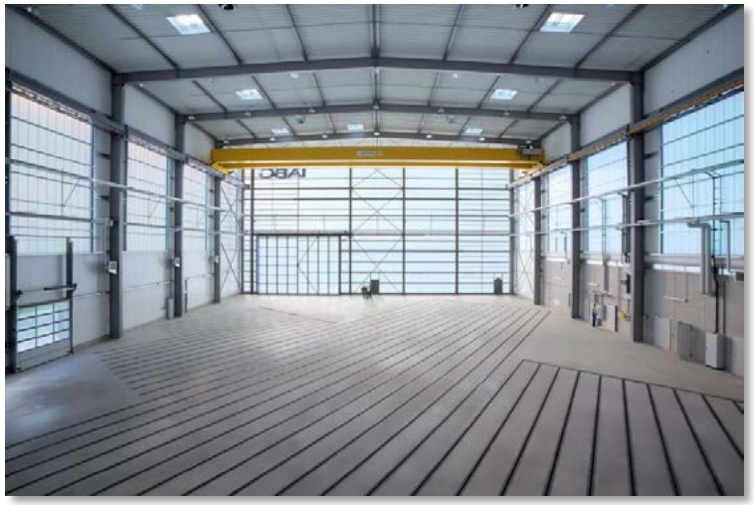
- Infrastructure (static)
  - Hydraulics 1,585 US gpm; 4,060 psi
  - Pneumatic 159 ft^3/s;109 psi

Test infrastructure - Sites

Dresden – Halle 2

- Base area 19,375 sq.ft
- Height 56ft
- Overhead crane (lifting power) 22 US t

- Infrastructure (static)
  - Hydraulics 555 US gpm; 4,060 psi
  - Pneumatic 59 ft^3/s; 109 psi



Test infrastructure - Sites

Erding – Mobile Test Hangar

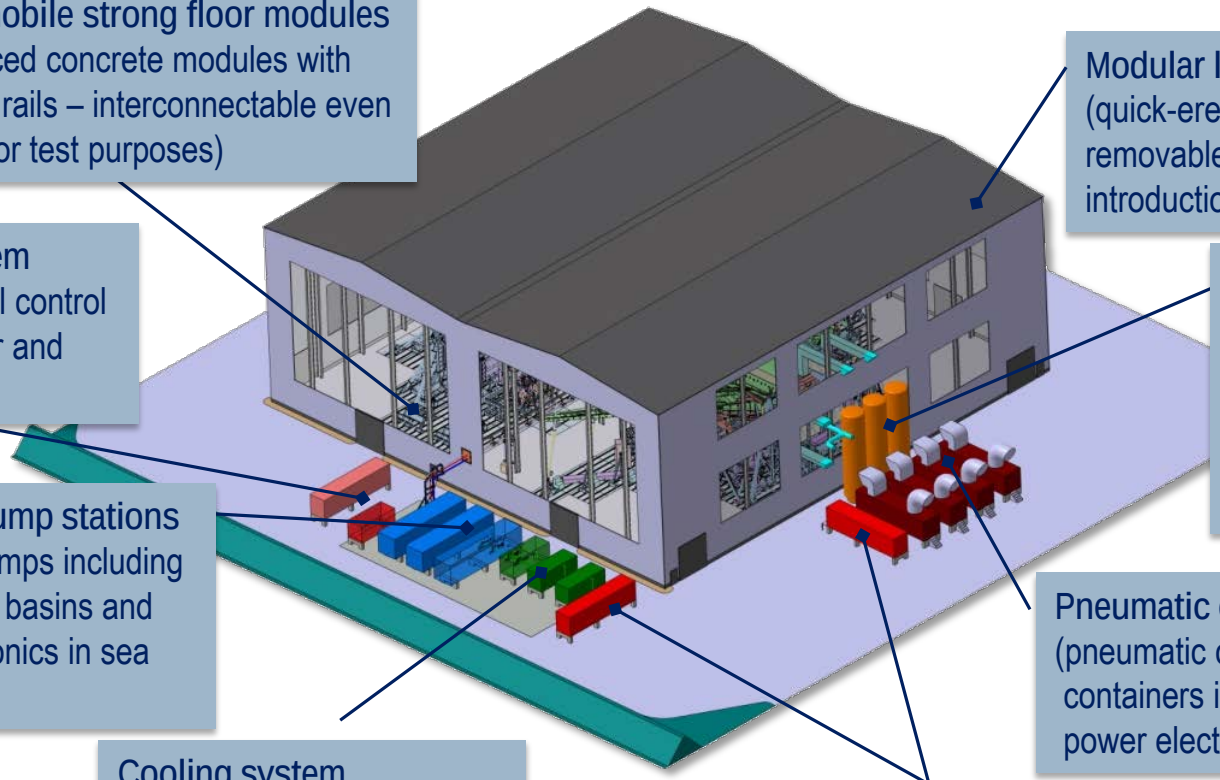
- Base area 53,820 sq.ft
- Height 89 ft
- Overhead crane (lifting power) 33 US t

- Infrastructure (mobile)
  - Hydraulics 555 US gpm; 4,060 psi
  - Pneumatic 94 ft^3/s; 109 psi

Mobile Modular Test-Infrastructure by IABG

Mobile Modular Test-Infrastructure

Flexibility due to scalability and mobility
Cost efficiency by higher usage intensity
Quick installation due to standardized interfaces



Semi-mobile strong floor modules
(reinforced concrete modules with anchor rails – interconnectable even for major test purposes)

Modular light-weight hangar
(quick-erection system with removable walls for specimen introduction)

Heating system
(environmental control for the hangar and equipment)

Pneumatic accumulators
(pneumatic vessels for loading adjustment at harmonized compressor utilization)

Hydraulic pump stations
(hydraulic pumps including tanks, stilling basins and power electronics in sea containers)

Pneumatic compressor stations
(pneumatic compressors in sea containers including air dryers and power electronics)

Cooling system
(environmental control for the high-energetic hydraulic pump stations)

Electric power stations
(electric power transformer including low voltage distribution in sea containers)

Test Benches – Overview

Test Beds

- Modular test facility (MTA)
- HYDRA / ELEKTRA

Large / Special Test Benches

- Loading Frame with 8900 p capacitiy
- Test Pit
- Multi-component vehicle body test bench (MEKKA III)
- Cylinder head test benches
- Thermo-mechanical fatigue testing unit (THETA chamber)
- Thermo-mechanical fatigue testing for exhaust systems (THEMA II)
- Shaker table HyMAS and LiMAS
- Fast single-cylinder test unit
- Large drop hammer
- Axle test bench for vehicle dynamics simulations (FDAP)

Resonance Test Benches

- Resonance test bench for springs with/without corrosion unit (CSTM/DSTM)
- Large resonance test bench for springs (GRFP)
- Stabilizer bar test bench (STAP42)
- Valve spring test bench (VSTM)
- Stone impact simulator (GISM)
- Spring/shock absorber test bench (FDP63)
- Rotating bending fatigue test bench (RBTM)

Fatigue Strength / Material Fatigue

- IABG fatigue strength test laboratory – room temperature
- IABG fatigue strength test laboratory – high temperature
- microme|x X-Ray Inspection System (2D/CT)
- Macro-thermogravimetric analyser LECO TGA 701

Pulse Generators

- Various pulse generators for resonance tests

Wheel Testing Equipment

- Radial impact test bench (RADIAS)
- Flat track tyre test bench Flat Trac® III CT [MTS]
- Biaxial wheel test bench (ZWARP) and brake disc test bench (BSP)
- Rotating bending facilities
- Wheel bearing test bench (REZ)
- Automatic half-axle test bench (AHAP)
- Impact test bench (TRIAS)

Environmental Simulation

- Large altitude chamber
- Vacuum chamber
- Temperature chamber
- Climatic chamber
- Vehicle chambers I & II
- Combined chamber
- Solar simulator
- Conditioning units
- Splash water test chamber
- Mobile corrosion unit (MoKo II)
- Dust test chambers

Miscellaneous

- High and low-pressure test equipment (HD/ND)
- EMP test facilities
- Various hydraulic universal test benches

Test Beds

Modular test facility (MTA)

APPLICATION

Structural tests mainly on aeronautical and automotive components

TECHNICAL DATA

- Rigid, planar 32.8 ft x 29.5 ft floor plate
- Modular design for flexible and fast test setup
- 4 independent supply units
- Permanently installed connections for hydraulics, pneumatics and power supply
- 2 cabinets with 20 control and monitor channels each for force, pressure and path control
- 400-channel measuring unit
- Maximum load: 90 lbf

Variable test bed setups (HYDRA / ELEKTRA)

APPLICATION

Functional, endurance and fatigue tests on components for the automotive, energy and aerospace industry

- Short lead times thanks to modular architecture
- Parallel execution of independent individual tests
- Individual and fast integration of test components
- Multitude of servohydraulic cylinders and pneumatic cylinders
- Digital measurement and control system to set, control and monitor signals online
- Execution of tests under simulated environmental conditions

TECHNICAL DATA

- Rigid, planar floor plate (main floor plate: 19.7 x 9.8 ft, secondary floor plate: 9.8 x 6.5 ft, t-slots in 10 in grid)
- Servohydraulic cylinders for forces up to 270 lbf and torques up to 2950 lbf ft
- Digital controller with multiple control PCs, up to 16 control channels and various bridge amplifiers, analogue and digital IOs
- 9 oil supply connections, each 32 US gpm at 4060 psi
- Various flexible mechanical superstructures, e.g. cylinder brackets, portals and clamping brackets, that enable us to quickly set up component tests with multidimensional test item loads
- Modelling of setups in CAD (SolidWorks), optional stiffness optimisation with FEM
- Optional simulation of environmental conditions
  - Temperature: -103°F to 356°F
  - Climate: 90% RH at max. 176°F
  - Abrasive media, e.g. dust, gravel or Skydrol and Pentosin oils

Loading frame with 900 kip capacity

APPLICATION

- Uniaxial loading
  - Static
  - Fatigue
- Measurement of all relevant parameters at 2,5 kHz
  - Load
  - Displacement
  - Strain at relevant areas

TECHNICAL DATA

- Load capacity:
  Static: Up to 900 kip (compression) and 430 kip (tension)
  Dynamic: Up to 314,7 kip (compression)
- Load cell: Specified measuring range up to 1124 kip (compression)
- Width of test specimen: Max. 63 in.
- Height of test specimen: Max. 67 in.
- Flexible measurement of loads, deformations/strain

Test Pit

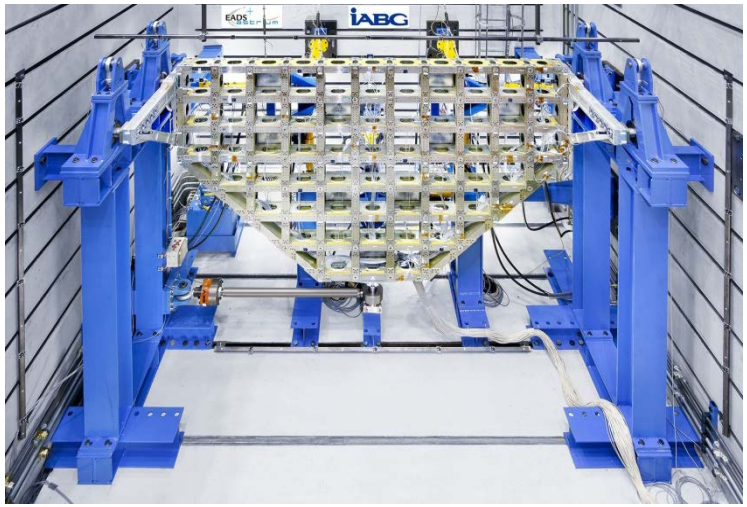
APPLICATION

The IABG test pit is used for tests on aerospace structures to allow:

- To simplify the steel test rig using the side walls
- To test high test articles (up to 21,9 yd) like Payload Stage of the Ariane Rocket

Features

- Strong floor and walls with anchors rails
- Hydraulic supply connection for load jacks
- Air ventilation



TECHNICAL DATA

- Dimension (l x w x h) 314,9 in x 236,2 in x 196,8 in
- Construction
  - Type of Construction Heavy Reinforced Concrete
  - Thickness (all around) 39,3 in
- Anchor Rails
  - Loading Capacity
    - Tension 41 kip/yd
    - Compression 41 kip/yd
    - Shear 20.5 kip/yd
  - Distance Rail to Rail
    - Test Pit Wall 19,6 in
    - Test Pit Floor 39,3 in

Major Test Benches

Multi-component vehicle body test bench (MEKKA III)

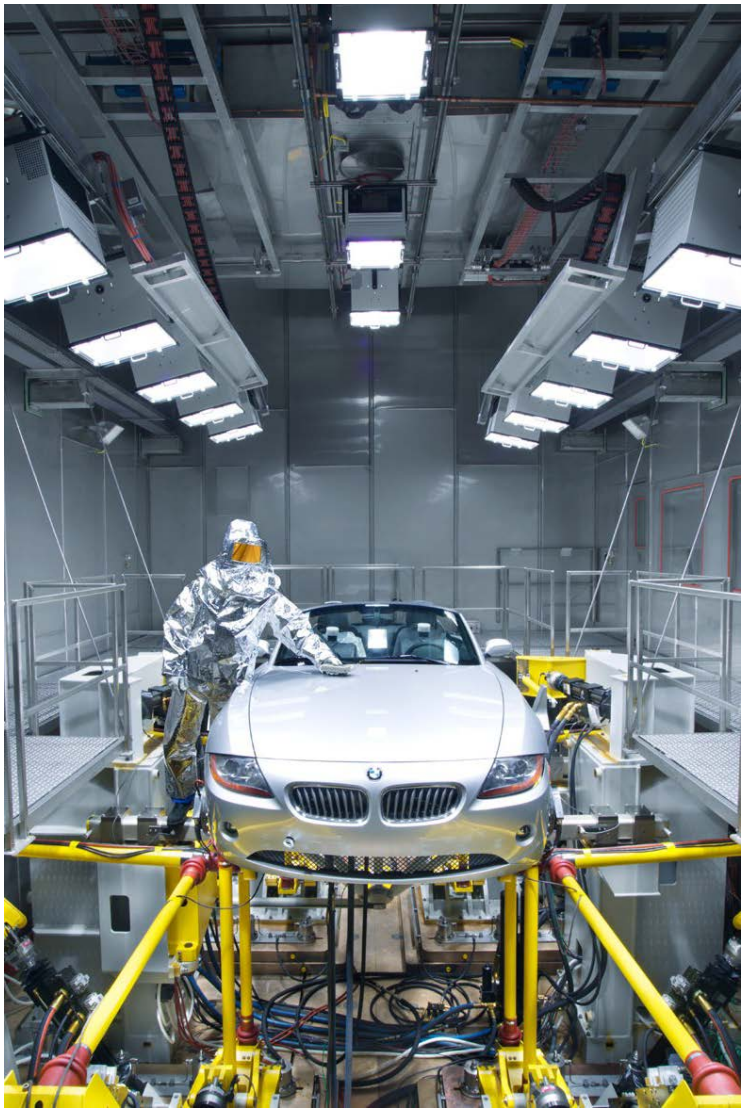
APPLICATION

Fatigue analyses for vehicle bodies under simulated relevant and realistic environmental conditions

- Real-time simulation of driving test measurements and synthetic test signals
- Iterative adjustment of operational loads to structural loads measured at the vehicle
- Superimposed simulation of temperature, humidity and sunlight
- Regular structure inspections and control of screw connections

TECHNICAL DATA

- 20 servohydraulic cylinders
  - Vertical, longitudinal and lateral force as well as driving and braking torque at all four wheels
  - Engine torque
  - Controlled securing of the vehicle body for low-frequency longitudinal and lateral loads
- Real time: Up to 50 Hz
- Temperature: - 40°F to + 194°F
- Relative humidity: 20% to 70%
- Solar simulation: 97 W/ft²
- Vehicle weight: Up to 3.9 US t



Cylinder head test bench I (ZKP I)

APPLICATION

Thermal fatigue strength tests for cylinder heads

- Examination of the thermal fatigue strength of cylinder heads
- Investigation of the fracture propagation behaviour in the top part of the combustion chamber
- Temperature measurements in the top part of the combustion chamber using an automatic infra-red camera system
- Unstaffed endurance tests; 10,000 cycles in roughly 10 days (approx. 1 min/cycle)

TECHNICAL DATA

Powering:	Six oxygen/propane torches with a max. heating performance of 75 kW
Coolant:	Water-glycol mixture Cold water: Max. 53 US gpm at 79°F Hot water: Max. 6.6 US gpm at max. 176°F Return temperature: Max. 248°
Gas supply:	3.2 US t propane 26 US t oxygen
Compressed air supply:	353 ft^3/min
Ventilation:	Recirculating air: 459,000 ft^3/h Discharged air used for heat recovery

Cylinder head test bench II (ZKP II)

APPLICATION

Thermal fatigue strength tests for cylinder heads

- Investigation of the thermo-mechanical fatigue and fracture propagation behaviour in the top part of the combustion chamber of a cylinder head
- Automated operation; approx. 1,000 thermal shock cycles per day
- Automated fracture documentation via high-res camera system
- Cylinder head tests on passenger cars, HGVs and buses as well as for shipbuilding and power engineering customers (stationary diesel and gas engines)

TECHNICAL DATA

Powering:	Six oxygen/propane torches with a max. heating performance of 75 kW
Coolant:	Water-glycol mixture Cold water: Max. 53 US gpm at 79°F Hot water: Max. 6.6 US gpm at max. 176°F Return temperature: Max. 248°
Gas supply:	3.2 US t propane 26 US t oxygen
Compressed air supply:	353 ft³/min
Ventilation:	Recirculating air: 459,000 ft³/h Discharged air used for heat recovery

Thermo-mechanical fatigue testing (THETA chamber)

APPLICATION

Stress tests for items exposed to simultaneous thermal and mechanical loads, e.g. spacecraft re-entering Earth's atmosphere

TECHNICAL DATA

- Fully automatic test system with manual control options
- Vacuum chamber diameter: Ø = 9.8 ft
  Vacuum chamber length: L = 11.5 ft
- Variable load profiles: T = f(x,y,z,t)
- Max. component size: 2.7 ft² to > 21.5 ft²
- Max. surface temperature: T_{max} > 3092°F
- Max. heat flow rate: > 79,000 kW/ft²
- Heating rate: dT/dt > 4.9 K/s
- Extendible clamping platform to quickly mount larger test items
- Special measuring options in high-temperature/vacuum environments

Thermo-mechanical fatigue testing for exhaust systems (THEMA II)

APPLICATION

Fatigue strength tests for entire exhaust systems, taking into account the following relevant load parameters:

- Dynamic load due to engine vibrations, uneven road conditions and load change behaviour of the drive unit (incl. switching operations)
- Thermal/thermo-mechanical load
- Load resulting from gas pulsations

TECHNICAL DATA

- Switching pilot (gearshift lever, clutch and accelerator)
- 2 electric dynamometers: P=240 kW
- Cooling: 450 kW
- Ventilation: 1060,000 ft³/h
- Fuel supply: 5,283 US gallons
- Maximum velocity: Approx. 186 mph (300 km/h) - 2,800 1/min
- 2 drive motors: 1475 lbf each
- Vertical excitation: 9/13 lbf/16 in, 0.01 lbm, 20 Hz
- Measurement data acquisition, evaluation and reduction using Catman©

Shaker table HyMAS (Heavy Multi-Axis Shaker)

APPLICATION

Simultaneous multi-axial (6DoF) vibration tests for the following applications:

- **Energy:** Simulation of synthetic design basis/safe shutdown earthquakes and the real-time course of earthquakes / reproduction of transient events (gusts of wind, plane crashes on buildings, detachment of components as a result of spallation)
- **Automotive:** Vibration tests on passenger car and commercial vehicle components
- **Transport:** Resonance and shock tests (rail vehicle equipment, electronic rail vehicle components)
- **Aeronautics:** Windmilling tests (fan blade-out, sustained engine imbalance)

TECHNICAL DATA

- Test item weight: Max. 22,000 lbm
- Frequency range: 0.5 Hz to 80 Hz
- Table dimensions: 8.2 x 6.6 ft
- Max. acceleration:
  - Vertical Z ±262 ft/s²
  - Longitudinal X ±164 ft/s²
  - Lateral Y ±131 ft/s²
- Max. path:
  - Vertical Z ± 2 in
  - Longitudinal X ± 5 in
  - Lateral Y ± 5 in
- Connection power:
  - 7185 US gpm at 4060 psi
- Measurement data acquisition:
  - Acceleration, paths, strains
  - Simultaneous acquisition and evaluation of up to 64 measurement data channels

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Shaker table LiMAS (Light Multi-Axis Shaker)

APPLICATION

Simultaneous multi-axial (6DoF) vibration tests for the following applications:

- **Automotive:** Vibration tests on passenger car and commercial vehicle components
- **Energy:** Simulation of synthetic design basis/safe shutdown earthquakes and the real-time course of earthquakes / reproduction of transient events (gusts of wind, plane crashes on buildings, detachment of components as a result of spallation)
- **Transport:** Resonance and shock tests (rail vehicle equipment, electronic rail vehicle components)
- **Aeronautics:** Windmilling tests (fan blade-out, sustained engine imbalance)

TECHNICAL DATA

- Test item weight: Max. 2,200 lbm
- Frequency range: 0.5 Hz to 200 Hz
- Table dimensions: 7.5 x 6.6 ft
- Max. accelerations (1323 lb/ 2,200 lb):
  - Vertical Z ± 426 ft/s² / ±1328 ft/s²
  - Longitudinal X ± 262 ft/s² / ±230 ft/s²
  - Lateral Y ± 344 ft/s² / ±230 ft/s²
- Max. path/angle:
  - Vertical Z + 5.3 to -6.3 in / Roll ±7.4°
  - Longitudinal X ± 3,9 in / Pitch +7.0° to -8.2°
  - Lateral Y ± 4,5 in / Yaw ±5.2°
- Environmental conditions:
  - Temperature range: -40°F to +397°F
  - Humidity: Up to 95% RH
- Measurement data acquisition:
  - Acceleration, paths, strains, temperatures
  - Simultaneous acquisition and evaluation of up to 64 measurement data channels

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Fast single-cylinder test unit I (SEZ I)

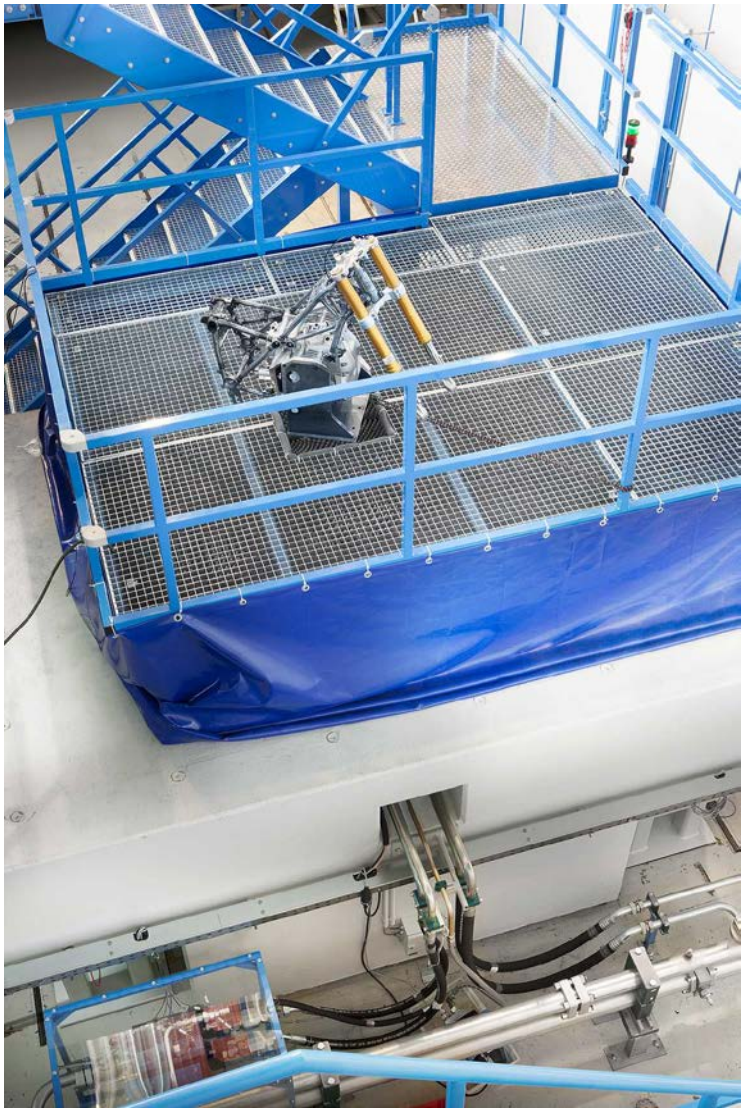
APPLICATION

Tests with single-axis (vertical) vibration signals in accordance with the following test standards:

- DIN EN 60068-2-6: Vibration – sinusoidal
- DIN EN 60068-2-50: Combined test – cold/vibration – sinusoidal
- DIN EN 60068-2-51: Combined test – heat/vibration – sinusoidal
- DIN EN 60068-2-57: Vibration – time history method
- DIN EN 60068-2-59: Vibration – sine beat method
- DIN EN 60068-2-64: Vibration – broadband random
- DIN EN 60068-2-80: Vibration – mixed-mode

TECHNICAL DATA

- Cylinder force: ± 11,240 lbf (stat.), +/- 9,000 lbf (dyn.)
- Cylinder path: ± 7.9 in
- Test frequency range: 0.5 Hz to 200 Hz
- Max. test item weight: 2,200 lbm (131 ft/s^2 at 3 Hz to 200 Hz)
- Maximum velocity: 13 ft/s
- Max. acceleration: 1969 ft/s^2 at 80 Hz
- Temperature range: -40°F to 248°F



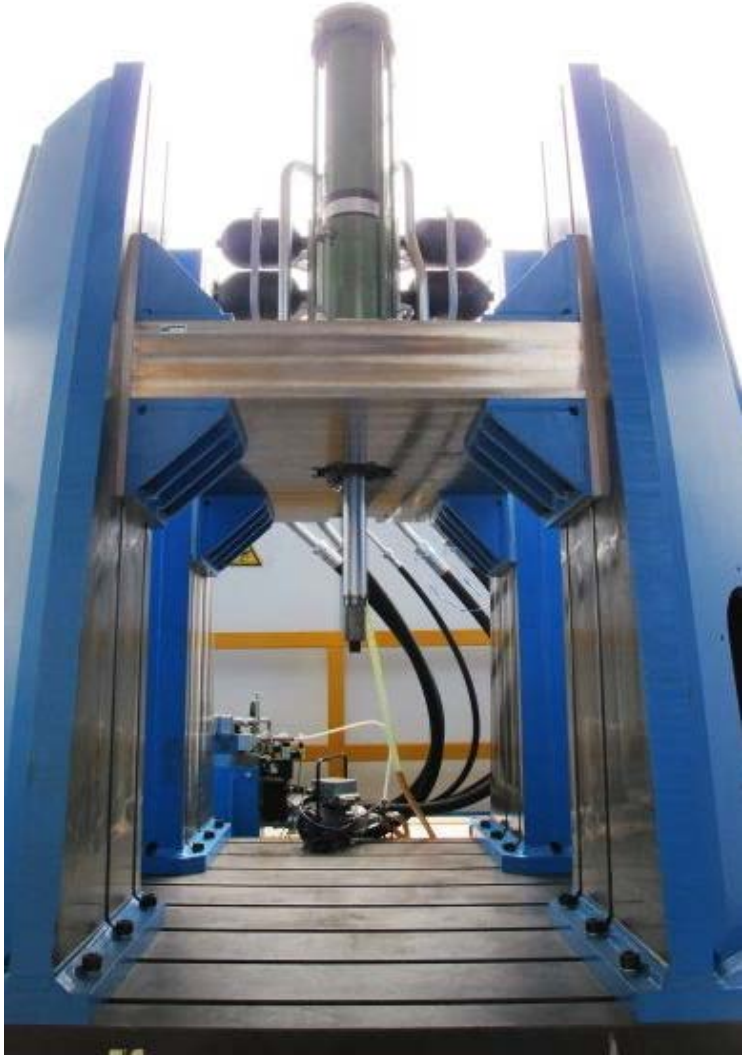
Fast single-cylinder test unit II (SEZ II)

APPLICATION

- High-speed tensile bond strength tests

TECHNICAL DATA

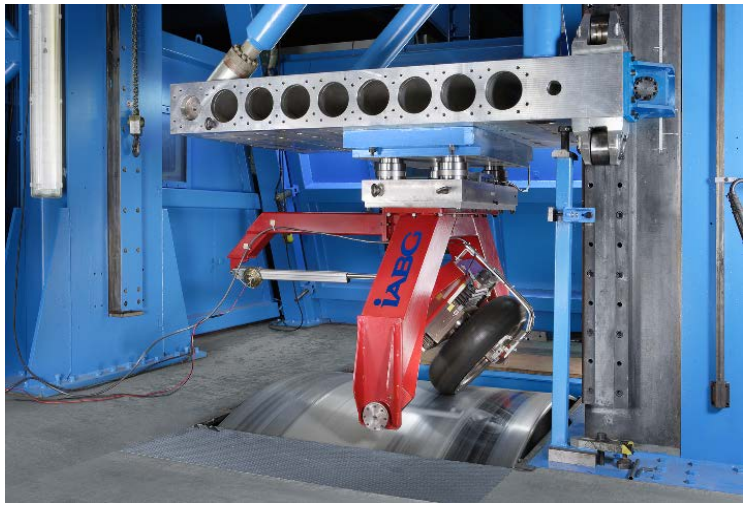
- Clear span: 35 in
- Max. test setup height: 63 in
- Test force: ± 674 lbf
- Test path: ± 8 in
- Maximum velocity: 36 ft/s



Large drop hammer (automotive tests)

APPLICATION

- Roll and burst tests
- Endurance tests, slide tests
- Cleat tests
- Drop and landing tests



TECHNICAL DATA

Drum

- Max. circumferential velocity: 249 mph (400 km/h)
- Drum diameter: 13.1 ft
- Drum width: 4.9 ft
- Drum driver power: 130 kW

Test bench

- Adaptable and multi-functional setup
- Obstacles and cleats of up to 6 in
- Adjustable slip angle, camber angle and vertical load
- Various steel or friction surfaces
- Various metrology equipment (wheel force sensor, wheel force dynamometer, load cells, strain gauges)

Large drop hammer (aeronautics tests)

APPLICATION

- Drop tests for aircraft landing gear
- Roll tests, endurance tests, slide tests, brake tests, vibration tests, tyre burst tests, tyre tests
- Cleat tests

Test bench

- Adaptable and multi-functional setup
- Obstacles and cleats of up to 6 in
- Adjustable slip angle, camber angle and vertical load
- Various metrology equipment (wheel force sensor, wheel force dynamometer, load cells, strain gauges)

TECHNICAL DATA

Drum

- Max. circumferential velocity: 249 mph
- Drum diameter: 13.1 ft
- Drum width: 4.9 ft
- Drum driver power: 130 kW
  (4Q drive/ drive and brake)
- Drum surface: Blank steel or friction surface
- Maximum drum load:
  - Vertical: 125,900 lbm
  - Axial: 45,000 lbm
  - Tangential: 90,000 lbm
- Mass moment of inertia for drum: 70,000 lbft^2
- Drop mass: Max. 30,864 lbm
- Drop height: Max. 36 ft
- Fall velocity with counterweight: Max. 23 ft/s
- Fall velocity without counterweight: Max. 33 ft/s

Axle test bench for vehicle dynamics simulations (FDAP)

APPLICATION

Fatigue strength tests on wheels and brake discs in operating load simulation tests

- Examination of the dynamic load resulting from steering and braking manoeuvres, uneven road conditions and load change behaviour
- Real-time simulation of vertical, roll, pitch and steering movements of the vehicle in real time
- Realistic simulation of endurance tests, for example extreme driving tests on the Nordschleife (North Loop) of Germany's Nürburgring (lateral force as per slip angle, camber angle as per original axle kinematics)

TECHNICAL DATA

Drive:	Two DC shunt motors (each 300 kW nominal output at 400 V)
Acceleration:	0 – 62 mph (100 km/h) in 2.1 s; 0 – 191 mph (308 km/h) in 8.6 s
Deceleration:	62 – 0 mph in 1.9 s; 191 – 0 mph in 8.2 s
Drums:	External diameter: 79 in, track width: 24 in, weight: 2,3 US t
Hydraulic cylinders:	2 servohydraulic linear cylinders (stroke: 10 in, nominal load: 9000 lbf) 1 servohydraulic rotary cylinder for operating the steering wheel
Brake pressure unit:	2900 – 3626 psi operating pressure; ABS controller

Resonance Test Benches

Resonance test bench for springs with/without corrosion unit (CSTM/DSTM)

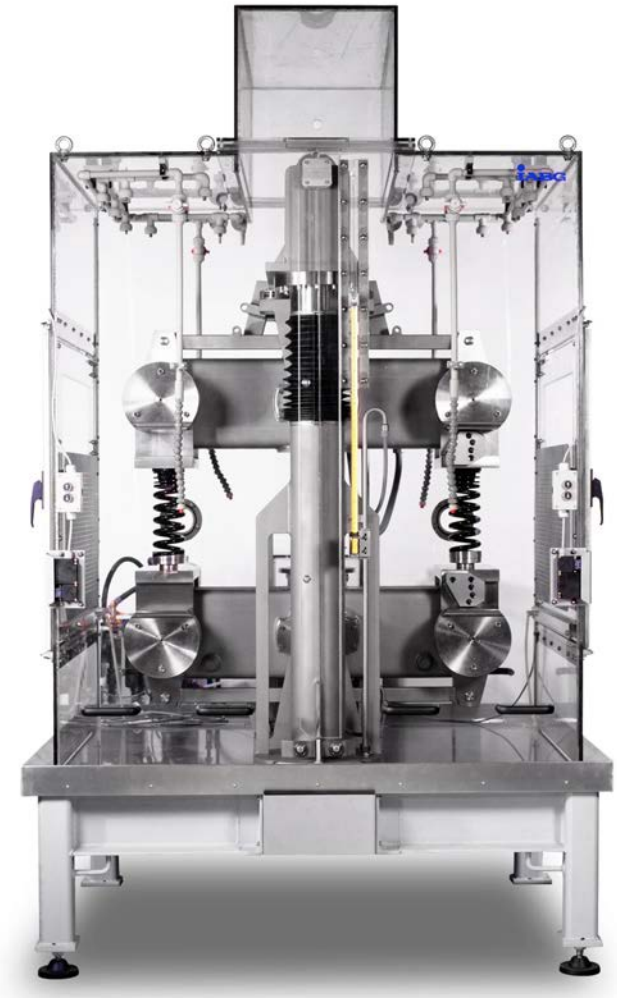
APPLICATION

Fatigue strength tests on springs exposed to corrosive media

- Measurement of spring force and compression (recording of spring characteristic and relaxation)
- Test items: Springs of all kinds with parallel and circular deformation, with and without corrosion impact
- Saltwater vessel (66 US gallons) with individually programmable spray intervals and heating up to 122°F
- Low noise and low vibration (no special foundations required)
- Time- and cost saving method for determining the fatigue strength of springs with and without exposure to corrosive media

TECHNICAL DATA

- Machine dimensions: L = 71 in, W = 79 in, H = 102 in
  (additional floor space required for control console, corrosion unit, water treatment unit and hydraulic oil supply)
- Weight: Approx. 3.9 US t
- Maximum load allowed for each of the two test positions: F_{max} = 9000 lbf
- Number of springs that can be tested simultaneously: 2, 4, … F_{max}
- Stroke (path-controlled): S = 0.4 – 12 in
- Maximum spring length: L_o = 30 in
- Test frequency: $f_o = 0.23....0.33 \times \sqrt{n} \times \sqrt{R}$ [Hz]
  n = Number of springs to be tested simultaneously
  R = Spring constant [N/mm]
  f_o = 1.8 Hz to 15 Hz



Large resonance test bench for springs (GRFP)

APPLICATION

Fatigue strength tests on large springs and leaf springs under laboratory conditions

- Time and cost saving method for determining the fatigue strength of springs under normal laboratory conditions (measuring the spring force and spring length)
- Simultaneous testing of multiple spring elements. The number of spring elements that can be tested simultaneously is limited only by the maximum load allowed and the available set-up space.
- Low noise and low vibration (no special foundations required)
- Test items: Springs of all kinds with parallel deformation

TECHNICAL DATA

- Machine dimensions: L = 87 in, W = 87 in, H = 138 in
  (additional floor space required for control console, control cabinet and hydraulic oil supply)
- Weight: Approx. 89.4 US t
- Hydraulic oil station
- Maximum load allowed for each of the two test positions: F_{max} = 45 lbf
- Number of springs that can be tested simultaneously: 2, 4, … F_{max}
- Stroke (path-controlled): S = 0.4 to 16 in
- Maximum spring length: L_o = 39 in
- Test frequency: $f_o = 0.19 \ldots 0.28 \times \sqrt{(n \times R)}$ [Hz]
  n = Number of springs to be tested simultaneously
  R = Spring constant [N/mm]
  f_o = 2 Hz to 20 Hz

Stabilizer bar test bench (STAP42)

APPLICATION

Validation of the fatigue strength of anti-roll bars in passenger cars and HGVs

- Deduction of measures to increase fatigue strength
- Design approval
- Examination of the influence of different production parameters
- Flaw detection
- In situ acceptance testing as per specifications

TECHNICAL DATA

Test items:	Anti-roll bars of all kinds for passenger cars
Diameter:	d = 0.4 to 1.7 in
Length:	L ≤ 79 in
Test frequency range:	f = 10 Hz to 25 Hz
Type of load:	Wöhler and fatigue strength tests at R = -1
Weight:	7,055 lbm
Dimensions:	L x W x H = 177 x 159 x 71 in

Benefits of the IABG anti-roll bar test bench

- Energy-efficiency by utilising the principle of resonance in tests
- Reliability and low maintenance
- Exclusion of exogenic forces and vibrations
- Software-based testing, documentation and evaluation
- Recognised by all leading car manufacturers
- Compliance with industry-standard anti-roll bar and spring specifications

Valve spring test bench (VSTM)

APPLICATION

Time and cost-saving tests based on the principle of resonance to determine the fatigue strength of valve springs at certain temperatures

- Tests with maximum stress almost to a block
- Simultaneous testing of a high number of valve springs
- Simulation of environmental conditions incl. increased temperature
- Statistical validation with systematic testing and a sufficient number of test items
- Determination of dynamic relaxation behaviour

TECHNICAL DATA

- Maximum load allowed for each of the two test positions:
  F_{max} = 4,500 lbf
- Maximum mean load allowed for each of the two test positions:
  $F_{m,\,max}$ = 2,923 lbf
- Maximum possible stroke: S = 83 in
- Maximum setup height: L = 10 in
- Test frequency: $f_o = 0.6\,\sqrt{(n \cdot R)}$ [Hz] = 2 Hz to 20 Hz
  n = Number of springs
  R = Spring constant [N/mm]
- Temperature regulation: T_{max} = 392°F
- Constant or variable amplitudes (collective loading)

Stone impact simulator (GISM)

APPLICATION

Defined and reproducible simulations of stone chip damage to components

- Type and amount of the test media as well as the impact velocity can be varied
- Defined impact velocity of the test media – independent of shape, size and weight
- Applications:
  Testing axle springs, anti-roll bars, shock absorbers, axle-mounted components, fronts of road and rail vehicles, vehicle body parts, fuel tanks, gearboxes, oil sumps, windscreens and wheelset axles / simulating the impact of hailstones on wind turbine blade tips or photovoltaic modules

TECHNICAL DATA

Max. impact speed:	128 ft/s / 273 ft/s
Angular adjustment:	Horizontal/vertical
Height adjustment:	Up to 28 in
Target area localisation via:	Laser
Max. particle size of the test medium:	0.8 / 1.6 in
Weight without control cabinet:	Approx. 1764 lbm
Dimensions without control cabinet:	L = 90 in, W = 43 in, H = 79 in

Spring/shock absorber test bench (FDP63)

APPLICATION

Fatigue strength tests for spring/shock absorber elements and air spring systems

- Dynamic and static fatigue strength and functional tests to validate the expected service life of a component
- Testing under realistic environmental conditions and simulation of the axle kinematics
- Vehicle-specific excitation of electronic shock absorber components
- Loading with block programmes (sine), superimposed sine or real-time signals

TECHNICAL DATA

- Max. static load: 14,163 lbf
- Max. dynamic load: Approx. 11,240 lbf
- Max. stroke: +/-5 in
- Maximum velocity: 5.2 ft/s
- Frequency ranges: 0 Hz to 20 Hz
- Max. mounting height: 39 in
- Clear span: 24 in
- Temperature range: -40°F to +212°F
- Measured variables: Path, pressure, force and temperature
- Test items: 2 or 4 air springs, with or without spring leg
- Optional simulation of the kinematics of a cam disc or a deflexion lever in a vehicle; automated pressure feeding

Rotating bending fatigue test bench (RBTM)

APPLICATION

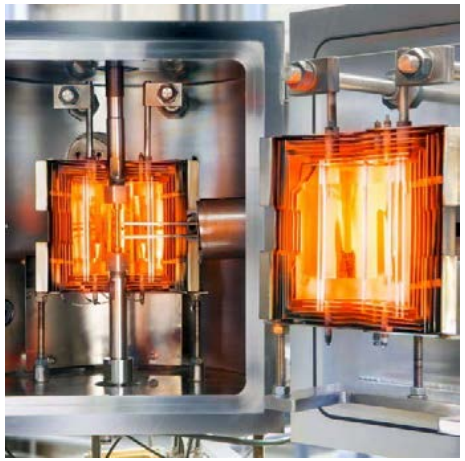
Determining the fatigue strength of high-tensile materials used to manufacture springs and anti-roll bars

- Comparison of fatigue strength before machining of the raw material into the end product
- Material optimisation (e.g. type of material, heat treatment, shot blasting parameters, reduction of variance etc.)
- Determination of fractures, inclusions and similar flaws in materials to assess the material quality
- Assessment of surface quality

TECHNICAL DATA

- Test items: Machined or unmachined cylindrical bars or tubes (also for stepped shafts)
- Bar/tube diameter: d = 0.3 to 1.2 in
- Bar/tube length: L = 60 d + 5.5 in (or special lengths)
- Test frequency: f = 5 Hz to 50 Hz (variable)
- Power consumption: < 1 kW
- Properties: No outgoing vibrations, very quiet
- Weight/Dimensions: Approx. 2,200 lbm, L = 102 in, W = 39 in, H = 59 in
- Circumferential bend, load input via crowned, non-wearing plastic rings
- Load (stress) and strain measurement, load cycle counter

Fatigue Strength / Material Fatigue



IABG fatigue strength test laboratory – room temperature

APPLICATION

- Fatigue strength tests for metallic materials (tension/pressure, bending, torsion)
- Fatigue strength tests for fibre-reinforced plastics (Wöhler tests, evaluation of the degree of stiffness degradation)
- Determination of fracture-mechanical properties
- Quasi-statistic determination of parameters for tension, pressure and bending tests

TECHNICAL DATA

- Servohydraulic test systems: 2,250 lbf to 22,500 lbf
- Spindle test bench: 22,500 lbf
- Temperature range: -321°F to 662°F
- Control modes: Path, force, strain
- Measurement sensors: Displacement sensor, load cell, extensometer, video extensometer
- Captured data: Path, force, strain
- Automatic hydraulic fluid supply

IABG fatigue strength test laboratory – high temperature

APPLICATION

- Material tests at temperatures of up to 3,632°F as follows:
  - High Cycle Fatigue (HCF)
  - Low Cycle Fatigue (LCF)
  - Complex Low Cycle Fatigue (CLCF)
  - Thermo-Mechanical Fatigue (TMF)
  - Creep tests
  - Relaxation tests

TECHNICAL DATA

- Servohydraulic test systems: 2,250 lbf to 22,500 lbf
- Furnaces for radiative heating
- High-frequency generator: 10 kW
- Controlled blowing of compressed air to cool down test items
- Water-cooled clamping jaws
- Control modes: Path, force, strain, temperature
- Measurement sensors: Displacement sensor, load cell, extensometer, thermal element
- Captured data: Path, force, strain, temperature
- Automatic hydraulic fluid supply

X-Ray Inspection System micromex (2D/CT)

APPLICATION

X-ray inspection is a non-destructive volumetric testing method for components and semi-finished parts made of various materials. Radiographic tests can be performed on solid materials including metals, steels and cast materials as well as plastics, ceramics and fibre composites. X-ray inspection is also used for foods in order to determine pore volumes and visualise internal structures.

- Non-destructive volumetric tests to detect defects
- Geometric measurements
- Collection of real CAD data for calculations
- Assembly tests for complex machinery
- Characterisation of composites and compound materials
- Failure analyses

TECHNICAL DATA

- Micro-focus tube: 180 kV / 20 W
- Cone angle: 180°
- Maximum sample size: 27 x 25 x 7 in
- Maximum sample weight: 22 lbm
- Geometric magnification: 2,160 x
- Total magnification: 23,320 x
- Detail detectability: < 3.9e-5 in
- Number of axes: 5
- View angle: 70°

Macro-thermogravimetric analyser LECO TGA 701

APPLICATION

- Quality assurance for fibre-reinforced plastics (CFRP, GRP) by determining the fibre-to-resin ratio
- Cost-efficient alternative to the wet-chemical determination of the fibre volume ratio of fibre-reinforced plastics as per DIN EN 2564 or a standard procedure for automotive manufacturers and suppliers, e.g. BMW Standard Test Method PR 527
- Determination of humidity, volatile components, ash, ignition loss in plastics as well as any kind of organic material, e.g. paper, food, coal/coke and – in cement – bonding agents

TECHNICAL DATA

Sample weight:	Max. 0.01 lbm
Sample count:	Max. 19 (simultaneous measuring)
Weighing accuracy:	2.2e-6 lb
Furnace control:	59°F/min RT…212°F; 106°F/min 212°F…1832°F
Gas flow:	0.9 US gpm to 2.6 US gpm
Gas pressure:	35 psi
Electricity supply:	~ 230 V, single-phase, 50 Hz, 25 A
Suction:	9 to 20 US gps
Environment:	59°F to 95°F; max. RH: 80%
Device dimensions (without computer):	20 x 24 x 22 in

Pulse Generators

High-frequency pulser (HFP 20)

APPLICATION

Vibration tests on components with a single-stage load or block programme

- Determination of cyclical material and component properties (Wöhler tests)
- Applications: Automotive and aeronautics components (particularly engine and control elements, piston rods and crankshafts)

TECHNICAL DATA

- Test force: Up to 45,000 lbf
- Maximum test frequency: 250 Hz
- Dynamic path: 0.16 in (± 0.08 in)
- Clear span: 20 in
- Max. test setup height: 31 in
- T-slotted floor plate to mount any type of component (22 x 29 in, M16 t-slots, slot distance: 5 in)
- Positioning of load cell at top or bottom
- Grease or pressure oil lubrication

High-frequency pulser (HFP 400)

APPLICATION

Vibration tests on components with a single-stage load or block programme

- Determination of cyclical material and component properties (Wöhler tests)
- Applications: Automotive and aeronautics components (particularly engine and control elements, piston rods and crankshafts)

TECHNICAL DATA

- Test force: Up to 90,000 lbf
- Maximum test frequency: 200 Hz
- Dynamic path: 0.24 in (± 0.12 in)
- Clear span: 24 in
- Max. test setup height: 48 in
- T-slotted floor plate to mount any type of component (39 x 39 in, M24 t-slots, slot distance: 3.9 in)
- Positioning of load cell at top or bottom
- Grease or pressure oil lubrication

HFP 1-3

APPLICATION

- Fatigue strength tests
  - Tension/pressure
  - Axial bending
  - Torsion
- K_{IC}: Increasing-force tests
- Thermal chamber
- Corrosion chamber

TECHNICAL DATA

- Maximum test force: 33,700 lbf
- Frame: Manufactured by Amsler
- Digital controller: Manufactured by RUMUL/ Zwick
- Various clamping devices

HFP 4

APPLICATION

- Fatigue strength tests
  - Tension/pressure
  - Axial bending
  - Torsion
- K_{IC}: Increasing-force tests
- Thermal chamber
- Corrosion chamber

TECHNICAL DATA

- Maximum test force: 33,700 lbf
- Frame: Manufactured by Amsler
- Digital controller: Manufactured by RUMUL/ Zwick
- Various clamping devices

HFP 5-6

APPLICATION

- Fatigue strength tests
  - Tension/pressure
  - Axial bending
  - Torsion
- K_{IC}: Increasing-force tests
- Thermal chamber
- Corrosion chamber

TECHNICAL DATA

- Maximum test force: 45,000 lbf
- Frame: Manufactured by Amsler
- Digital controller: Manufactured by RUMUL/ Zwick
- Various clamping devices

Wheel Testing Equipment

Radial impact test bench (RADIAS)

APPLICATION

Fatigue strength tests and simulation of failure behaviour under impact loads

- Radial impact test on car wheels with tyres
  - Safeguarding the fatigue strength of rims from fracture (e.g. when driving through potholes)
  - Preloading of wheels with impact loads for subsequent fatigue strength tests
- Impact load tests for motorbike forks and control arms
- Crash tests for semi-finished CFRP parts and crash energy-absorbing elements

TECHNICAL DATA

Drop weight (increasable):	331 lbm
Maximum drop height:	26.2 ft
Impact energy at a drop height of 1m:	1471.5 J
Velocity at drop height of 1m:	14.5 ft/s
Max. impact force at the centre of fin:	22.500 lbf
Fin angle:	150˚ (exchangeable)
Fin dimensions (W x L):	8 x 20 in
Wheel dimensions:	Currently 15-21 inches
Wheel camber angle:	1˚ (variable, 0–3°)

Flat track tyre test bench Flat Trac® III CT [MTS]

APPLICATION

- Determination of characteristics, stationary and dynamic measurements
- Standardised and customer-specific test procedures
- Definition of tyre parameters
- Data evaluation for parameterising different tyre models
- Special tyre measurements

TECHNICAL DATA

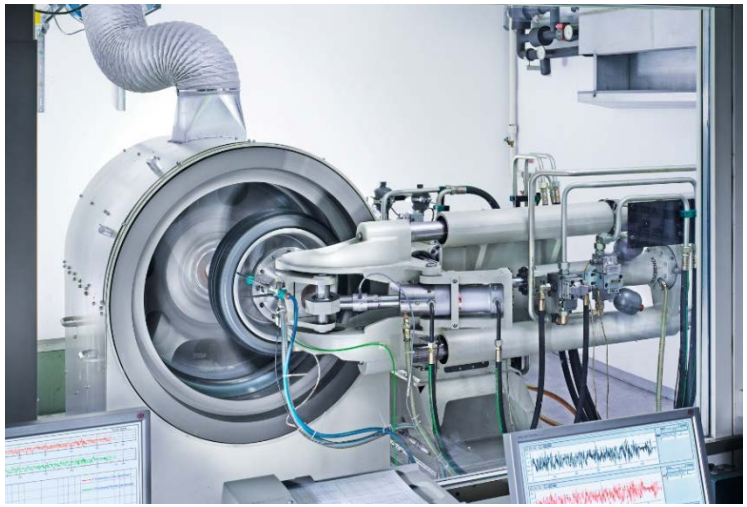
- Wheel diameter: 36 in
- Wheel width: 18 in
- Track speed: 228 ft/m
- Braking / driving with separate spindle drive
- Slip angle: ±30°
- Camber angle: -12… 45°
- Measuring of force and torque with multi-component wheel measuring hub:
  Fx 2,250 lbf, Fy 3,370 lbf, Fz 5,620 lbf, Mx 2,065 lbft, My 2,065 lbft, Mz 2,213 lbft (maximum values)

Biaxial wheel test bench (ZWARP) and brake disc test bench (BSP)

APPLICATION

Fatigue strength tests on wheels (ZWARP) and brake discs (BSP) in operating load simulation tests

- Dynamic loading of lateral and radial forces
- Simplified simulation of endurance tests on the Nordschleife (North Loop) of the Nürburgring race track in Germany (lateral force through thrust rings, managed and controlled impact in optimum emulations of loads locally exerted in the wheel rim)
- Operational load simulation tests or New European Driving Cycle (NEDC)



TECHNICAL DATA

ZWARP drive:	AC asynchronous induction motor with a power of 65 kW
BSP drive:	DC motor with a power of 166 kW
Drum:	External diameter: 46 in, Internal diameter: 41 in, depth: 29 in
Thrust rings:	Distance variable from 6 in to 12 in
Test items:	Maximum radius: 17 in, maximum tyre width: 12 in
Hydraulic cylinder for F_y and F_z:	Stroke: 10 in, maximum static force: 9,000 lbf maximum dynamic force: 5,620 lbf
Hydraulic cylinder for camber angle setting:	Stroke: 150 mm, maximum force: 22,500 lbf
Camber angle setting:	From -15° to +15°

Rotating bending facility (ULB) for wheels

APPLICATION

Tests to evaluate the fatigue strength of vehicle wheels, in particular the dynamic fatigue strength of wheel discs exposed to extreme lateral force

- Loading through rotating bending torque until failure through cracks and/or fracture
- Prerequisite for approval by TÜV and DEKRA material test centres

TECHNICAL DATA

- Rotating flyweight to realise different bending torques (up to 11,000 lbft)
- Wheel bolt control with embedded torque measurement system
- Velocity range: 500 rpm to 2,400 rpm
- Nominal wheel diameter: 10 inches to 23 inches
- Total weight: 4400 lbm

Wheel bearing test bench (REZ)

APPLICATION

Biaxial tests to assess the service life of passenger car and SUV wheel bearings

- Service life test with additional thermal loads
- High strain test
- Service life test applying real-life loads to wheel bearings

TECHNICAL DATA

Maximum radial load:	± 9,000 lbf
Maximum axial load:	± 5,620 lbf
Maximum velocity:	1,600 rpm
Signals:	Block programmes with variable forces and velocities
Measured variables:	Force, path, temperature and acceleration ("noise")
Test items:	2 or 4 wheel bearings installed with adapters or original mounting components
Optional:	External heating of bearings Assessment of bearings (races, ball bearing, grease analysis etc.) Additional mud testing with a mixture of Arizona dust, salt and water

Automatic half-axle test bench (AHAP)

APPLICATION

Fatigue strength tests for spring/shock absorber elements and air spring systems

- Dynamic and static fatigue strength and functional tests to validate the expected service life of a component
- Testing under realistic environmental conditions and simulation of the axle kinematics
- Vehicle-specific actuation of electronic shock absorber components; automated pressure feeding
- Loading with block programmes (sine), superimposed sine or real-time signals

TECHNICAL DATA

	Vertical	Horizontal
Max. static load:	±22,500 lbf	±2,250 lbf
Max. dynamic load:	±18,000 lbf	±1,800 lbf
Max. stroke:	±5 in	±2 in
Max. piston speed:	±10 ft/s	±1.6 ft/s

- Temperature range: -40°F to +212°F
- Measured variables: Path, force, pressure and temperature
- Water cooling using cooling jackets
- Testing with original kinematics, also with simulation of the steering angle

Impact test bench (TRIAS)

APPLICATION

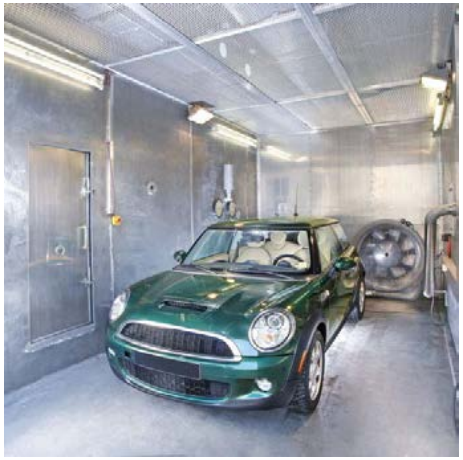
Fatigue strength tests and simulation of failure behaviour under impact loads

- Impact test in compliance with ISO 7141
- Misuse test (side impact against kerbstone)

TECHNICAL DATA

- Drop weight (depending on vehicle weight): 1025 lbm to 2150 lbm
- Drop height: 9 in

Environmental Simulation



High altitude chamber – up to 12,500 ft above zero

APPLICATION

- Altitude simulation
- Exhaust analysis and fuel consumption measurements (EU and US)
- Driving dynamic analysis in combination with altitude and temperature

TECHNICAL DATA

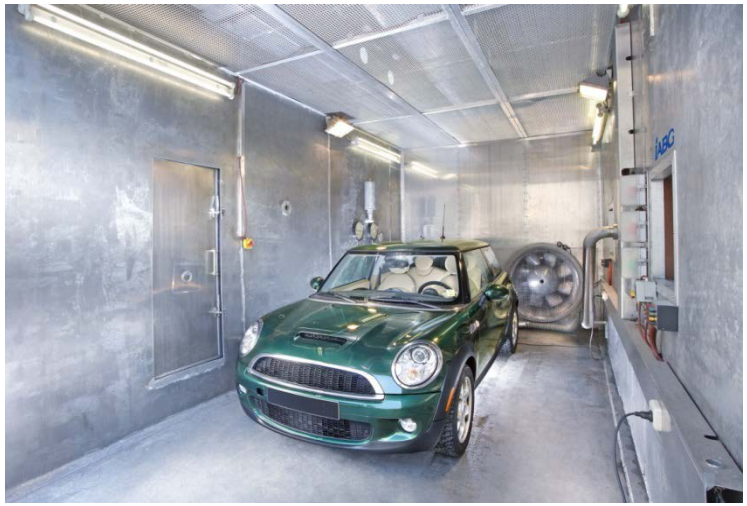
- Dimensions (L x W x H): 27.9 x 14.8 x 14.1 ft
- Temperature range: -22°F to +122°F
- Cooling capacity: Max. 180 kW
- Ambient pressure: Approx. 14 psi to 9 psi (abs.) (approx. 1,837 ft to 12,467 ft)
- Controlled humidity: Up to 95 % relative humidity
- Single Roller Dynamometer:
  P_{max}= 210 kW, tractive force = 1,350 lbf,
  v_{max}= 124 mph (200 km/h), vehicle weight simulation of up to 8,000 lbm, axle load max. 4,400 lbm
- Air fan:
  Rear wheel drive vehicle: max. 1200,000 ft³/h, max. 80 mph (130 km/h)
  Front wheel drive vehicle: max. 918,000 ft³/h, max. 62 mph (100 km/h)
- CVS emission measurement: 2 sampling lines
  (1. tailpipe : diluted emissions in bags and modal emissions /
  2. engine out: undiluted emissions at separate sampling point)

Altitude chamber II – up to 65,600 ft above zero

APPLICATION

- Function tests, e.g. cold-start tests with altitude simulation
- Endurance tests

- Please bear in mind, that a medical certificate is needed while attending the tests in a chamber under reduced pressure. If you want to attend the tests, this certificate is needed and it should be adhere, that there is no concern against abidance under reduced pressure. Above the altitude of 13,123 ft, entry to the chamber is not permitted.



TECHNICAL DATA

- Dimensions (L x W x H): 19.7 x 9.8 x 19.8 ft
- Temperature range: -94°F to +176°F
- Cooling capacity: Max. 70 kW
- Ambient pressure:
  Approx. 14 psi to 0.7 psi (abs.) / (approx. 1837 ft to 65,600 ft)
- Humidity: Not controlled
- Floor loading: Max. 88,500 lb in
- Cable entry: d = 4 in and d = 5.5 in
- Power supply: 230 VAC or 400 VAC (16 A and 32 A CEE)
- Pressure supply: Max. 116 psi
- Water supply: Well water (in- and outlet)
- Exhaust gas extraction system: Up to max. 13,123 ft

Temperature chamber

APPLICATION

- Functional tests, e.g. low - and high temperature testing, snow and icing tests
- Endurance tests
- Combined environmental simulation (temperature, rain, snow or ice)

TECHNICAL DATA

- Dimensions Chamber (L x W x H):
  18.0 x 14.8 x 13.1 ft
  Door (W x H): 15 x 13 in
- Temperature range:
  -94°F to +302°F
- Temperature gradient: Max. 1 K/min
- Cooling capacity: Max. 70 kW
- Humidity: Not controlled
- Floor loading: Max. 7 lbf/in²
- Cable entry: d = 4 in (3x)
- Power supply: 230 VAC or 400 VAC
  (16 A, 32 A, 63 A and 125 A CEE)
  programmable AC Power Source
  available

Climate chamber

APPLICATION

- Ageing with temperature / climate cycles
- Endurance tests
- Functional tests, e.g. cold start
- Combined environmental simulation (temperature, rain, snow, ice or sun)

TECHNICAL DATA

- Dimensions: Chamber (L x W x H): 31.2 x14.8 x 14.1 ft
  Door (W x H): 13.1 ft x 9.8ft
- Temperature range: -40°F to +248°F
- Temperature gradient: Max. 1 K/min.
- Cooling capacity: Max. 120 kW
- Controlled humidity: 0 % to 95 % relative humidity
  (at a temperature of +50°F to +27°F)
- Exhaust gas volume flow: Max. 53,000 ft³/h
- Floor loading: Max. 5 lbf/in²
  (respectively 4,500 lbf max. wheel load)
- Cable entry: d = 6 in (2x)
- Power supply: 230 VAC or 400 VAC (16 A, 32 A, 63 A and 125 A CEE)
  programmable AC Power Source available
- Pressure supply: Max. 116 psi
- Water supply: Well water (in- and outlet)

Vehicle chamber I

APPLICATION

- Function tests, e.g. cold-start tests
- Endurance tests

TECHNICAL DATA

- Dimensions (L x W x H): 23.0 x 11.5 x 9.5 ft
- Temperature range: -94°F to +176°F
- Cooling capacity: Max. 190 kW
- Humidity: Not controlled
- Single Roller Dynamometer: P_{max} = 40 kW, v_{max} = 74 mph (120 km/h)

Vehicle chamber II

APPLICATION

- Dynamic measurements
- Endurance tests

TECHNICAL DATA

- Dimensions (L x W x H): 26.2 x 16.4 x 8.2 ft
- Temperature range: -22°F to +140°F
- Cooling capacity: Max. 110 kW
- Ambient pressure: Not controlled
- Humidity:Not controlled
- Single Roller Dynamometer:
  P_{max} = 53 kW,
  v_{max} = 74 mph (120 km/h) H2-compatible,
  explosion-proof for hydrogen-powered vehicles

Climate combination chamber

APPLICATION

- Ageing with temperature / climate cycles
- Endurance tests
- Functional tests, e.g. cold start

TECHNICAL DATA

- Dimensions (L x W x H): 13.1 x 7.2 x 8.9 ft
- Temperature range: -94°F to +248°FF
- Temperature gradient: Max. 5 K/min
- Cooling capacity: Max. 70 kW
- Controlled humidity: 10 % to 95 % relative humidity
- Cable entry: d = 5 in (3x)
- Power connection: 230 VAC or 400 VAC (16A, 32A, 63A and 125A CEE) programmable AC Power Source available
- Pressure supply: Max. 116 psi
- Water supply: Well water (in- and outlet)

Solar radiation unit

APPLICATION

- Ageing of surfaces
- Measurement of the temperature distribution of components and systems
- Artificial sunlight and temperature superposition function tests

TECHNICAL DATA

- Dimensions (L x W): 6.6 x 9.8 ft
- Radiation performance: up to 111 W/ft²
- Variable distance to the solar panel
- Temperature range: -22…194°C
- Controlled humidity : up to 95% relative humidity
- Test box to simulate also indoor conditions

Soaking boxes

APPLICATION

- Vehicles preconditioning for tests in the high altitude chamber for emission measurements

TECHNICAL DATA

- Dimensions per cell (L x W x H): 18.7 x 8.9 x 7.7 ft
- Temperature range : -13…122°F
- Independent temperature control of both cells

Splash Water Cabinet

APPLICATION

- Temperature shock test with splash water to evaluate the thermal shock resistance of components and systems located in the splash water area of a vehicle.

TECHNICAL DATA

Dimensions (L x W x H):	2.6 x 3.9 x 2.6 ft
Temperature range test sample:	RT …248°F
Temperature range water:	0 … 39°F
Test medium:	distilled water with 3% Arizona dust
Nozzle head:	2 jets with 8.7 inwidth each
Splash water cycle:	every 30min or 60min 3s
ISO norm:	ISO 16750-4

Mobile corrosion unit (MoKo II)

APPLICATION

Simulation of the effects of corrosion on metallic components

- Temperature control, humidification of a test chamber
- Salt spray and salt fog tests
- The tests are based on common standards including DIN EN ISO 9227, DIN EN ISO 6270-2, DIN EN 60068-2, DIN EN ISO 7253 and DIN EN ISO 4628 as well as various manufacturers' specifications.

TECHNICAL DATA

Effective test chamber dimensions (L x W x H):	51 x 24 x 28 in (see figure)
Temperature range:	-4°F to +212°F
Relative humidity:	Up to 95% RH
Salt spray test:	Via brine feed and spray jets
Salt spray fog test:	Via brine feed and perspex fog jet
Climate and temperature:	Via two large-volume isolated hoses incl. air circulation
Ducts:	For actuators, fastenings and electrical connections

Dust test chambers

APPLICATION

IABG has **three dust test chambers** to examine the dustproofness, contamination, surface resistance and operability of objects exposed to dust. Test items can be examined in an operating state to validate their functionality.

Our facilities can be used for testing in compliance with standards such as DIN EN 60068-2-68, MIL-STD 810, IP protection tests according to DIN 40 050, IEC EN 60529 and VDE 0470 as well as tests according to various manufacturer-specific standards.

Typical test items
Measuring devices, notebooks, bearings, sensors, actuators, fuel cells, electric motors, aerials etc.

More test options on request

TECHNICAL DATA

Dust test chamber 1

- Effective test chamber dimensions (L x W x H): 9.5 x 6.2 x 6.2 ft
- Temperature range: RT
- Floor loading: Max. 4409 lbm
- Cable feedthrough: d = 4 in
- Electricity supply for test item: 230 V, 16 A / 32 A
- Access door (W x H): 6.2 x 6.2 ft

The test chamber can be opened up completely.

Dust test chambers 2 and 3

- Effective test chamber dimensions (Ø x H)
  2.6 x 2.6 in and 1.6 x 0.1.5 ft
- Access door (W x H):
  1.3 x 1.3 ft and 1.0 x 1.0 in

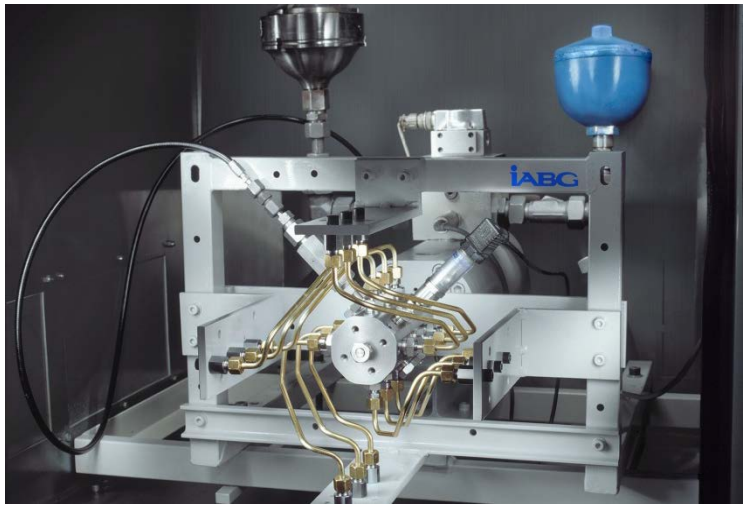
Miscellaneous Test Facilities

High and low-pressure test equipment (HD/ND)

APPLICATION

Assessment of the fatigue strength and endurance limit of components and systems under internal pressure load

- Static load tests and burst tests
- Cyclical variable-pressure tests with adjustable mid-load
- Parallel assessment of up to 18 test items
- Test bench adaptable to test items
- Computer-operated control and test monitoring
- Simulation of variable ambient temperatures
- Use of different pressurising media (e.g. water, special oils)



TECHNICAL DATA

High-pressure test

Max. pressure (static/cyclical):	58,015 psi / 43,500 psi
Max. test frequency:	Approx. 5 Hz to 20 Hz, depending on number of test items and load range
Test chamber dimensions:	L = 2.6 in, W = 2.6 in , H = 1.3 in
Test medium:	Hydraulic oil
Climate control (optional):	-40°F to +248°F
Test item installation	High-pressure distributor with 18 connections

Low-pressure test

Max. pressure (static/cyclical):	4,060 psi
Max. test frequency:	Approx. 10 Hz to 15 Hz, depending on number of test items
Test chamber dimensions:	L = 3.9 in, W = 2.3 in, H = 2.3 in
Test medium:	Hydraulic oil or alternative media (e.g. water)
Climate control (optional):	- 40°F to +356°F
Test item installation	Test adapter as arranged with the customer

EMP 1

APPLICATION

- Quasi-static tests
- K_{IC} as per ASTM399
- Thermal chamber
- Corrosion chamber

TECHNICAL DATA

- Maximum test force: 22,500 lbf
- Frame: Manufactured by Instron
- Digital controller: Manufactured by Doli
- Various clamping devices

Hydraulic universal test benches

	UHU 1	UHU 2	UHU 160
Clear span	27.6 in	35.4 in	39.4 in
Max. test setup height	63 in	63 in	59 in
Test force	± 9,000 lbf	± 9,000 lbf	± 36,000 lbf
Test path	± 49 in	± 49 in	± 49 in
			

Hydraulic universal test benches

	SchwiFe 1	SchwiFe 2	SchwiFe 3
Clear span	18.9 in	18.9 in	16.5 in
Max. test setup height	31.5 in	31.5 in	39.4 in
Test force	± 5,620 lbf	± 22,500 lbf	± 9,000 lbf
Test path	± 2.0 in	± 2.0 in	± 4.9 in
			

Hydraulic universal test benches

	Pulser 5	Pulser 10
Clear span	27.6 in	3.9 in
Max. test setup height	63 in	63 in
Test force	± 141,630 lbf	± 35,970 lbf
Test path	± 2.0 in	± 2.0 in
		

HUBI

APPLICATION

- Standard pulse generator with pivot-mounted cylinder

TECHNICAL DATA

- Clear span: 23.6 in
- Max. test setup height: 47.2 in
- Test force: ± 4,500 lbf
- Test path: ± 1.0 in