



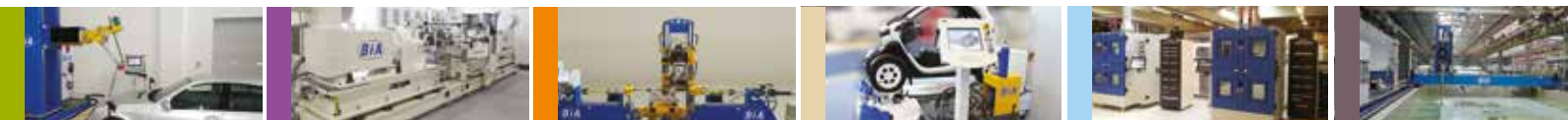
ENGLISH EDITION



TURNKEY TEST SYSTEMS



## ■ SOLUTIONS THAT FIT ■



- AUTOMOTIVE SAFETY TESTING
- ENGINE & POWERTRAIN TESTING
- VEHICLE DYNAMICS TESTING
- COMPONENTS FOR TEST SYSTEMS
- ENVIRONMENTAL TEST CHAMBERS
- AEROSPACE NDT



BIA is a technology leader that designs, develops and manufactures test systems for the automotive, aerospace and other industries since 1986. BIA has provided a wide range of test equipment from components to full turnkey solutions to major companies such as aerospace suppliers, automotive manufacturers, automotive suppliers, independent laboratories, research institutes and universities.

Our philosophy is to provide innovative solutions, resulting from our close collaboration with the client, to always improve the quality and optimize the cost of testing.

To extend this cooperation and support our customers throughout the world, we are continuously developing our own capacities locally and through partnerships in Europe, Asia, North America and South America.

## key dates

- 1986 ■ Foundation of BIA
- 1989 ■ Ultrasonic Scanning
- 1996 ■ Transmission Test System - Asynchronous Electric Motor (High Torque / High Speed / Low Inertia)
- 1998 ■ Universal Impact Simulation Test System (Closed Loop Servo-Hydraulic Propeller)
- 1998 ■ Foundation of BIA Germany
- 1999 ■ Partnership in North America
- 2001 ■ Worldwide Patented 6 DoF Chassis Dynamometer
- 2003 ■ Partnership in China
- 2004 ■ BMC800 Universal Test Application Controller with its UTM Control Software
- 2005 ■ Partnership in Korea
- 2006 ■ Partnership in India
- 2008 ■ Worldwide Fixed Cylinders High-Frequency 6 DoF Hexapod
- 2010 ■ High Speed / High Torque Electric Dynamometer for EV Motors and Powertrain (>20000tr/min)
- 2011 ■ Delivery of the Highest Accuracy Rolling Resistance Machine Available in the Market
- 2012 ■ Electric / Hybrid Vehicle Lab Development & Integration with Hardware in the Loop and Model in the Loop
- 2012 ■ First Worldwide Flat Belt Rolling Road Simulator for Heavy Duty Vehicle
- 2014 ■ Foundation of BIA Russia
- 2014 ■ Foundation of BIA North America

ACTIA  
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AIR PRECISION  
AIRBUS  
ALCATEL  
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ARAI  
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VOLKSWAGEN  
VSMPO



## AUTOMOTIVE SAFETY

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Seat Belt Anchorage  
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Electric & Hybrid Test Solutions  
Realistic Engine Simulator  
Engine Parts

## VEHICLE DYNAMICS

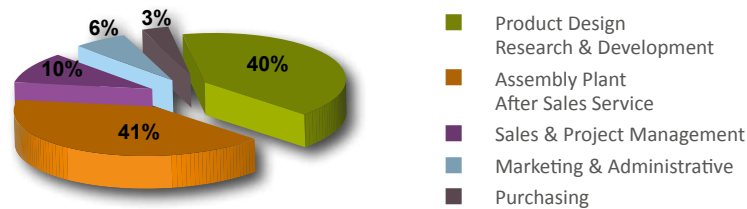
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Steering  
Brake Dynamometer  
Shock Absorbers  
Four Posters Road Simulation  
Kinematics & Compliances  
Heavy Duty Flat Belt Road Simulator  
Multi-Axis Simulation  
Elastomeric Parts  
6 DoF Chassis Dynamometer  
Wheel & Tire Endurance  
Tire Testing  
Tire Rolling Resistance Measurement

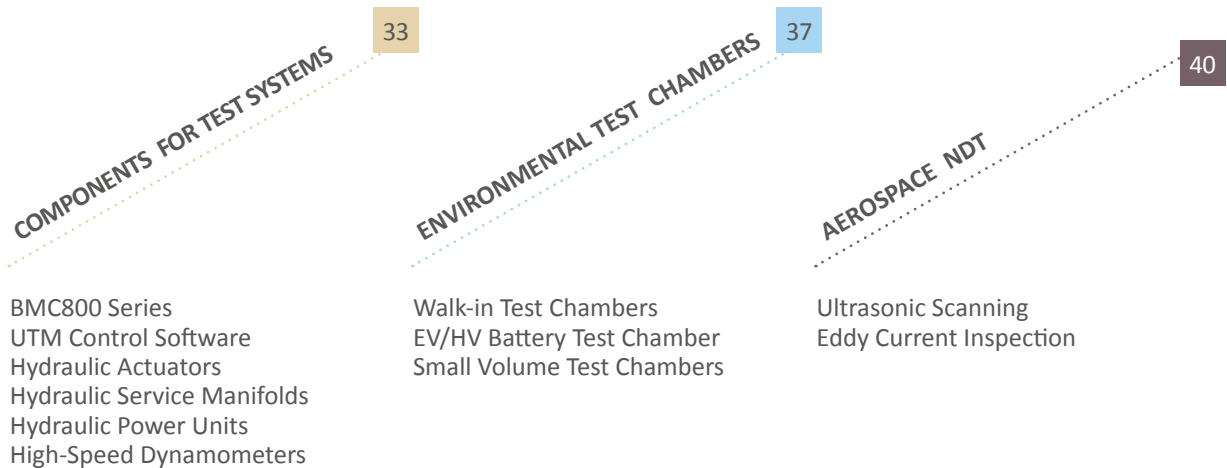
We offer turnkey test systems based on your needs. We utilize state-of-the-art computer design and modeling such as CATIA®, MathLab SimLink®, and proprietary analysis tools to ensure you the most accurate, efficient and cost-effective applications.

Our innovative systems incorporate the latest technologies in mechanical, hydraulic, pneumatic, electrical, electronic, and automation.

Our solutions come with full customer support, from a thorough analysis of test definition requirements through equipment prove-out, installation, customer personnel training and post-installation support.



BIA WORKFORCE





### ■ Universal Impact Simulation

#### ■ EEVCG17, FMVSS201, FMVSS222, FMVSS226, ECE R12, ECE R21, ECE R95, GTR 9 and other similar standards

BIA offers the most complete solution for interior and pedestrian impact simulation testing. Up to 11 modules can be added to the base unit.

#### ■ RELIABLE AND ACCURATE SOLUTION

BIA's launchers are fully servo-hydraulic, with closed loop control which allows a perfect speed, acceleration and position control until free flight.

Two sizes of servo-hydraulic launchers are available: BHIA 150 for interior impact tests and BHIA 250/450 for pedestrian impact testing and larger impactors.

The control software provides automatic compensations to ensure correct impact velocity, angle and location. It takes into account the effects of gravity, the impact angle, the free-flight distance, the head form shape and the angle of the impact surface. Thus, the first shot is the good one.

#### ■ EASIER, FASTER AND PRECISE ADJUSTMENT

A wide range of displacement in each axis allows maximum mobility to meet all test conditions. The control system provides automatic positioning, and can record several positions.

The remote control allows the operator very easy positioning of the impactor in each axis and also in virtual X' axis to adjust free-flight distance.



## UP TO 11 IMPACTORS EXCEEDING SAFETY STANDARDS

Pedestrian Upper Legform	EEVC WG17
Pedestrian Lower Legform	EEVC WG17 - GTR9
Pedestrian Headform	EEVC WG17 - GTR9
Guided Head/Impactors	ECE R12 - ECE R95 FMVSS 222
Body Block	ECE R12
Pendulum	ECE R21
Interior Head	FMVSS 201
Ejection Mitigation	FMVSS 226
Knee Impactor	
Linear Impactor	
Flex-PLI	ECE R127

## ■ NEW HIGH ENERGY LINEAR IMPACTOR

In order to perform tests that require limited intrusion, or to crash specific parts of the vehicle, BIA designed a new module which can be adapted to the BHIA-450 launcher.

The new high energy guided module front face can accept different shapes depending on test requirements. This module is recommended for any test requiring to limit intrusion, such as airbag, knee testing or reparability study for insurance costs.



### HIGH ENERGY LINEAR IMPACTOR New Version Characteristics

Mass	20 to 90 kg
Speed	11 m/sec for 20 kg mass 9 m/sec for 30 kg mass 6 m/sec for 90 kg mass
Intrusion	Up to 600 mm
Front/Rear Safety Shock Absorber	
Support for a higher rigidity	
Rebound protection on launcher	





### ■ BHIA 250/450-VC New Launcher



#### Characteristics

Cable-free technology with a closed-loop control accelerometer

Built in Voice coil servo-valve

High accuracy:  $\pm 0.5\%$  of absolute speed

Speed up to 12.5 m/s (20 m/s for BHIA 450-VC)

#### ■ Head Test - GTR9, FMVSS201 / FMH, ECE R12, ECE R21

The newly-developed BHIA 250-VC launcher supports all types of head impact simulations. This new equipment is complementary to BIA Universal Impact test system, and simply requires a standard industrial robot, used as the base unit. It can also be integrated to other existing positioning systems, including BIA's.

A notable innovation is the optical link between the accelerometer and the launcher for both data transmission and sensor configuration (sensor identification and calibration).

### ■ Bumper Pendulum



#### ■ FMVSS 581, ECE-R42, Allianz, CMVSS 215 and other similar standards

This test system simulates front and rear collision shocks against a vehicle, at low speeds. The test aims at verifying the quality and efficiency of protection devices, e.g. bumpers.

#### ■ TEST CONFIGURATIONS

- Stationary vehicle
- Wheels in the longitudinal direction
- Brake released, transmission in neutral position

This pendulum is specific since shock position can be adjusted vertically, but radius will remain the same [3500mm]. In such a case, the user's task is simplified since there is no equivalent mass to calculate. Errors are thus avoided.

Performance	Range	Accuracy
Speed	0-20 kph	$\pm 0.05$ kph
Pendulum Position	$\pm 20^\circ$	$\pm 0.02^\circ$
Radius	3500 mm, constant	
Vertical Impact Position Adjustment	100-600 mm	$\pm 1$ mm
Pendulum Mass	650-3500 kg	$\pm 0.5$ kg

## ■ Roof Crush & Door Intrusion



### Performance

Roof Crush Alpha Angle	0-40°
Door Intrusion Angle	90°
Beta Angle	± 20°
Max. Load	250 kN
Max. Stroke	1 m
Max. Vehicle Height *	2.40 m

\* 2.70 m as an option

### ■ FMVSS 214, FMVSS 216 and other similar standards.

BIA Roof Crush & Door Intrusion test system offers great maneuverability, precision measurements, and state-of-the-art data acquisition to quantify structural integrity with better accuracy and simplicity.

BIA's solution can perform both Roof Crush and Door Intrusion tests with the same equipment. Its unique design enables vertical Roof Crush test. (Alpha angle can be set at 0°.)

### ■ RELEVANT MEASUREMENT

- 4 tri-axial load cells to locate the load application point.  
Accuracy of force measurement after software treatment: 0.5%
- Magneto-strictive position sensor to measure absolute displacement.

## ■ Seat Belt Anchorage



### Benefits At A Glance

- Up to 50 kN force /1000 mm stroke for each cylinder
- User-friendly software for test setup and data acquisition
- Remote control for easier test setup
- Reduced distance among anchorages

### ■ FMVSS 207, FMVSS 210

### ECE R14, ECE R16, ECE R17 and other similar standards

BIA has developed a compact and very quiet Seat Belt Anchorage test system designed for maximum accuracy and flexibility, with optimized hydraulic functionality. Motorized adjustability combined with the control software simplify the positioning process.

BIA's Seat Belt Anchorage Test System can be set up from one to nine axis configuration in its standard version, and up to 12 on the higher-capacity version. It is available in either compact or cableless design.

### ■ A HIGH PERFORMING CONTROL SYSTEM

BIA's UTM control software provides a user-friendly environment to build complex test sequences through its advanced graphical interface.

In case of any failure in the belt anchorages, the control system compensates for the test duration. The real force level is thus applied during the expected time.





### ■ Head & Seat Back Restraint



#### Performance

Seat Back Torque	Up to 5 000 Nm
Seat Back Angle	0-60°
Head Form Force	Up to 2 000 N
Head Form Stroke	Up to 1 000 mm

#### ■ FMVSS 202a, CMVSS 202, ECE R17, ECE R25 and other similar standards ECE R80 as an option

BIA's solution can perform both Head and Seat Back restraint tests with high performance characteristics in a user-friendly software environment.

Using full electric actuators, this equipment can perform tests on up to 3 seats simultaneously. Each actuator can be independently controlled in closed loop, either in force, torque or position, at each step of the test sequence.

Depending on the size of the vehicle, the width of the torso located in the middle can be adjusted in increments of 10 mm.

#### ■ ACCURATE MEASUREMENT

- Using a specific torque meter with a double range calibration, measurements are accurate for both high and low torque measurements.  
Total accuracy: 0.5%
- Because of its linear guided displacement, lateral loads do not affect the head form force measurement.
- Displacement measurements are made through optical (linear and rotative) encoders.

### ■ Laser Speed Measurement Device



The device is a Class II laser measuring system. A transmitter and a receiver are used to provide high accuracy speed measurements. Each part of the system is attached on a tripod and positioned on both sides of the impactor trajectory.

This device can be used as a stand-alone system with its own display, or connected to a laptop using a serial interface connection. Two models are available depending on application.

#### ■ MEASUREMENT

- Accuracy better than 0.2 %
- Display resolution: 0.01 km/h
- Maximum distance between transmitter and receiver: 10 m
- Speed measurement: up to 50 kph or 250 kph depending on the model

A corresponding calibration certificate is provided with each system.

## ■ Vehicle Crash/Sled Test Facility



### Performance

Max. Speed	40 kph
Acceleration Distance	14 m
Max. Specimen Load	3.5 t
Max. Traction Force	10 kN

■ ECE R42, FMVSS 581, CMVSS 215, AZT (Allianz), RCAR, IIHS and other similar standards

### ■ A VERY INNOVATIVE MECHANISM

BIA's solution is based on an innovative catapult system using belt technology, usable for pulling entire vehicles. It can be associated with a very precise hydraulically-actuated, non-consumable, decelerator sled. The car is accelerated with a long synchro-belt actuated by an electric synchronous motor. It is released within 1 meter of the impact point at the exact targeted speed.

BIA can provide a camera pit covered by a transparent cover.

## ■ High-Capacity Acceleration Sled with Dynamic Pitch and Yaw Functionality



### Performance

Speed	Up to 25 m/s
Brake Capacity	Up to 4000 kN
Payload	Up to 4000 kg
Acceleration *	Up to 100 g
Jerk	Up to 24 g/ms

\* Deviation:  $\pm 1$  g

■ ECE R11, ECE R16, ECE R17, ECE R44, FMVSS208, FMVSS 213 , Euro NCAP, US NCAP, Euro NCAP Knee Mapping, Whiplash and other similar standards

■ BIA's very innovative solution reproduces precise acceleration profiles in order to test safety performance of vehicles components such as instrument panels, headliners, seats, seatbelts, airbags, and others in crash conditions.

The modular and cost-effective solution takes into account the latest safety regulations, now and in the foreseeable future.

## ■ Decelerator Sled & ECE-R100 Dynamic Crash Simulation

### ■ ECE R100 Mechanical Shock/Crash Simulation, Half-Sine, Mechanical Integrity/Crush



■ UN ECE-R100 new regulations will impose additional tests to ensure the integrity and safety on electric vehicle batteries.

BIA's latest 250 kN servo-hydraulic decelerator system can support several test protocols within one test system: mechanical shock/crash simulation, half-sine, and mechanical integrity/crush. A major advantage of the new device is the soft docking between the mobile carriage and the deceleration piston, avoiding any unpredicted shock at first contact. The closed-loop controls compensate potential mass or speed errors, assuring thus high-accuracy pulses.

A specific module can be added to the mechanical shock/crash simulation sled in order to run mechanical integrity/ crush tests. The same hydraulic actuator is then driven to push.

In addition to its capability to perform different types of tests as a standalone system, BIA's decelerator module can also be integrated to existing sleds for other automotive crash test purposes.

## ■ Battery Abuse



■ BIA has developed a complete set of tools for battery testing, both for performance evaluation and for safety assessment. The test bench can carry out tests on battery cells, modules and packs, on any type of technologies, including Lithium-Ion batteries.

### ■ PERFORMANCE EVALUATION

Performance evaluation is run through charge and discharge cycling within controlled boundary conditions:

- environment simulation (environmental chamber);
- vibrations (electrodynamic shaker);
- temperature control (air/liquid cooling).

#### Performance

Max. Force	500 kN
Max. Speed	22 m/sec
Max. Mass	500 kg
Temperature	-20°C to 60°C

### ■ SAFETY ASSESSMENT

Safety assessment testing entails long process that includes a variety of so-called abuse tests:

- mechanical abuse (such as controlled crush penetration, drop, mechanical shock);
- thermal abuse (thermal stability, simulated fuel fire, elevated temperature storage, rapid charge/discharge, thermal shock cycling);
- electric abuse (overcharge/overvoltage, short circuit, over-discharge/voltage reversal, partial short circuit).

### ■ QUASIC-STATIC & DYNAMIC TESTS

This test may be carried out in a quasi-static or dynamic condition, run on both charged and uncharged battery. The dynamic tests may be performed directly with the actuator or with a mass over a guided trolley accelerated at the required impact speed (or better energy) by the hydraulic piston. The quasi-static test is performed directly by the actuator pushing the impactor on the specimen side.





## ■ Manual / Automatic Transmission

BIA provides advanced test solutions to evaluate and develop clutch, gearbox, synchronizer or complete transmission whether they are MT, AT or AMT. Durability tests (gear, bearing, differential, casing,...), Noise Vibration & Harshness analysis (NVH), efficiency and quality of gear change are some examples of tests that can be performed.

BIA standard solution for complete transmission is composed of three direct drive asynchronous or PM motors without intermediate gearing or belts. With its inline configuration design, BIA's solution allows smaller testing area, and simplifies integration of noise protection and climatic module.

Passenger Vehicle	Input Shaft	Output Shafts (x2)
Max. Torque	900 Nm	5 000 Nm
Max. Speed	20 000 rpm	3 000 rpm
Max. Inertia	from 0.08 kg.m <sup>2</sup>	up to 17 kg.m <sup>2</sup>

BIA offers another major innovation in the field of transmission and gearbox testing: a high-speed electric motor with water cooling. The combination of very low inertia (0.08 kg.m<sup>2</sup>) and high-speed capabilities (20000 rpm) extends testing to electric and hybrid vehicle.

Energy consumption is optimized by connecting output electric motors to a power recycling unit. Each servo-motor is closed loop controlled in speed or torque, which allows high precision.





## ENGINE & POWERTRAIN



### ■ NVH ANALYSIS

The graphical display of BIA NVH Analysis software simplifies the setting of preventive defect detection and the post-analysis of any transmission failure. From accelerometer and speed transducer feedbacks, the control system provides FFT spectrum and automatically suggests the cause of the vibration defect.

### ■ CLIMATIC MODULE

To simulate different climatic conditions, a climatic box combined with a mobile climatic generator is available. Temperature ranges from -40° to + 140°C with  $\pm 0.5^{\circ}\text{C}$  accuracy.

### ■ DRIVER CAB

In order to simulate the driving conditions and to evaluate the gear change quality, a driver cab can be added as an option.

## ■ Transmission Durability Test for Tractor



■ This system has been designed to characterize and realize durability tests on transmission for tractors equipped with engine from 65 to 180 HP. Any type of gearboxes can be tested.

■ The transmission is made of a gearbox and a powered axle, with a total of four shafts. The primary shaft supplies power to three output shafts, two for the rear wheels and one for the 4-drive wheels (4WD).

	Input Motor	Output Motor (x3)	4WD
Power	180 kW	95 kW	90 kW
Nominal Speed	1 700 rpm	20 rpm	430 rpm
Nominal Torque	1 000 Nm	45 000 Nm	2 000 Nm
Max. Speed	2 500 rpm	250 rpm	2 000 rpm

## ■ 4WD Drivetrain



Motor	Input	Output (x4)
Power	560 kW	320 kW
Nominal Speed	2 000 rpm	85 rpm
Nominal Torque	2 700 Nm	35 000 Nm
Max. Speed	4 000 rpm	340 rpm

■ This comprehensive 5 dynamometers test bench performs various testing configuration on four-wheel drive heavy duty drivetrains, including gearbox robotized switching and power shaft loading.

A reduction box on differential outputs allows users to cover a wide range of torque/speed working points: transmission ratio at the wheels motors is about 11. The maximum torque at the wheels is 35.000Nm@85 RPM.



## ■ Synchronizers



■ BIA has developed systems to test synchronizers in durability and performance. This bench allows different tests: simulation of stationary vehicles (from idle speed to Gear 1) and rolling vehicles. Realistic conditions of speed and inertia can be reproduced.

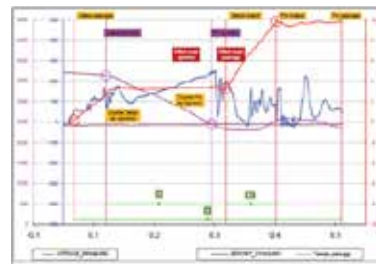
■ This test bench can be used with or without the gearbox. For both versions, the synchronizer is shifted by a high dynamic gear change robot (see below) simulating human behavior. For the version without gearbox, an oil lubrication system is replicated as it is in a gearbox. Oil is sprayed on the synchronizer and also in the shaft, under pressure.

■ **BMC800 Universal Test Application Controller:** The bench controller allows a complete analysis and characterization of shifting run: force, stroke, speed.

As an option, climatic conditions and cold start tests can be utilized.

### Performance

Input Inertia	variable, or the one from vehicle inertia
Output Flywheel	50 Kg.m <sup>2</sup> (value extended for trucks)
Max. Rotation Speed, in input	7 000 rpm
Max. Rotation Speed, in output	2 500 rpm



## ■ High Dynamic Gear Change Robot



### Performance

Max. Peak Load	2 000 N
Continuous Load	215 N
Max. Speed	4 m/sec
Max. Speed with Continuous Load	3 m/sec

### Learning Mode

Shift number
Load / Position of selecting actuator
Load / Position of shifting actuator
Max load for selecting actuator
Max load for shifting actuator

■ The gear change robot aims at reproducing gear change for gearbox as well as synchronizers. It combines two linear actuators, one for selecting and the other one for shifting. This robot is equipped with position and load sensors. It is fixed on a support which permits vertical and angular adjustments.

### ■ CONTROL MODES

Many control modes are available in position, speed or load, in order to reproduce human behavior. Depending on the software set up, this robot can be adapted to any manual or automatic gear box.

This robot can classically command 6 speeds and rear. Its learning mode allows as much shift position as necessary. When positions are learned, it is possible to automatically shift the gear, with the remote or with the software.

Every time gear is shifted, load VS displacement can be visualized on oscilloscope.

### ■ CV Joint Testing



#### Performance

Torque	10 000 Nm
Speed	100 rpm
Torque Pulse Frequency	10 Hz
Angle Adjustment	$\pm 52^\circ$

#### ■ SINGLE SPECIMEN FATIGUE TEST

BIA's solution is able to apply high torque in combination with continuous rotation until specimen end of life. This unique performance is achieved with a hydraulic closed-loop.



#### ■ FOUR-SPECIMEN DYNAMIC TEST WITH STEERING & VIBRATIONS

This test system aims at testing the durability of four CV joints in a close kinematic loop. The rotation speed is similar to the one in vehicle ( $\pm 2\,500$  rpm). A torque up to 4 000 Nm is also applied to this kinematic loop.

The longitudinal distance is parameterizable depending on the transmission parts. The shafts are fixed on a mobile platform in order to simulate steering angle as well as vertical vibration as on vehicle.

All the major parameters are controlled by synthetic signals (ramp, sinus, triangle) but road load conditions can be applied using the latest software module, THPC (Time History Parameter Control).

The shafts are warmed up to 200° during testing to simulate engine or brake temperatures.

In order to detect CV joint failure, the test system is equipped with laser grease detectors.



#### Performance

Driving Motor Speed	up to 2 500 rpm
Nominal Torque	$\pm 4\,000$ Nm
Power Transmitted to CV Joint	up to 400 kW
Steering Angle	$\pm 35^\circ$
Steering Frequency	5 Hz

#### Simulation of Vertical Vibration from Wheels

Vertical Displacement	$\pm 200$ mm
Frequency	30 Hz
Speed	4 m/sec
Acceleration	26 g



## ■ NVH & SHUDDER

This test bench allows a complete analysis and characterization of CV joint under torque and induced vibrations. Shudder test measures induced forces at fixed angle, varying torque and speed. NVH evaluates transfer functions along the CV joint of vibrations.

A two axis electrodynamic shaker (slip table) generates any required vibration profile.

## ■ APPLICATIONS

The following type of test may be performed:

- **Shudder:** Measure of the forces due to the not ideal behavior of the plunging joint of tripod type or similar. Evaluation of the effect, on shudder, of grease selection, torque, speed, angle.

The following tests conditions may be executed:

- Constant torque and speed
- Fixed angle

Engine Side	
Angle	0 - 20°
Torque	536 Nm
Speed	1 750 rpm

- **NVH:** Calculation of the function of transfer between or axial or radial vibration on engine side and loads transmitted to the wheel hub; analysis of a transmission under dynamic plunging and modal analysis.

The following test may be run:

- Dynamic plunging
- Transfer function calculation
- Modal analysis

Wheel Side	
Torque	200 Nm
Speed	250 rpm
Frequency	0 - 3000 Hz



### ■ Transmission Parts

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#### ■ PEDAL

Using either electric or hydraulic actuators, BIA test systems for pedal mechanism reproduce the real loading profile in speed loop control with force limitation.

#### ■ PROGRAMMABLE LOAD SYSTEM FOR GEARSHIFT

This system aims at characterizing gearbox command (such as gearshift) by simulating gearbox load on selecting and shifting mechanism. This system is installed in order to replicate vehicle configuration.

Then, the gearbox load is simulated by an actuator, which can be setup by a corridor profile in load and stroke.

#### Exemples Of Applications

Flexibility • Load vs Displacement • Friction • Clearance • Hysteresis •  
Exceptional high force capabilities

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The gearshift displacement is controlled with a second actuator.

#### ■ CLUTCH

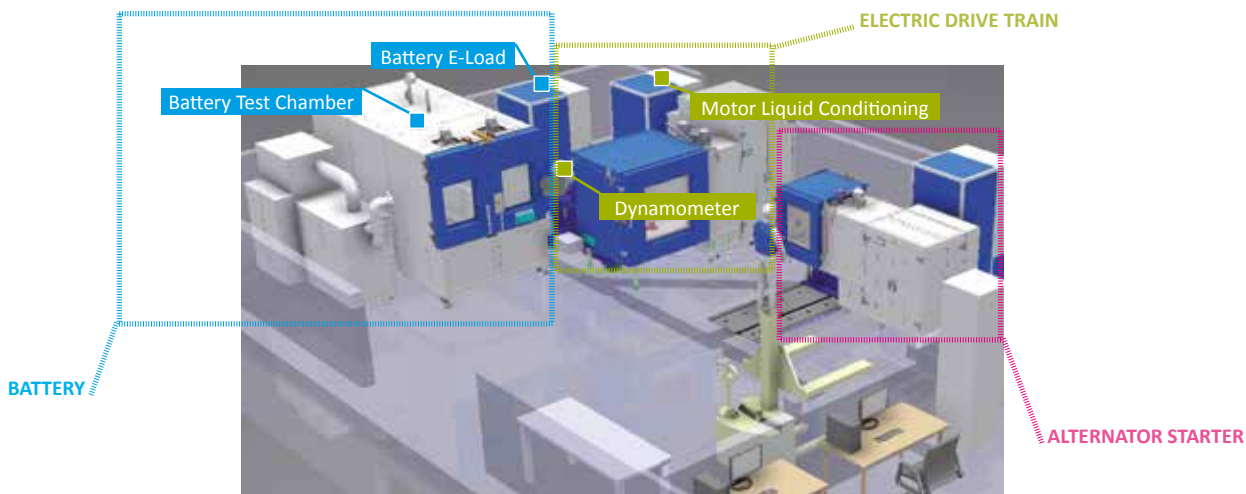
BIA's solution evaluates independently clutch durability and characteristics. Electrical actuators are closed loop controlled to reproduce the real loading profile, integrating displacement due to the clutch wear.



## ■ Electric & Hybrid Test Solutions



A complete set of equipment for EV/HEV powertrain testing is available covering most R&D needs from the battery to the traction motor.



### ■ A VERY FLEXIBLE SOLUTION

The key feature of BIA's solution relies on its flexibility. A collection of modules is available and each can be selected and combined to fulfill most testing requirements. The modularity of the designed solution enables all parts from single component to the full powertrain to be tested.

If any part of the powertrain is missing, it can be modeled and virtually simulated.

For each specimen, the laboratory has the opportunity to simulate the environment (temperature, humidity, and vibration), the source (battery and inverter simulation) and the load (battery tester, motor and road-load simulation) – actually the motor is considered a load even though it may act as a generator during vehicle braking.

### ■ ENVIRONMENTAL SIMULATION

For battery tests, BIA provides a range of standard chambers in different sizes of housing from the small LV start battery up to an electric vehicle multicell traction battery. Temperature and humidity are precisely controlled in a wide range of -40°C to 80°C and 10 to 95% RH. As well as climatic simulation, the battery chamber features a kit of accessories that makes the testing procedure easier and safer – wall passage for power and signal cables; gas, flame and smoke detection; fire extinguisher; and explosion pressure relief.

- **Climatic enclosure**

Climatic control is in the form of an «enclosure» to condition the other equipment under test – a running motor or an inverter.



## ENGINE & POWERTRAIN



- **Liquid cooling**

The liquid conditioning unit supply a water-glycol mixture, controlled both in temperature and flow for conditioning of various equipment under test.

For more details, see «Climatic Chambers» section.



HSD Series	Power	Torque	Speed	Inertia	Vibration
BASM	50 kW	280 Nm	13 000 rpm	0.142 kgm <sup>2</sup>	n.a
HSD 130	126 kW	400 Nm	20 000 rpm	0.056 kgm <sup>2</sup>	< 2 mm/s
HSD 200	200 kW	380 Nm	20 000 rpm	0.087 kgm <sup>2</sup>	< 2 mm/s
HSD 230	230 kW	390 Nm	20 000 rpm	0.087 kgm <sup>2</sup>	< 2 mm/s
HSD 270	270 kW	410 Nm	20 000 rpm	0.087 kgm <sup>2</sup>	< 2 mm/s

### ■ HIGH-SPEED DYNAMOMETERS

Research into the maximum performance of hybrid vehicle traction has led to the development of high-speed and high-torque electric motors that require specific design dynamometers.

More common motors are available for alternator and starter testing, including start-and-stop capability.

The dyno controller performance includes running any type of stationary test, speed and torque control, as well as whole vehicle road simulation.

### ■ POWER ELECTRONICS

A wide selection of two- and four-quadrant, high-speed IGBT converters are available. The existing ranges in terms of voltage and current capability cover any requirement for both R&D and end-of-line testing applications.

- **Battery testing/simulation**

The E-load concept permits reproduction of any profile for battery charge/discharge/simulation from the common for start batteries, to a real road load simulation....

- **Motor simulation**

For vehicle inverter testing purposes the motor can be replaced with its simulator.

Voltage	Current	Accuracy	Response Time	Internal Resistance	Internal Resistance Resolution
12-1000 V	22-5000 A	0.2 %f.s.	2@50%Δ	0-1000 Ω	1 Ω

### ■ CONTROL AND SIMULATION

All the units installed in the test rig are controlled by BIA's BMC800 controller, providing the ability to run very complex and fully synchronized simulation cycles with control over all available physical parameters – temperature/humidity, current/ voltage and speed/torque.

The BMC, with its UTM suite, can replace any component of the electric powertrain with a model developed on MATLAB/Simulink or equivalent tools. The battery can be tested with a vehicle electric load simulation, the inverter supplied by a battery simulator, and the inverter tested with a motor emulator.

For more details, see «BMC800 Universal Test Application Controller» datasheet.

## Realistic Engine Simulator



BIA's Realistic Engine Simulation test system is an innovative solution to simulate different configurations of the engine driven components such as steering pump, alternator, A/C compressor, crankshaft pulley and rollers. Before the production of the engine prototype, it permits to study the effects of dynamic torque loads on the engine driven components and to characterize the behavior of the driving belt.

### EXAMPLES OF TEST APPLICATIONS

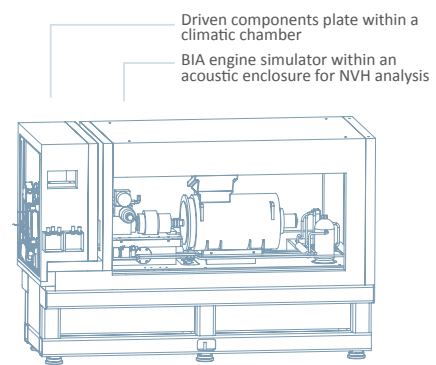
- Durability
- Cold engine start simulation
- Idle engine speed simulation
- Engine high speed simulation
- Start & Stop cycles

BIA's Engine Simulator is made of an asynchronous electric motor associated with a hydraulic spinning rotary actuator. BIA's UTM control software drives and synchronizes each actuator to reproduce real-world crankshaft speed profiles. The specimen mounting plate is used to position the engine driven components in three-dimension.

The test system also simulates the working load of driven components like steering pump, A/C compressor and alternator.

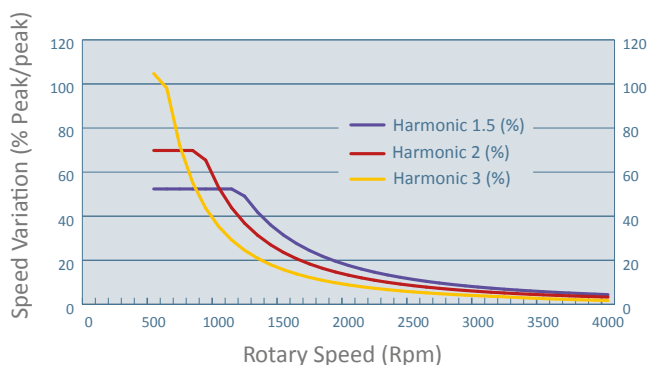
### MEASUREMENT

- Torques and rotary speed of each driven components in real-time
- Belt temperature
- Belt idler position
- Belt beats (bending and twist)
- Microphones and noise analyzers



### BIA Engine Simulation Performance

Reaction Inertia: 0.07 Kg.m<sup>2</sup> Reaction Torque: 70 Nm



### Engine Simulator

Max. Speed	8000 rpm
Max. Torque	900 Nm
Max. Frequency	600 Hz
Inertia	0.01 kg.m <sup>2</sup>
Noise Level	50 dBA at 500 rpm 77 dBA at 4000 rpm
Climatic Conditions	-30°C to +140°C

## ■ Engine Parts



### Cylinder Head Fatigue

Simulated Engine Speed	500 rpm to 6000 rpm
Peak Pressure	Up to 250 bars
Cylinder Temperature	60 to 180°C
Engine Type	3 cylinders to 12 cylinders

### ■ CYLINDER HEAD FATIGUE

Many new diesel engines generate high pressure peaks, causing high stress levels on cylinder heads. BIA has developed a new system to perform durability and fatigue tests on cylinder heads under actual pressure signals and frequencies. It uses hydraulic power supply and high dynamic servo-valves to simulate the combustion. A great variety of cylinder heads can be tested with quick and easy installation.

The control system provides closed loop control with multiple frequencies algorithm with FFT analysis and automatic cracks detection.

### ■ SWIRL, TUMBLE & PRESSURE DROP

New environment norms require engine manufacturers to reduce exhaust emissions by improving combustion efficiency. One way is to control air intake conditions by optimizing cylinder head and intake manifold designs. BIA has developed innovative equipment to perform three essential measurements on a wide range of cylinder heads: swirl, tumble and pressure drop (up to 0.2 kg/s air flow simulation).

To get high accuracy measurement, BIA solution integrates innovative swirl meter using honeycomb structure with high resolution torque measurement, associated with mass flow meter.

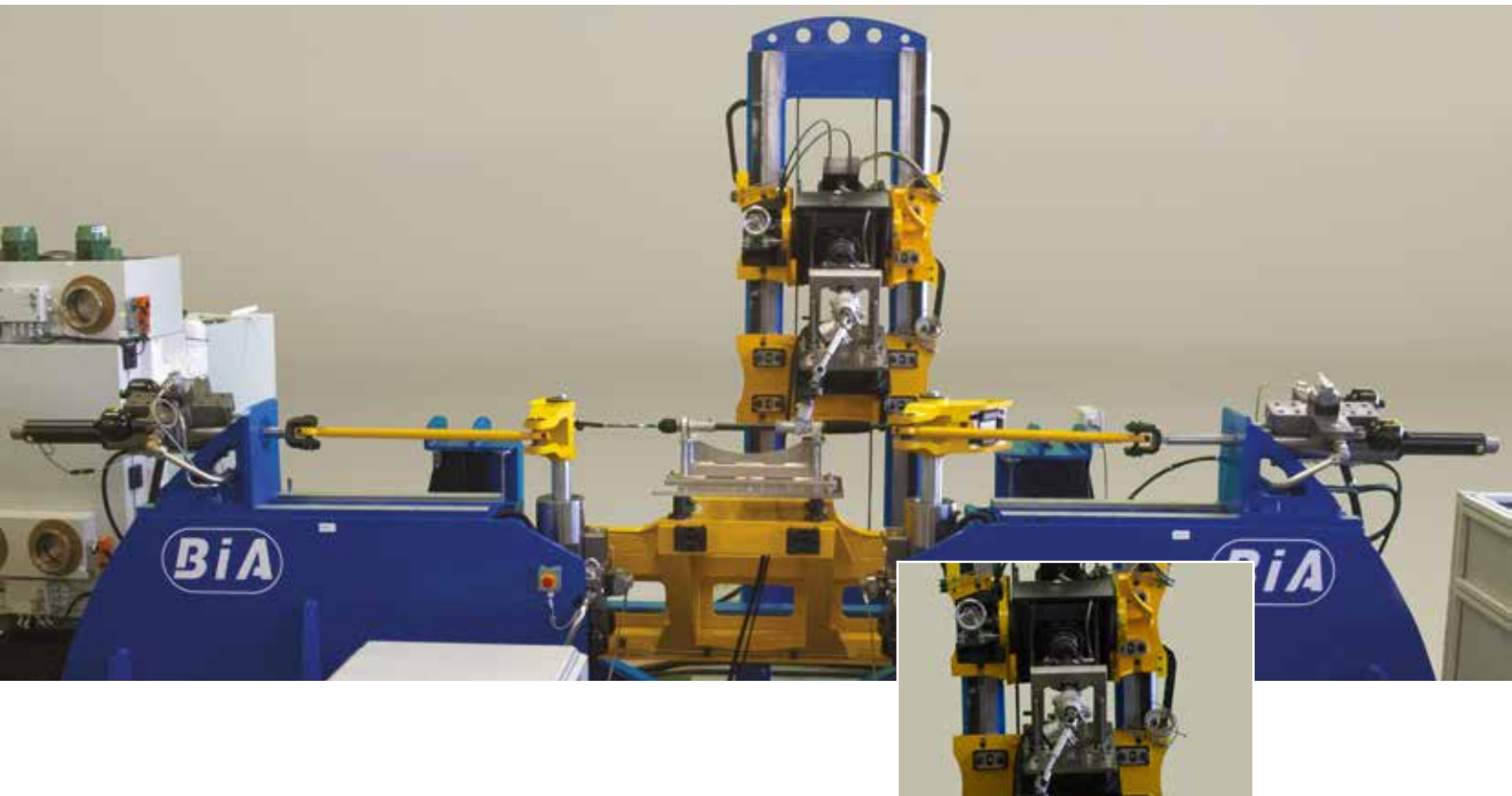
### ■ FRICTION MEASUREMENT

BIA's solution measures the friction loss inside the cylinder block. Associated systems regulate the air pressure due to the combustion (up to 180 bars) and the water and oil circuit temperatures.

### ■ WATER COOLING CIRCUIT

To evaluate the durability of water cooling circuit, BIA's test system can simulate the vehicle configuration and then apply a realistic gradient of water temperature under actual pressure conditions.





## ■ Steering

■ Whether the interest is in fatigue or development tests for steering sub-systems, BIA provides the most adapted installation to designers or steering components manufacturers.

Since most steering systems use electric or hydraulic power systems, full communication under CAN/FlexRay protocol is available. In addition, BIA also offers a real turnkey solution by providing a climatic module for steering axle and rack conditioning.

Additional modules complete the test setup: EPS power supply, hydraulic oil conditioning, hydraulic pump driver, and others.



### ■ STEERING COLUMN CHARACTERIZATION

To characterize steering column, an electric actuator is used to simulate steering wheel actions. On the output side, several modules are available to measure:

- Twist rigidity by applying torque on rack side
- Friction torque (with or without load)
- Velocity uniformity defects by comparing input and output rotation.

#### Column Evaluation

Steering Wheel Torque	Up to $\pm 50$ Nm
Steering Wheel Speed	Min. 0.1 rpm
Reaction Torque	Up to 20 Nm

### ■ STEERING COLUMN FATIGUE

For fatigue & durability tests, the steering column is adjusted in height and angle. Two hydraulic rotating actuators are positioned on wheel and rack sides. They are used to drive the steering column up to 150 Nm in static tests, and in dynamic tests, the frequency can reach 10Hz. In addition, another linear actuator aims at oscillating on rack side, at a 10Hz frequency.

#### Steering Column Fatigue

Static Tests Torque	150 Nm
Dynamic Tests Frequency	10 Hz
Linear Oscillation	10 Hz
On Rack Side	$\pm 25$ mm



# VEHICLE DYNAMICS

## ■ THREE TO SIX AXIS DYNAMIC EVALUATION BENCH

BIA has developed a universal steering test system that is able to perform dynamic performance tests as well as fatigue tests for any type of steering system (hydraulic, electrohydraulic, electric).

The bench has two lateral and two vertical hydraulic actuators to simulate wheel load and vibrations, one steering column and one variable speed engine simulator.

Various tests can be performed with up to 6 actuators.

- Violent wheel swerve: acceleration up to  $15000^\circ/s^2$  with 6000 N resistive force on rack
- Wheel release after wheel turn: steering column behavior after wheel releasing, under real load on the rack
- Dynamic characterization (direct or reverse): system response measurement under vibrating (force/displacement)
- Hydraulic and electric power assisted steering evaluation
- Derating: power electronics failure analysis
- Complete road load simulation with 5 actuators

### Dynamic Evaluation Bench

Steering Wheel Torque	Up to 500 Nm
Steering Speed	0.1 to 2000 °/sec
Tie Rod Force	25 kN
Tie Rod Speed	2 m/sec
Vertical Force	25 kN
Vertical Speed	4 m/sec
Frequency	Up to 50 Hz

## ■ POWER STEERING INTEGRATION

Two units designed to supply EPS or drive HPS. Main control parameters are set through CAN in order to simulate real world scenarios based on vehicle and engine speed.

### Electric Characteristics

Power	10 kW
Voltage	0 to 80 V
Current	0 to 160 A

## ■ ENVIRONMENTAL SIMULATION

Environmental simulation includes individual climatic chambers for every section of the steering train as well as harsh environment modules with humidity and mud sputtering.

Cold start test and parameters dynamic control following real time histories.

### Environmental Simulation

Temperature	-40 to 130 °C
Humidity	20 to 95 RH%
Controlled Sections	Passenger Compartment Engine Hood
Mud Sputtering	On Steering Rack

### Hydraulic Characteristics

Speed	10 to 10000 rpm
Torque	44 Nm@ 4000 rpm
Oil Conditioning	Ambient to 120 °C



## ■ HARDWARE-IN-THE-LOOP SIMULATION

Associated with the vehicle and the driver model as well as the road profile, the system can reproduce actual behavior allowing design and control strategy optimization.





## ■ Brake Dynamometer

■ Based on the combination of flywheels and a programmable inertia simulation, using an electric motor, BIA offers several types of braking test systems in order to assess fatigue and durability of brakes or to develop new products based on Noise, Vibration And Harshness (NVH) analysis.

### ■ FATIGUE

BIA's Braking test system evaluates the durability of the main brake sub-system under simulation of lateral force applied at the tire contact points. Parking brake and ABS influence can also be tested.

As in real driving conditions, BIA's solution integrates air flow to cool down the brakes. Additionally, to reproduce all weather conditions, a climatic chamber can be provided to get rainy conditions and mud projection with water spray.

### ■ NVH ANALYSIS

To enhance simulation, BIA developed a flat road surface module in order to test axle with brakes, wheel and tire in real conditions. NVH analysis can be performed on this full module under climatic conditions.



## ■ Shock Absorbers



### ■ ELECTRIC VERSION

Made of an electric crank driven system, this solution can execute classical speed/force or displacement/force diagrams, check noise or leaks. Hysteresis or work calculations are also possible.

### ■ HYDRAULIC VERSION

For higher frequencies and random profiles, hydraulic solutions are also available for passenger car as well as for heavy-duty vehicles. A radial load module, shock absorber oil cooling module, shock absorber rod rotation and noise analysis chamber are available as optional devices.

#### Electric Shock Absorbers

Stroke	± 100 mm
Speed	1.2 m/s
Frequency	12 Hz
Maximum Load	15 kN

#### Hydraulic Shock Absorbers

Max. Stroke	200 mm
Max. Speed	7 m/s
Max. Frequency	50 Hz
Max. Dynamic Load	400 kN
Temperature Conditioning	-55 °C to +120 °C

### ■ Four Posters Road Simulation



■ BIA has introduced state-of-the-art four-poster test systems, fully integrated equipment for dynamic road simulation on complete vehicle. Each single component (actuators, hydraulics, bedplates...) is in-house designed in order to achieve the best optimization of performance.

BIA has also developed a 14-poster test system with a center of gravity retention system. The 350 kN actuators' performance reaches  $\pm 200$  mm of stroke, 7 m/sec, 50 Hz.

A custom version for heavy duty application with payload simulation is available as well.

#### ■ POSTERS

High-end hydrostatic hydraulic cylinders with embedded displacement sensor. All accessories are installed on board in order to have a sleek design and a well-arranged installation.

#### ■ WHEEL BASE AND TRACK ADJUSTMENT

Automatic servo-electric positioning of every single poster for a maximum testing flexibility. Hydraulic clamps safely lock the poster when the desired test position has been reached. Positioning data are stored in the vehicle data base for fast test setup.

#### ■ ENVIRONMENTAL CHAMBER INTEGRATION

The highly customizable multi-axial four-poster test bench can combine a walk-in chamber to simulate environmental conditions – with temperatures from  $-40^{\circ}\text{C}$  to  $+80^{\circ}\text{C}$  and relative humidity from 10% to 90% – and reproduce real road driving conditions. This equipment can thus be used for fatigue and NVH testing.

The test bench is designed to ease testing preparations and procedures during tests. Its innovative ergonomic design is based on a rigid and mobile interface between the climatic chamber and the actuators.

Specific provisions close the gap between the poster and the chamber floor to completely insulate the chamber from the pit. A unique design allows steps less positioning of vehicle over the wheels pans.

#### ■ A TURNKEY SOLUTION

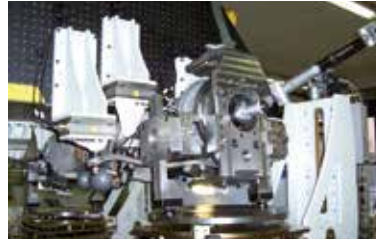
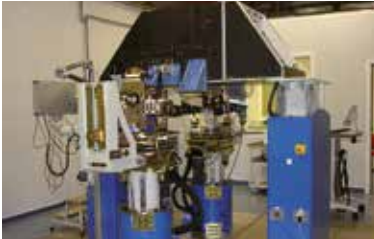
BIA engineering team can offer a turnkey project including the posters, overall hydraulics, and reaction mass as well as environmental simulation.



#### LD Vehicle

Max. Speed	5 m/sec
Max. Acceleration	25 G
Max. Stroke	$\pm 150$ mm
Max. Force	40 kN@28 MPa
Control	Position, force, acceleration

## Kinematics & Compliances



■ In order to maximize handling and ride performances of vehicles, BIA developed a noiseless fully electric Kinematics & Compliances test bench to measure quasi-static suspension characteristics.

### SUSPENSIONS CHARACTERISTICS

From two to four wheels loading stations, with closed loop controlled in either position, speed, force or caster, this test bench allows suspension developers or manufacturers to reproduce vertical, lateral, longitudinal, and rolling under different steering conditions. The combination of movements is also programmable.

With this large variety of input signals, effects of suspension geometry and steering characteristics are measured to enhance kinematic simulations and suspension development. For compliance measurements, effects of suspension springs, anti-roll bar and elastomeric bushes are evaluated.

### ACCURATE MEASUREMENTS ON AXLE, REALISTIC VALUES ON VEHICLE

Since a vehicle is not completely rigid, accurate measurements can be made on a vehicle axle fixed to the chassis frame. This test bench can also be used with the complete vehicle to get information in a real environment. To avoid tires effect on measurements, a dummy wheel had been developed. This accessory replaces any wheel since diameter and rim offset are adjustable.

Displacements of wheel center, toe, camber and caster angles are evaluated by a measuring arm. Stiffness and hysteresis effects are also assessed. Additionally, a center of gravity measurement module can be added on this rig to multiply test capabilities.

Performance		Measurement	
Wheel Base Adjustment	2 ~ 3.4 m	Wheel Displacement X & Z	0.2 mm
Track Adjustment	1.4 ~ 1.8 m	Wheel Displacement Y	0.05 mm
X	± 70 mm	Toe Angle	8''
Y	± 70 mm	Camber Angle	18''
X & Y	± 8 KN, 0 ~ 100 mm/min	Caster Angle	36''
Z	± 25 KN, ± 200 mm, 0 ~ 250 mm/min		
Z Rotation	± 300 Nm, ± 45°		
Load & Torque Accuracy	0.1 %		



### ■ Heavy Duty Flat Belt Road Simulator



#### ■ A HEXAPOD COMBINED WITH A FLAT BELT

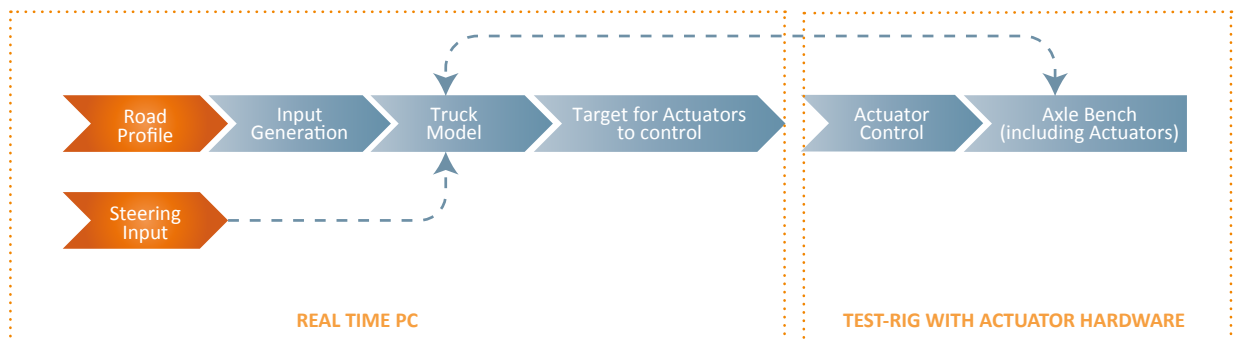
BIA Flat Belt Road Simulator has been designed to perform advanced tests on heavy-duty vehicles' axle and chassis during R&D stage. BIA's road simulator is actually a 6 DoF platform combined with a flat belt.

Instead of controlling each actuator independently, the system enables a displacement of the whole structure's center of gravity as the platform is controlled in close loop with multi-modal calculations.

The two road modules control the flat belt speed and, the rotation angle to simulate road turns and measures the wheel torque applied to the road when the wheels are turning. The distance between the two road modules is adjustable in order to test several sizes of vehicles.



#### ■ MODEL IN THE LOOP



BIA road simulator integrates the theoretical model of the complete vehicle in order to recreate road profiles. With a specific model of the vehicle, the user can play the profile and performs all required measurements on a single axle. The system will calculate and generate the influence of the virtual part of the vehicle on the tested part. With these measurements, the parameters of the theoretical model can then be adjusted until optimization of the specimen's reaction. New vehicles can be designed according to optimized values of the model.

Performance		Accuracy & Control	
Max. Speed of Belt	Up to 90 kph	Belt Speed control	± 0.1% FS
Max. Vertical Load	400 kN	Load Reproduction Accuracy	± 0.5% FS
Max. Wheel Torque	34 kNm	Belt Lateral Displacement Control	± 2 mm
Max. Wheel Angle Movement	± 40°	Platform Position Control	± 0.5% FS
Max. Rotation Speed of Wheel	40°/s	Wheel Angular Position Control	± 0.5°
		Wheel Torque Accuracy	± 0.1% FS



## ■ Multi-Axis Simulation



### ■ TWO-AXIS VIBRATING TABLE WITH A REVOLUTIONARY DESIGN

The horizontal axis hydraulic actuator is embedded inside the vertical table providing the utmost compact design and no-frills layout.

The hydrostatic vertical cylinder features two additional hydraulic linear guides to accommodate lateral efforts.

A custom specific head expander, with first eigenfrequency over 120 Hz, allows users to test specimens up to 4500 x 2100 mm.



Performance			
Table Dimensions	1000 x 1000 mm	Stroke	± 30 mm
Payload	1500 kg	Force	170 kN@28 MPa
Frequency	1 to 120 Hz	Control	Position Acceleration
Acceleration	25 G	Head Expander	4500 x 2100 mm
Speed	0.6 m/sec		

### ■ MULTI-AXIS SIMULATION TABLE

This test system provides 6 Degrees of Freedom (DoF) loads on the test specimen sub-system. It can simulate the heave, sway, surge, roll, pitch, and yaw accelerations.

To replay the road load profiles recorded on vehicles, the UTM control software integrates the MAST module and the THPC software to create the actuators input signals.

Performance	
Max. Standard Table Size	2.20 x 1.80 m
Max. Specimen Static Mass	1 200 kg
Max. Vertical Acceleration	10 g
Max. Lateral Acceleration	6 g
Max. Longitudinal Acceleration	6 g
Max. Frequency	150 Hz
Optional Max. Torque Input	6 000 Nm (± 30°)





■ DYNAMIC FUEL TEST SYSTEM

BIA has developed a multi-axis simulation table for performing dynamic tests on automotive fuel tanks with the ability to simulate real road conditions. The behavior of the liquid fuel and the fuel tank itself can be tested and evaluated.

Synchronized with the multi-axis simulation table (MAST), a fluids management system is filling up and emptying the tank according to a programmed consumption history as well as tuning the pressure inside the tank (fuel vapor emulation).



Performance	
Standard Table Size	2 x 2 m
Specimen Static Mass	1000 kg
Rotation Stroke	± 30° Rx Ry ; ± 20° Rz
Displacement Stroke	± 375 mm
Max. Frequency	20 Hz
Max. Dynamic Acceleration	2 G

■ MULTI-AXIS VIBRATING ACTUATOR

BIA's Multi-Axial Vibrating Actuator provides a highly effective mean of simulating vehicle dynamic behavior (up to 100 Hz frequency).

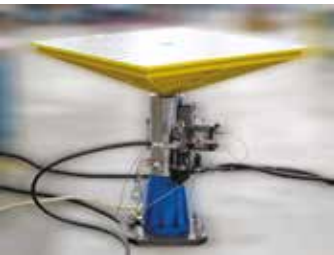
This 6-DoF actuator is closed loop controlled using a 6-axis load cell. Each axis is independently controlled in force or motion.

All the hydraulic actuators and hoses are integrated inside the structure to optimize volume and hydraulic power needs, and reduce risk of component damage.

■ 6-DEGREE OF FREEDOM MOTION PLATFORM

The TS2000 simulator is a 6-axis fully electric table designed to reproduce complex rotation and displacement motions. Examples of applications are to evaluate dynamic behavior of specimen during road or sea transportation, to test fuel tanks, to simulate driving.

Performance			
Standard Table Size	3.2 x 2.3 m		
Loading Position	1.5 m	Max. Acceleration	2 g
Rotation Stroke	± 30°	Max. Frequency	20 Hz
Displacement Stroke	± 350 mm	Max. Load	2 t



## ■ Elastomeric Parts Testing



### ■ SIX AXIS TEST SYSTEM FOR CHARACTERIZATION AND FATIGUE TESTING OF ELASTOMERIC PARTS

To improve understanding of components using elastomers in various forms and technologies, BIA has developed a test system capable of loading a specimen in six directions simultaneously, in a climate controlled environment.

The innovative technology can control the loading in position / speed or force independently on each axis. It can also reproduce realistic loading as road load signals.

### ■ THE UNMATCHED SOLUTION FOR ELASTOMERS TESTING

The morphology of the six-axis actuator is unique in its kind and patented, allowing the capability of reaching high frequencies (150 Hz) and offering high angular and linear strokes.

All movements of the servo-hydraulic system, uses hydrostatic bearings, and allows very high reliability with minimal maintenance. Note that there are no flexible hydraulic hoses in motion.

Six axis force transducer ( $F_x$ ,  $F_y$ ,  $F_z$ ,  $M_x$ ,  $M_y$ ,  $M_z$ ), six wire transducers and twelve accelerometers allows the control system to compensate for the loading effect on the frame.

The repository used for motion and loading is freely configurable.

Powerful software based on BIA's UTM platform, offers a wide capability for building automated testing procedures for investigations, combining static and dynamic loading, changes in temperature and humidity, and automated data acquisitions and treatments.

It is thus possible to characterize better and more efficiently than ever before, all kinds of components with integrated elastomers such as: engine mount, gearbox support, suspension stops and bearings, axle bearing, damper stop, sway bar.

### Main Characteristics

Application	Fatigue and Characterization
Frequency	Up to 150 Hz
Cylinders Bearings and Ball Joints	Hydrostatic
Morphology	BIA patented HEXAPOD
Forces ( $F_x$ , $F_y$ , $F_z$ )	$\pm 35$ kN, $\pm 35$ kN, $\pm 150$ kN
Displacements	$\pm 50$ mm, $\pm 50$ mm, $\pm 75$ mm
Rotations $R_x$ , $R_y$ , $R_z$	$\pm 15^\circ$ , $\pm 15^\circ$ , $\pm 25^\circ$
Climatic Characteristics	-40°C to 150°C
Control Modes	Force/Speed/ displacement
Frame Deformation Compensation	Low Frequencies: 6 wire sensors High Frequencies: 12 accelerometers



### ■ Six DoF Chassis Dynamometer



#### Performance

Motion Frequency	Up to 50 Hz (100 Hz in Z axis)
Flat Road Surface Speed	Up to 250 kph
Z Axis Acceleration	Up to 35 g
X And Y Axis Acceleration	Up to 15 g
Z Axis Displacement	± 50 mm (± 150 mm in option)
X And Y Axis Displacement	± 50 mm
Angular Displacement	± 6° (± 12° in option)
Moving Table Mass	250 kg

#### ■ A UNIQUE SOLUTION...

Protected by a worldwide patent, BIA 6-DoF Chassis Dynamometer combines the real rolling conditions with an interchangeable flat road surface. The mechanism is a one-wheel dynamometer on flat road surface with a 6-DoF actuator.

BIA's compact and noiseless solution is available in three standard configurations that can be customized:

- single-wheel to conduct tire or suspension tests
- two-wheel to perform complete axle tests
- four-wheel to evaluate the global behavior of vehicles

#### ■ ...INTEGRATING BIA LATEST INNOVATIONS

Like a chassis dynamometer, BIA 6-DoF Chassis Dynamometer is able to simulate the traction forces applied to the wheel (up to 7 kN) depending on the vehicle's characteristics, the road profile and the required speed.

The wheel itself undergoes up to six axis of motion, controlled in displacement or force and based on measured or user-defined surface profiles. All types of road conditions can be reproduced. Several kinds of belt surface are currently available.

#### ■ MEASUREMENT

Each module is instrumented to measure:

- displacement/speed of each linear axis,
- rotation angle/speed,
- traction force applied to the wheel (torque),
- flat road speed and load under central bearing,
- additional load feedbacks when using an instrumented wheel.

When integrating a steering column actuator, it is also possible to perform dynamic steering test.

## ■ Wheel & Tire Endurance



### Performance

Tire Diameter	13 to 21"
Vertical Load	± 30 kN
Lateral Load	± 15 kN
Steering Capacity	± 15°
Max. Speed	280 kph
Drum Size	1.7 or 2 m

### ■ A FULLY ELECTRICAL SOLUTION

For wheel rim and tires durability analysis, besides the available traditional hydraulic equipment, BIA has developed a new fully electrical solution using 1.7 or 2.0 m diameter drums. This compact dual station equipment allows users to apply vertical and lateral loads onto the tire. The bending moment produced is used for realistic wheel fatigue tests.

The drum is water cooled during testing.

Air flow through each wheel box allows for extraction of the worn rubber.

## ■ Tire Testing

### ■ FMVSS139, FMVSS109, FMVSS119 and other similar standards

A comprehensive test bench for both tire R&D and end-of-line production conformity check according to FMVSS139, FMVSS109, FMVSS119 and equivalent standards.

### Performance

Tire Diameter	500 - 1 000 mm
Tire Width	≤ 500 mm
Flat Deflection Fz	20 kN
Camber	± 5°
Parking Torque	2 kNm
Parking Angle	± 15°
Plunger Force	20 kN
Bead Unseat Force	20 kN

### 3 Types of Test

Flat Deflection	Fz Load
	Camber Angle
	Parking Torque Mz
Tire Strength	
Bead Unseating Resistance	

Flat deflection unit may be equipped with tire foot print pressure measurement and laser profilometer.



### ■ Tire Rolling Resistance Measurement



Performance			
Drum Diameter	2 m	Fz	15 kN , $\pm 10$ N FS
Maximum Speed	250 kph $\pm 0.1$ kph	Fx	$\pm 0.2$ N when $< 200$ N, 1.5 kN Accuracy $\pm 0.35$ N when $> 200$ N
Toe Angle Adjustment	$\pm 6^\circ$ ( $\pm 0.02^\circ$ )	Torque Method Accuracy	0.025 % FS
Camber Angle Adjustment	$\pm 6^\circ$ ( $\pm 0.01^\circ$ )	Coast Down Method Accuracy	0.065 % FS
Pressure Measurement	FS: 6 bars Accuracy : $\pm 0.2$ % FS	Power Method Accuracy	$> 3$ % FS

#### ■ THE HIGHEST ACCURACY LEVEL FOR EACH OF THE FOUR METHODS

**ECE R30/108/54/109/75/108/64/106; FMVSS109/119; SAE J1269/J2452; ISO 18164 / 28580 or ECE R117 and other similar standards**

Standard deviation lower than 0.05 N/kN through all methods as for reference requirements.

Rolling resistance is now a key parameter for vehicle fuel consumption. BIA offers a fully electric solution to allow advanced studies on the effects of rolling resistance, including up to four different methodologies [Force/Torque/Power/Coast Down] and adjustment of camber and toe angles.

Accurate and repeatable, this system can evaluate the different results, with the different methodologies, taking advantage of each of them. Transient measurement as well as real-time value of rolling resistance is available during the test. When the system is stabilized, measurements are performed and test reports are generated.

The test system structure has been designed to minimize deflection as any angle errors could influence the results. Bearing friction is minimized and controlled thanks to temperature control of lubricated oil bearings. The software allows users to easily configure either standard or customized tests with automatic analysis templates.

The test bench can be equipped to perform tire uniformity characterization as well as profile laser scanning.



### ■ BMC800 Universal Test Application Controller

#### ■ DIFFERENT CONFIGURATIONS

BMC800 is the universal test application controller used to easily control in closed loop independent servo-actuators or complete test systems. It is designed for a wide range of durability and performance testing equipment from the simplest to the most complex applications.

Based over twenty five years of experience, the BMC800 series of controllers is a field-proven solution that integrates advanced digital technology used to control all BIA test systems. BMC800 is available in three different configurations (19" rack, portable, or compact), and in two different versions (with or without touch screen).



#### ■ BMC-2C, THE COST EFFECTIVE SOLUTION

BIA has developed a compact version of BMC800 for powerful, versatile and reliable control for any servo-hydraulic and servo-electric actuators. This new version is specifically designed for simple applications.

With up to two actuators and their sensors in closed loop mode, the BMC-2C is a cost-effective solution for simple applications and high accuracy. The use of field approved real-time control techniques guarantees optimum accuracy.

BMC-2C makes the test procedure - from the system calibration to the result recording - easier.

An external PC can be added for user interface, additional reporting, remote control and monitoring.



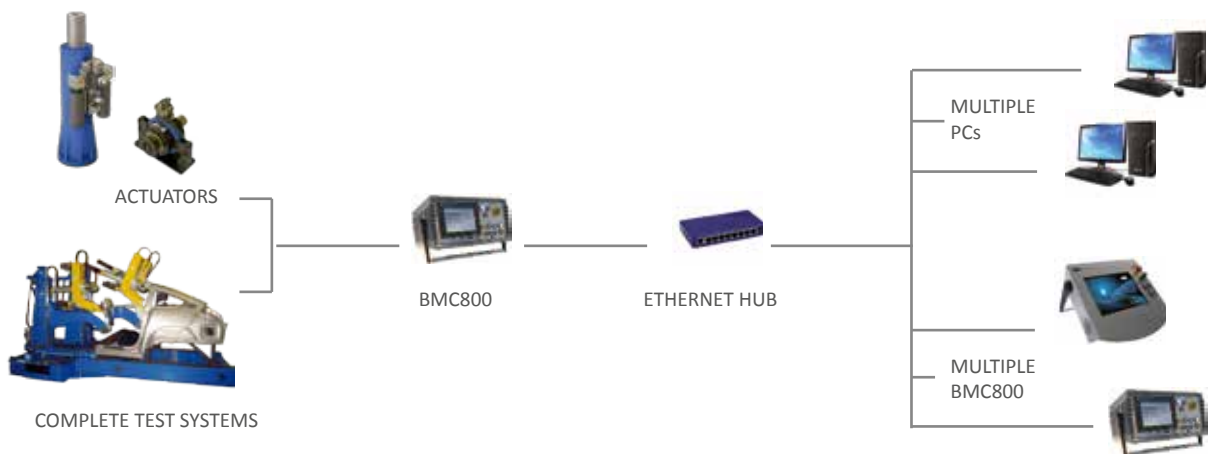
## COMPONENTS FOR TEST SYSTEMS

### ■ MULTIPLE CONTROL CHANNELS

BMC800 can support multiple control channels.

Each control channel is suitable for servo-hydraulic or servo-electric actuators, integrating servo-valve drivers, digital conditioners of main sensor signals, hydraulic service manifolds, hydraulic power unit and any other accessory control.

As a complete package, the BMC800 is supplied with UTM software which provides powerful control functions in a user-friendly environment.



### ■ UTM Control Software

■ Delivered with the BMC800 controller, UTM is a powerful and flexible software developed to control any testing application. The user can set up the hardware, define test procedures, run tests on specimen and perform post-treatment.

#### ■ USER-FRIENDLY SOFTWARE

The UTM software provides an easy-to-use “drag and drop” environment for building standard and non-standard sequences. In this environment, users can link basic processes, including function generation (sinus, square, triangle, pause, imported file, etc.), data acquisition, events, and triggers, to quickly and easily build complex test cycles.

### ■ Hydraulic Actuators

■ To help accelerate the development process and get reliable test results, BIA provides a full range of hydraulic components, from a variety of high-performance hydraulic actuators to hydraulic power units, including service manifolds. All of these components can be controlled altogether with the BMC800, BIA Universal Test Application Controller, through UTM, BIA's Universal Control software. It allows users to build cost-effective test systems adapted to his needs, or to upgrade existing ones.

#### Examples of Applications

Fatigue & Durability of Chassis Parts • Transmission Evaluation • Steering Sub-Systems • Seat & Seat Belt Anchorage • Roof Crush & Door Intrusion • Shock Absorber Evaluation • Suspension Sub-Systems • Vibration Simulation • Road Simulators • Multi-Axial Tables



### ■ LPHS, LPHD, RPHS, RPHD SERIES

This series of hydraulic actuators is designed for performance and durability test applications. Several solutions are available: linear/rotary motion, hydro-static/hydro-dynamic bearings depending on your test needs. Based on BIA's field-proven experience, these cylinders provide high performance results for servo-control applications with low maintenance operation.

Special designs for higher performance or propulsion applications are also available to meet your specific requirements.

### ■ Hydraulic Service Manifolds

■ BIA Hydraulic Service Manifolds (BHSM) are used to control pressure and flow distribution between hydraulic power unit and test stations. Each BHSM integrates pressure regulation, energy storage in hydraulic accumulators and oil filtration.

### ■ Hydraulic Power Units

■ BIA's standard hydraulic power units can supply flow from 20 to 600 lpm. For higher needs, several units can be associated in parallel and operated only when needed, depending on the flow consumption.





## ■ High-Speed Dynamometers

As new electric vehicles are using high-speed motors, BIA has introduced a new range of dynamometers to meet the evolving needs: the HSD series.

To combine high torque at low speed and constant power at high speed, BIA has developed a hybrid hydraulic bearings technology to allow very high natural frequency and durability.



HSD Series	Power	Torque	Speed	Inertia	Vibration
BASM	50 kW	280 Nm	13 000 rpm	0.142 kgm <sup>2</sup>	n.a
HSD 130	126 kW	400 Nm	20 000 rpm	0.056 kgm <sup>2</sup>	< 2 mm/s
HSD 230	230 kW	390 Nm	20 000 rpm	0.087 kgm <sup>2</sup>	< 2 mm/s

### Characteristics

Technology	Permanent Magnet Synchronous motors
Cooling	Water

## ■ OVERDRIVE

In order to test both the E-motor and the vehicle powertrain on the same dynamometer, BIA has developed a specific double input device.



### Characteristics

2-input dynamometer	▪ 1:1	- High speed (up to 20000 rpm) - Low Torque (up to 390 Nm) - Low inertia (up to 0.087 kgm <sup>2</sup> )
	▪ 1:10	- Low speed (up to 2000 rpm) - High Torque (up to 3900 Nm)

Hydraulically clutchable device

Independent contactless torque meter on each input



Motor & Gear Reducer



E-Motor Only





### ■ Walk-in Test Chambers

■ BIA has developed an extensive custom-designed climatic chambers dedicated to environmental testing:

- climatic four-poster,
- climatic multi-axial table,
- climatic emission lab,
- full spectrum solar simulation,
- rain chambers...

These chambers can simulate a wide range of environment conditions and can fit voluminous and heavy-duty specimens (up to 35 tons).

#### Examples of Applications

Altitude simulation • Deep cooling up to the liquid nitrogen temperature • Atmosphere of salt spray and sun radiation simulation • Humidity and icing tests • Intake air treatment for engine test (temperature, humidity, pressure) • Partial depression and high vacuum

■ Several chambers of the same or different types (ex. salt spray and low temperature thermostatic chambers) may be integrated in the form of test centers to accomplish many parallel full range tests governed by a powerful planning utility. This approach may revolutionize test protocol in large laboratories as it significantly reduces the test phase time.



## ■ EV/HV Battery Test Chamber



■ For battery tests, BIA provides a range of standard chambers in different sizes of housing from small LV start battery up to an electric vehicle multicell traction battery. Available in 650 L, 1000 L, 3700 L.

These chambers reproduce extreme climatic conditions while taking into account the specific industrial connectors and the suitable safety precautions to carry out those tests.

In addition to the specific system of ventilation of the chamber, a generator can be independently integrated to the chamber to inject air-conditioned for pack battery testing. The generator has its own temperature controller, its components of refrigeration, heating, and safety.

The offered unit is a system with lost air. The air blown in the battery is evacuated outside via exhaust ductwork. The gases are analyzed in the tubing of extraction and the generator is stopped in the event of gas detection.

### ■ A USER-FRIENDLY SOFTWARE

A touch-screen PC is integrated to the chamber. CLIMPILOT™ software makes it easier to control test chambers, to create test programs and to store and analyze data.

### ■ A SAFER TESTING PROCEDURE

In addition to the climatic simulation, BIA's battery test chamber features a kit of accessories that makes the testing procedure easier and safer: wall passage for power and signal cables; gas, flame and smoke detection; fire extinguisher; and explosion pressure relief.



Hazard	Detection	Actions
Toxic Gas	H <sub>2</sub> , NOx, O <sub>2</sub> , LEL *	Alarm
Fire & Smoke	Flame & Smoke	Alarm, Fire Extinguisher
Explosion	Overpressure	Pressure Relief
* other upon request		



## Air Generator Characteristics

Variable Air Flow	20 m <sup>3</sup> /h to 500 m <sup>3</sup> /h
Adjustable Temperature	0°C to +50°C
Speed Variation in Temperature	2°C/min

## Chamber Characteristics

Temperature	-40°C to +120°C
Humidity (as an option)	10 RH% to 98 RH%
Homogeneity of Temperature	± 2°C

### ■ EASIER CONNECTIONS

Embedded in the wall passage in a completely customer-configurable panel are the high current copper bars, temperature and voltage signal sockets, communication bus connectors.

### ■ BATTERY AIR COOLING

The air generator brings thermostatically controlled air to the battery with a variable flow of 20-500m<sup>3</sup>/h and temperature controlled within 0-30°C. The liquid conditioning supply delivers up to 20 liters/min of water glycol mixture at -40°C to 150°C.

## ■ Small Volume Test Chambers

### Standard Product Range

- HOT / COLD
- HUMIDITY: 10% to 98% relative humidity
- FAST VARIATION OF TEMPERATURE: 3°C/min to 20°C/min
- THERMAL SHOCK in two separate volumes or in FVT
- VACUUM: down to 1 mbar
- VIBRATION: integrations of shakers



■ BIA offers a wide variety of standard climatic chambers with capacities ranging from 30 to 2000 liters and temperatures from -70°C to +200°C. To meet specific requirements, BIA has also supplied custom-designed climatic chambers worldwide.

All BIA climatic chambers are manufactured according to European safety regulations and meet international standards.

### ■ MAIN FEATURES

- High quality components
- An innovative system of ventilation that ensures perfect air homogeneity
- A unique and reliable humidity control (± 3% RH)
- Connection through RS232, IEEE488, RS485, RS422, 0/10 V, 4/20 mA, USB.

### ■ CLIMPILOT™ SOFTWARE

ClimPilot is a user-friendly software that makes easier to control test chambers, to create test programs and to analyze data.





### ■ Ultrasonic Scanning

#### ■ Certified by General Electric and SNECMA for Engine Parts

Designed for easy operation and low maintenance, BIA's Ultrasonic Scanning Tank is recognized globally in the aerospace industry, and others that need precision non-destructive testing. It is used in production process, laboratory and maintenance operation to detect flaws and material defects on engine parts and complete panels.

#### ■ SPECIFICATIONS

- Compatible with most ultrasonic generators including Phased Array Technology
- Scanning robot with 5 or 6 motorized axes + turntable
- Up to 4 data acquisition gates for real-time C-scan display and storage of peak amplitude and time-of-flight data
- Anti-clash system to avoid damages in case of incorrect programming
- Automatic calibration according to standards



### ■ Eddy Current Inspection

#### ■ SPECIFICATIONS

- 8 axis robot + rotating table.
- Several tools available
- BIA CFPILLOT™ Software for automatic programming from piece drawing and SCAN PLAN
- 3D inspection simulation tools and acquisition report
- Customizable operator interface
- Signal conditioning and digital synchronous acquisition system





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