

ElectroForce® BioDynamic™ Test Instruments

Characterization of Biomaterials and Tissues in a Biological Environment

Bose® ElectroForce® BioDynamic™ test instruments provide accurate characterization of biomaterials and biological specimens within a sterile cell culture media environment. The ability to precisely load specimens and simulate biological conditions in one system opens up new research possibilities for tissue engineering and biomaterials research.

The instruments can be used for the evaluation of a variety of specimens, including biomaterials, acellular and cell-seeded scaffolds, native tissue samples and tissue-engineered constructs. Since BioDynamic test instruments can be used to simulate in vivo conditions for the culture and testing of three-dimensional samples, they can be a valuable tool to bridge the gap between basic in vitro exploratory studies in culture dishes and in vivo animal experiments.

BioDynamic test instruments provide specimen loading and media circulation control under a variety of programmable conditions. Each test chamber is packaged with its own closed media flow loop system to minimize contamination. The instruments are well-suited for research needs in tissue construct and biomaterial performance, scaffold

engineering, as well as many other biocompatibility evaluations. Long-term, time-dependent experiments can also be carried out under a variety of conditions.

The availability of material property information provides important benchmarks for the performance requirements of new biomaterials as well as tissue-engineered medical products. Application areas include characterization of vascular tissue and myocardial patches for cardiovascular tissue engineering, as well as bone, cartilage, meniscus, ligament, tendon and spinal disc tissues for musculoskeletal applications.

BioDynamic test instruments are available either as single or multiple specimen configurations. Either way, the ability to integrate sample conditioning and properties characterization in the same environment is a significant advancement over traditional test systems.



**ElectroForce BioDynamic Instrument
for Dynamic Compression and
Perfusion Flow**



**200 N Pulsatile Flow Instrument for
Vascular Tissues**



**200 N Dynamic
Tension Instrument**

BioDynamic™ Test Configurations

Bose® BioDynamic™ test instruments are integrated systems that combine ElectroForce® linear motors with environmental technologies and fully-automated computer control and software. Proprietary ElectroForce motors provide exceptional fidelity because of their simple and durable moving-magnet design. Thanks to their advanced performance and clean packaging for biomedical laboratories, ElectroForce instruments have been well received by researchers worldwide.

New advances in biomedical research depend upon understanding the mechanical properties of tissues and biomaterials under many different conditions. Of significant value is the ability to perform in vitro testing under controlled conditions to more efficiently study biofunctionality and biocompatibility factors. BioDynamic instruments from Bose provide a versatile platform for biomaterials research, including tissue-engineered constructs and scaffolds.



200 N Tension/Compression and Pulsatile Flow Instrument for Vascular Tissues

Compact BioDynamic Instrument

The compact BioDynamic instrument is suitable for incubator use in a biomaterials or cell/tissue culture laboratory. The system is available in a single-axis (tension/compression) or dual-axis (tension/compression and pulsatile flow) configuration, and optional capabilities are available depending on the application. The test chamber can be easily removed from the motor assembly to accommodate experimental setup, or to conduct experiments with multiple test chambers on a revolving basis.

The BioDynamic instrument is provided as a complete system with a media perfusion flow loop, load cell, displacement transducers, pressure transducers (if applicable), and a chamber stand for use in a sterile flow hood. The testing assembly can be placed in a suitable cell culture incubator for precise environmental control.

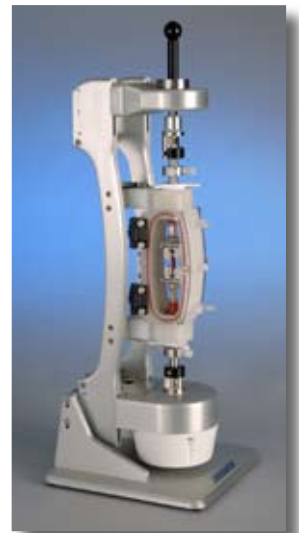
The compact BioDynamic instrument is available as a 20 N or 200 N maximum force system, and can be packaged for a variety of tissue applications.

Orthopaedic Research

The compact BioDynamic instrument can be equipped with an ElectroForce linear motor for dynamic tissue and biomaterial characterization under tension/compression and perfusion flow loading regimes. Porous and non-porous platens used for compression are interchangeable with tensile grips in the same orthopaedic chamber to accommodate a variety of orthopaedic applications. Bone, cartilage, meniscus, spinal disc, ligament and tendon tissues and biomaterials can be characterized under sterile conditions while stimulated in a biocompatible chamber. A fully integrated digital video extensometer can be added to the system for primary, secondary and shear strain measurements.



Orthopaedic Chamber with Porous Platens



20 N Dynamic Tension and Chamber Perfusion Setup

Vascular Applications

ElectroForce linear motors are used to provide accurate pulsatile loading (with programmable stroke volume and frequency) and tension/compression to tubular specimens such as native arteries and veins, vascular grafts, tissue-engineered blood vessels and other tubular biomaterials. The pulse generated by the ElectroForce motor is combined with steady flow from a media pump to generate the desired pulsatile waveform. A laser micrometer can be added to the system to measure diametric changes in the samples due to pulsatile flow and to study creep and elasticity.

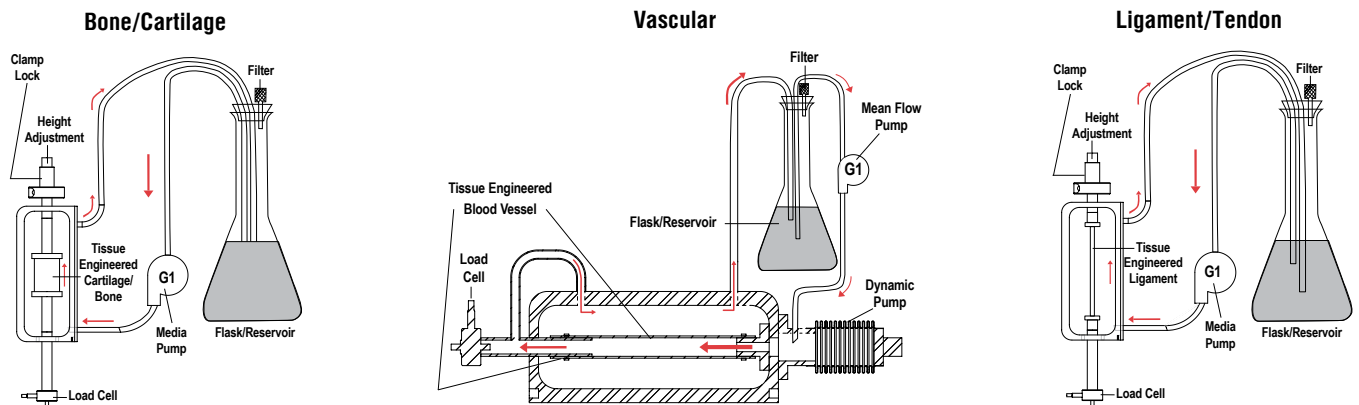


Vascular Chamber for Pulsatile Flow or Tension/Compression and Pulsatile Flow

BioDynamic™ Instrument Design Features

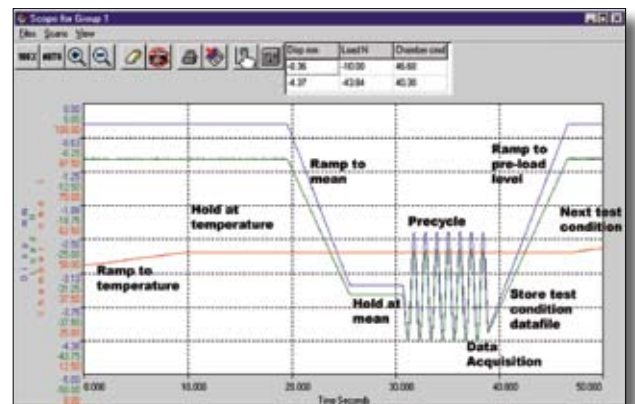
Chamber and Flow Loops

- The BioDynamic™ test chamber is constructed from materials suitable for autoclaving or ethylene oxide sterilization and is designed for long term use. Several porting options are provided as standard features for flow inlets/outlets and monitoring purposes. These ports can be used to insert pressure, temperature, dissolved oxygen, carbon dioxide, and pH sensors, thus allowing flexible setup and measurement for many biomedical research applications.
- A support stand is provided with each BioDynamic test instrument for secure chamber positioning during specimen mounting and harvesting inside a sterile flow hood. The BioDynamic chamber can be mounted horizontally and partially filled with saline or culture media, or positioned vertically to facilitate specimen mounting. In addition, one or both chamber doors can be opened to provide better access to the chamber for attaching tissues or biomaterials to the hose barb fittings, grips, or platens.
- The orthopaedic and cardiovascular chambers use interchangeable modular components so that a BioDynamic chamber can be adapted to either an orthopaedic or a vascular assembly. Each chamber has its own closed-loop media system to minimize contamination risk, while a media pump is utilized to circulate nutrients in the flow loop. A media reservoir is also available to facilitate media gas exchange in an incubator and serve as an additional sampling port.
- Bone, cartilage, or other disc-shaped specimens are compressed between platens, and the flow loop can be configured to provide chamber perfusion and/or specimen perfusion through porous platens. Vascular grafts or other tubular specimens are mounted on hose barb fittings and stimulated by lumen and/or chamber perfusion. Ligaments, tendons, skin, or other thin and elongated specimens are attached with tensile grips while the chamber is perfused with nutrients.



Control and Measurement

- The BioDynamic test instrument is controlled by a PC using Bose® PCI digital controls and WinTest® software. WinTest software is an intuitive control system for performing complex test routines with minimal training.
- When the instrument is integrated with optional Dynamic Mechanical Analysis (DMA) software from Bose, tissue viscoelastic properties can be determined for comparison and correlation under a variety of dynamic conditions.
- Measurement transducers are provided for each active control channel, including pressure sensors, axial load and displacement measurement.
- An optional precision laser micrometer or digital video extensometer can be used to monitor tissue response.



WinTest® Software



BioDynamic™ Test Instrument Product Guide and Specifications

Application	Vascular				Orthopaedic	
	Blood vessels and stents				Cartilage, bone, ligaments and tendons	
Force	20 N		200 N		20 N	200 N
Loading	Pulsatile	Axial/Pulsatile	Pulsatile	Axial/Pulsatile	Axial	Axial
Motor(s)	One	Two	One	Two	One	One
Motor Capabilities	± 2.5 mm stroke 3.6 mL/pulse 0-300 mmHg	± 2.5 mm stroke 3.6 mL/pulse 0-300 mmHg	± 6.35 mm stroke 8.8 mL/pulse 0-800 mmHg	± 6.35 mm stroke 8.8 mL/pulse 0-800 mmHg	± 2.5 mm stroke	± 6.35 mm stroke
Mean Flow Rate	17-1700 mL/min	17-1700 mL/min	17-1700 mL/min	17-1700 mL/min	1-280 mL/min	1-280 mL/min
Displacement Transducer(s)	One	Two	One	Two	One	One
Load Cell(s)	One	One	One	One	One	One
Pressure Transducer(s)	Two	Two	Two	Two	Optional	Optional
Laser Micrometer (optional)	Yes	Yes	Yes	Yes	-	-
Video Strain Extensometer (optional)	Yes	Yes	Yes	Yes	Yes	Yes
DMA (optional)	-	-	-	Yes (Axial only)	Yes	Yes
Chamber Features	Transparent viewports, horizontal or vertical setup and testing, sterilizable by autoclaving or ethylene oxide					
Perfusion Flow Loop	Mean flow pump, media reservoir, tubing and fittings					
Cell Culture Sensors (optional)	Real-time monitoring of pH, temperature, dissolved oxygen, carbon dioxide, lactate and glucose (consult Bose)					
Environment	Incubator-compatible (consult Bose)					

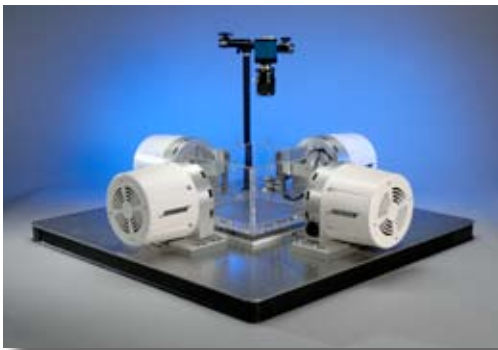
Specifications are subject to change

Additional BioDynamic Configurations

- Consult Bose on combined tension/compression and torsion BioDynamic™ test instruments for orthopaedic applications.
- Bose also offers dynamic (pulsatile) flow through porous platens in addition to compression loading for bone, cartilage, meniscus and intervertebral disc applications.
- Refer to the multi-specimen BioDynamic test instrument brochure for experiments that require simultaneous characterization and stimulation of several specimens in the same or individual frames.



TestBench Instrument with Vascular BioDynamic™ Chamber



TestBench Planar Biaxial Instrument with Heated Saline Bath and Video Extensometer

Biomaterials and Tissue Testing Options

- BioDynamic chambers are compatible with other ElectroForce® instruments such as the TestBench and ElectroForce 3200 for experiments with less critical temperature requirements.
- Planar biaxial configurations are available for dynamic testing of tissues and strain measurement in a saline bath.



ElectroForce® 3200 Instrument with Orthopaedic BioDynamic™ Chamber