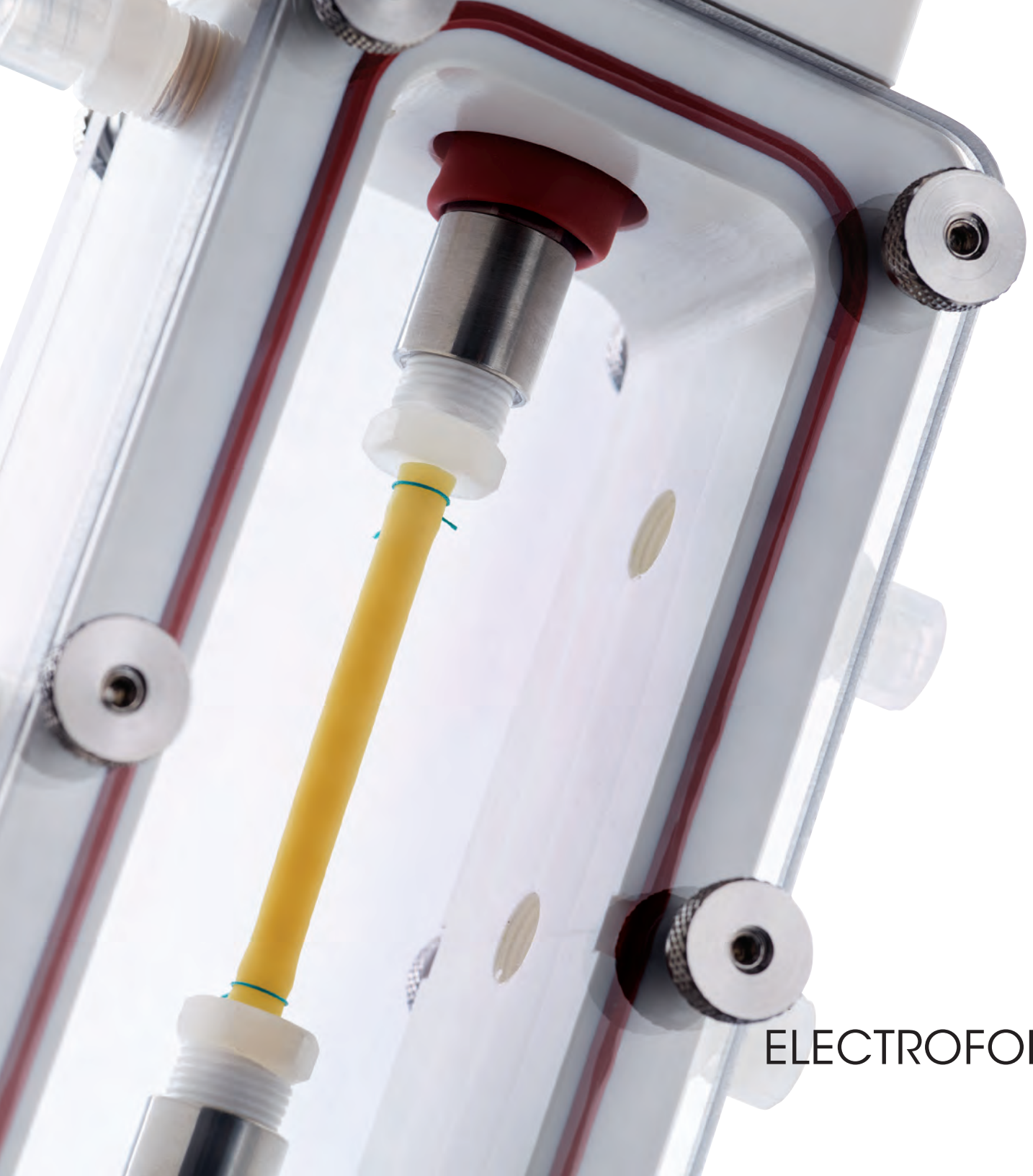
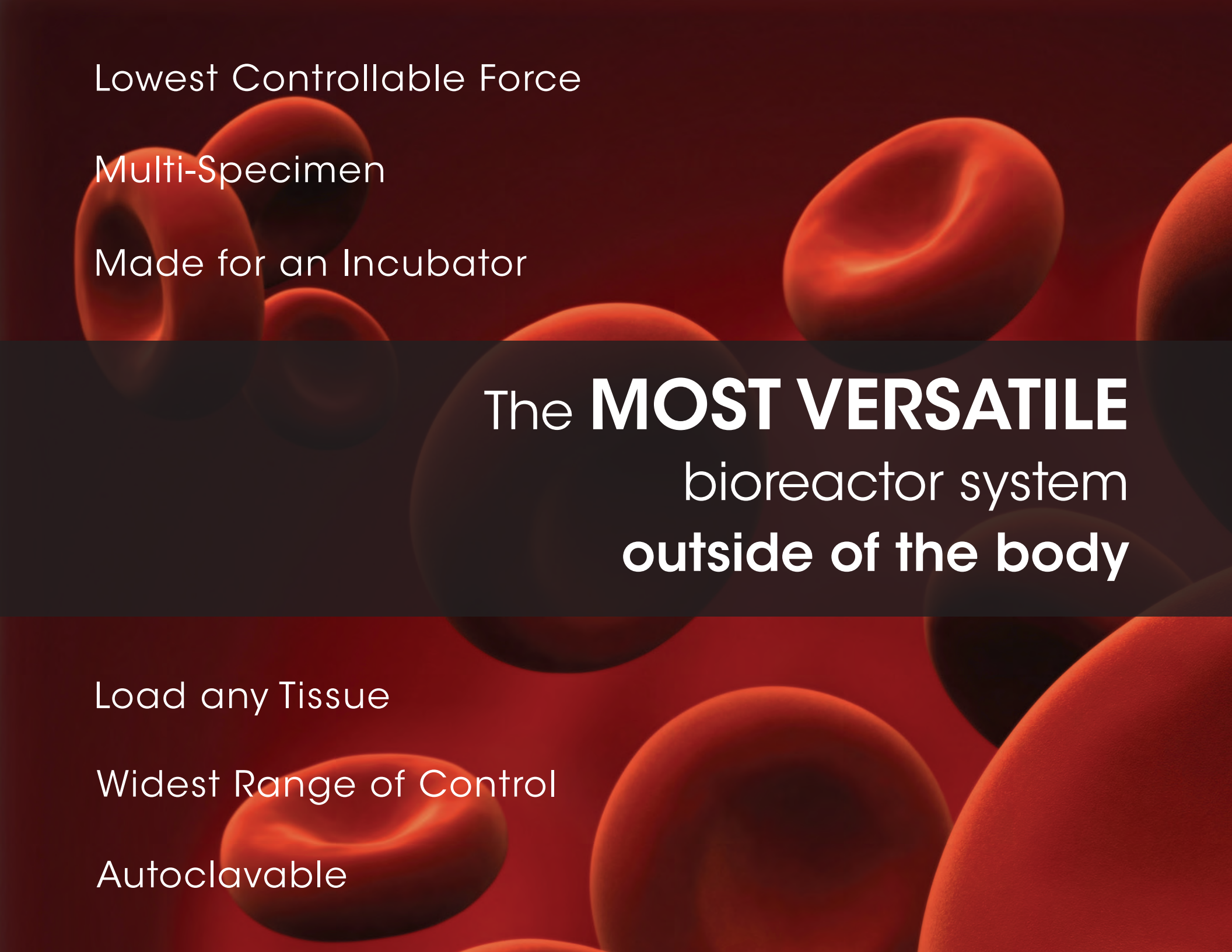


ELECTROFORCE® BIODYNAMIC® TEST INSTRUMENTS

Welcome to **TRANSFORMATIONAL** biomedical technology, engineered to **ADVANCE TISSUE GROWTH**


Lowest Controllable Force
Multi-Specimen
Made for an Incubator
The MOST VERSATILE
bioreactor system
outside of the body
Load any Tissue
Widest Range of Control
Autoclavable

Design simplicity provides unmatched performance & reproducible test results

ElectroForce® BioDynamic® test instruments provide long-term tissue engineering solutions within a sterile cell culture environment. With a full range of capabilities, choose the configuration that is right for you, from introductory bioreactors to the most versatile mechanical stimulation bioreactors on the market.

Apply physiologically-relevant loading conditions

Transfer mechanical stimuli precisely while perfusing media and maintaining sterility

Engineered for reliability and durability

Designed for long-term use and experimental repeatability

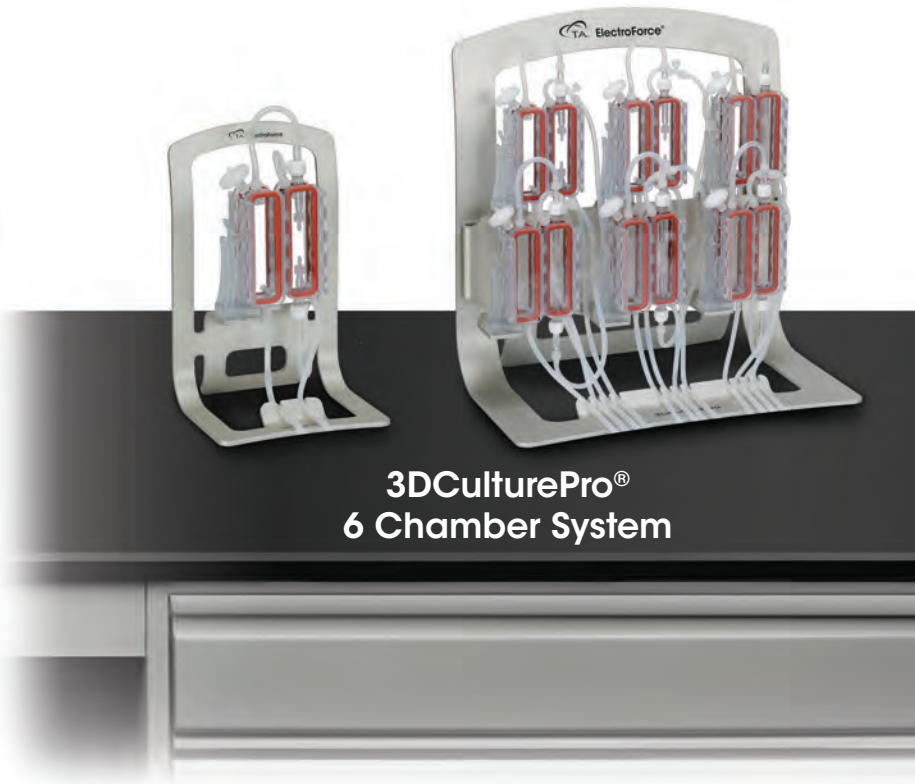
Simultaneously stimulate and characterize any type of tissue

Widest range of force and displacement control to meet the increasing mechanical needs of your tissue

ElectroForce® BioDynamic® Series

Blood Vessels
Ligaments
Cartilage
Bone
Biomaterials
Stem Cells
Scaffolds
Biocompatible
Mechanotransduction
Regeneration
Differentiation
Proliferation
Migration
Alignment

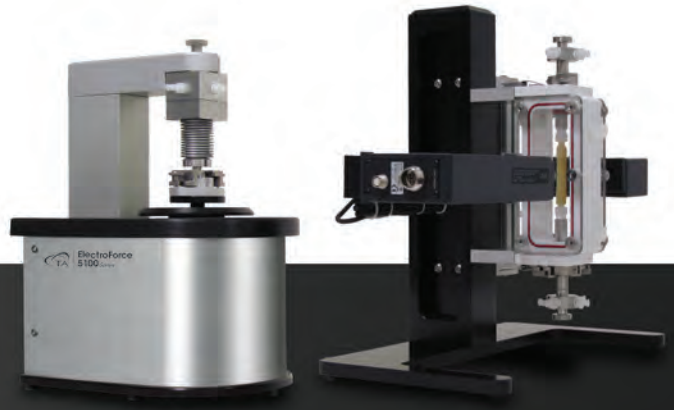
Perfusion Bioreactors



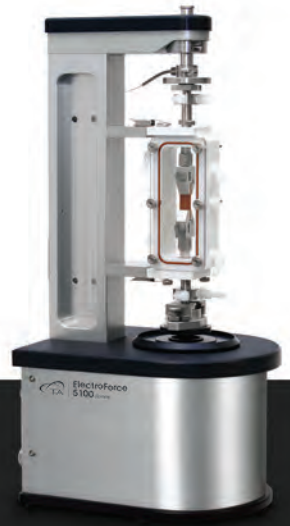
3DCulturePro®
6 Chamber System

Single Specimen Mechanical Stimulation Bioreactors

Multi-Specimen Mechanical Stimulation Bioreactors



BioDynamic® Pulsatile Test Instrument



BioDynamic 5110 Axial Test Instrument

BioDynamic 5270 Axial/Pulsatile Test Instrument

Industry **LEADER** in biomedical testing applications for over 20 years

Superior chamber architecture

ElectroForce bioreactors are engineered so tests can be set up quickly and easily, while still giving users the greatest versatility to run limitless experiments.

Scalable configurations meet growing research needs

Chambers are optimized to conserve space while allowing for the addition of multi-specimen fixtures, multiple bioreactors, and added loading capability.

Unmatched waveform control and fidelity

Patented ElectroForce frictionless motor design facilitates precise force, displacement and pressure control with unrivaled responsiveness.

Explicitly engineered for 3D cell culture in an incubator

ElectroForce maintenance-free motors withstand years of use in the challenging conditions of environmental chambers.

The industry's only 10-year motor warranty

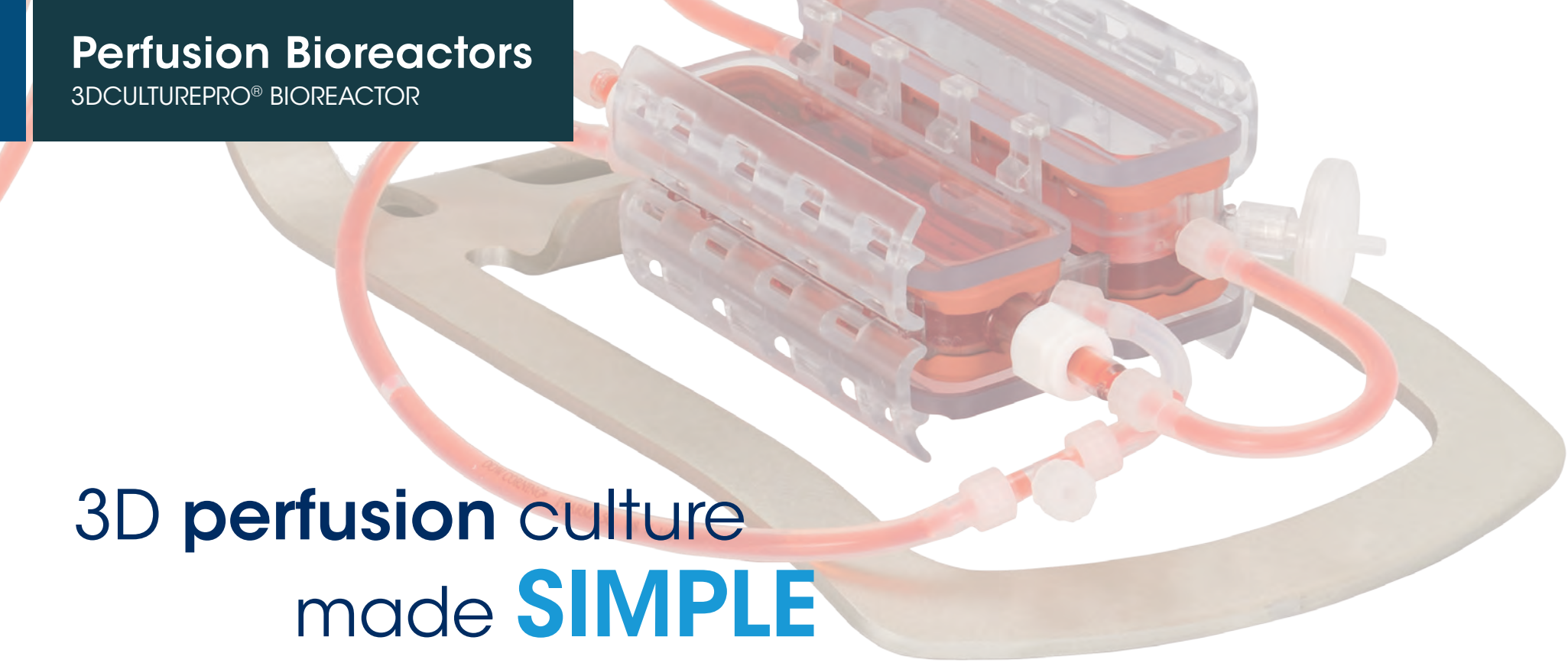
We give you confidence that your system will continue to perform as your research evolves.

Introducing a **complete portfolio** of tissue culture solutions

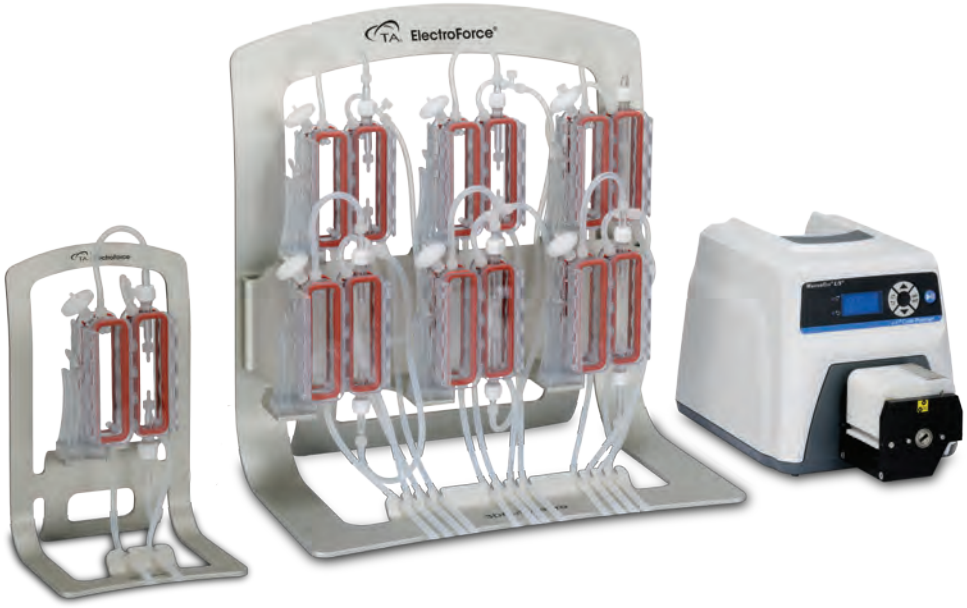
- **Perfusion Bioreactors**
- **Single Specimen Mechanical Stimulation Bioreactors**
- **Multi-Specimen Mechanical Stimulation Bioreactors**

Perfusion Bioreactors

3DCULTUREPRO® BIOREACTOR



3D **perfusion** culture made **SIMPLE**



Set up a test in minutes

- Easy to use, tool-less chamber design
- Integrated media reservoir
- Portable and compact

Adaptable design

- Includes fixtures for a variety of sample types
- Can be positioned in 3 orientations
- Accommodates multiple flow loops

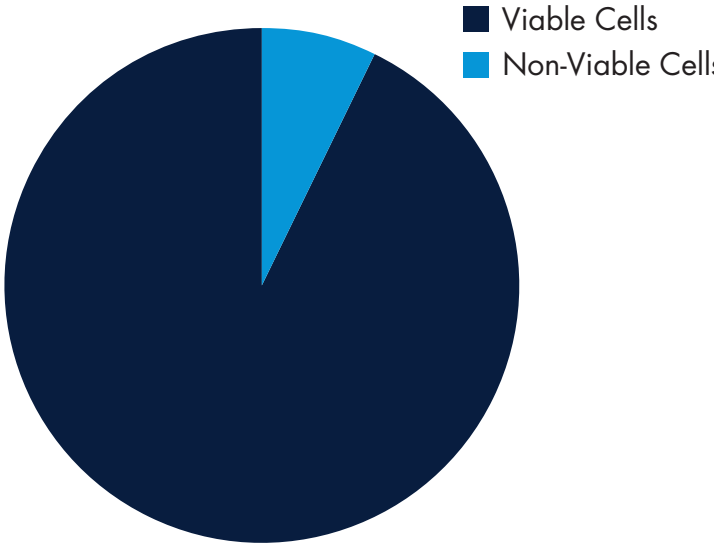
Keep your cells

viable during a multi-month

tissue culture experiment

so you are measuring

the cellular response that actually matters*

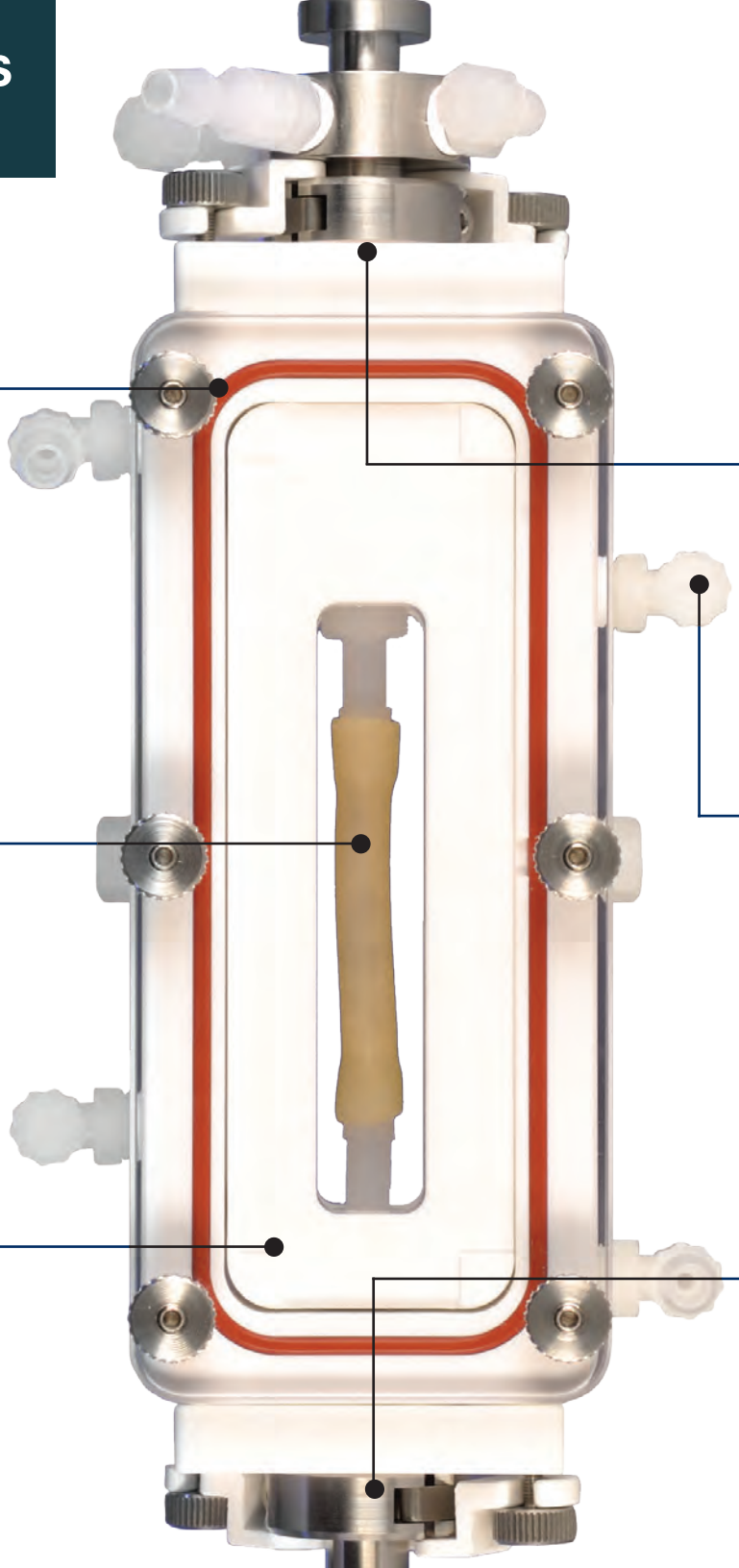


6 Week Flow Culture of Smooth Muscle Cells

*SV Biechler. 2015. Perfusion flow keeps cells viable in long-term 3D culture. TA ElectroForce Application Note ESG001.

Perfusion Bioreactors

BIODYNAMIC® BIOREACTOR



All components in contact with fluid are designed to last many autoclave cycles

Frictionless, rolling seal designed to precisely load a delicate sample

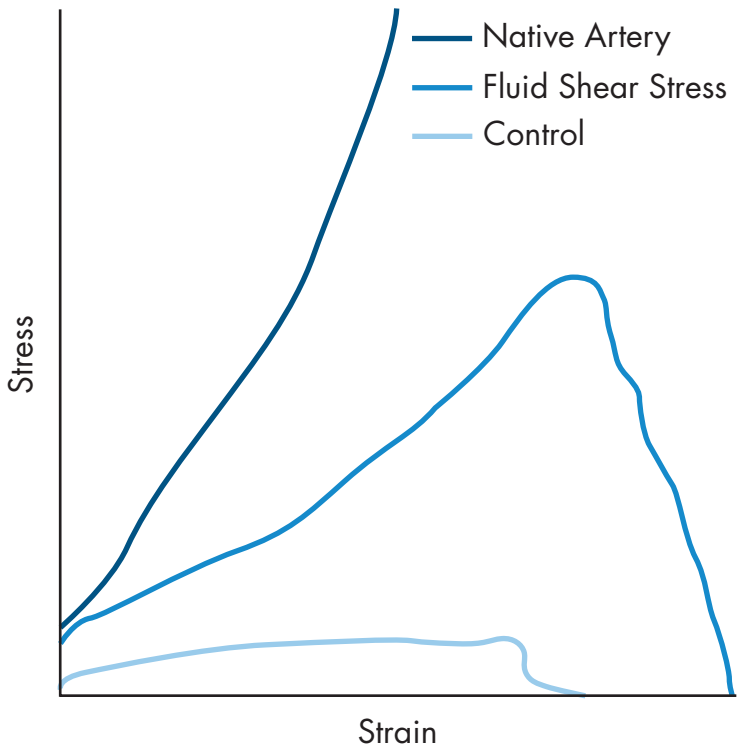
Flow ports let you choose the flow loop that is right for your test

Transparent viewing windows allow you to image your sample during stimulation

Chamber fillers minimize fluid volume and reduce consumable costs

Adjustable hollow shafts lock in place so unwanted load isn't applied to the sample during setup

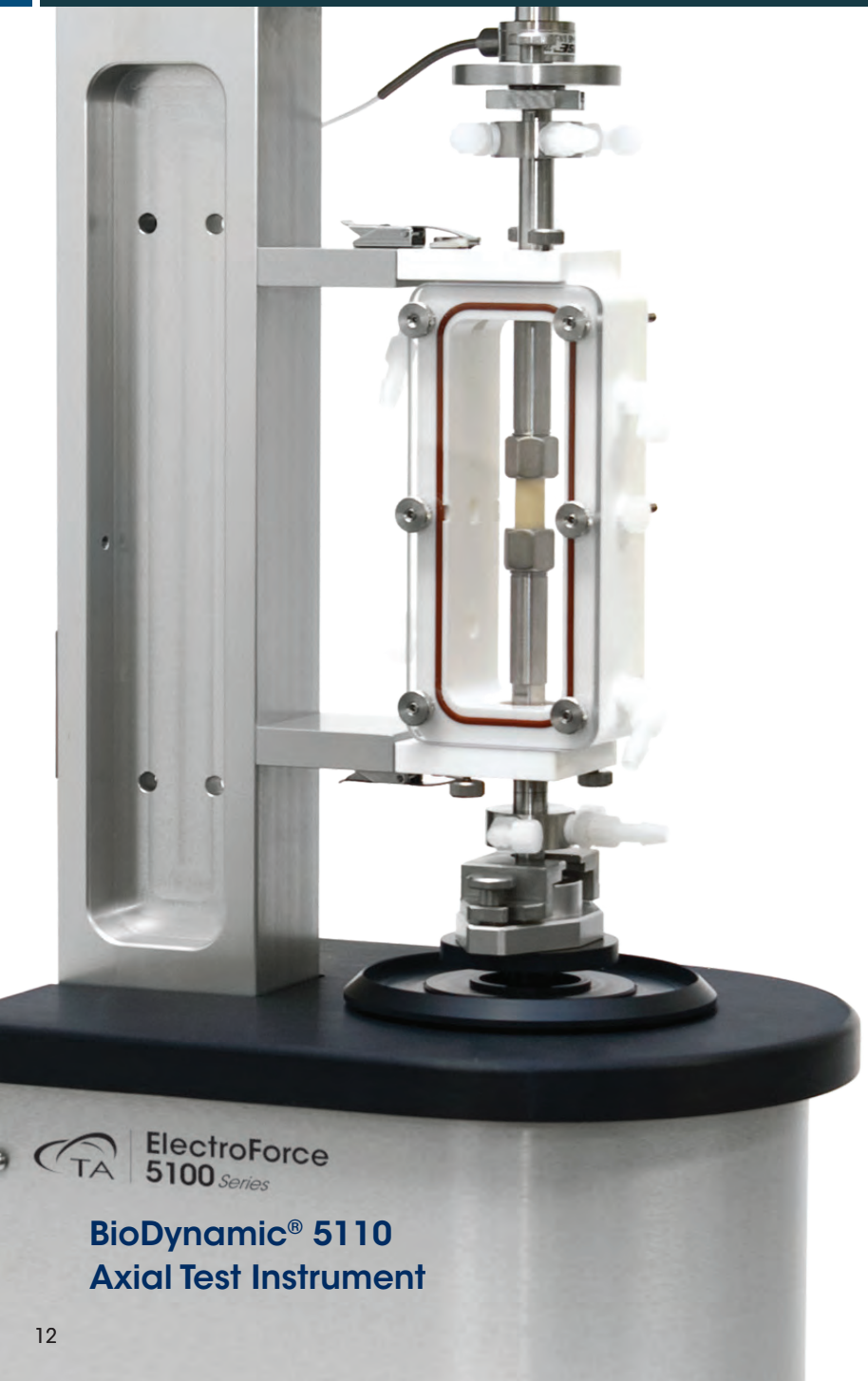
Apply fluid shear stress to **stimulate** cellular remodeling of the **extracellular matrix (ECM)** and **enhance** the mechanical and biological properties of vascular **tissue** *



*F Boccafoschi, M Bosetti, C Mosca, D Mantovani, and M Cannas. 2012. The role of shear stress on mechanically stimulated engineered vascular substitutes: influence on mechanical and biological properties. Journal of Tissue Engineering and Regenerative Medicine 6(1):60-67

Single Specimen Mechanical Stimulation Bioreactors

SINGLE AXIS



BioDynamic® 5110
Axial Test Instrument

BioDynamic Pulsatile Test Instrument

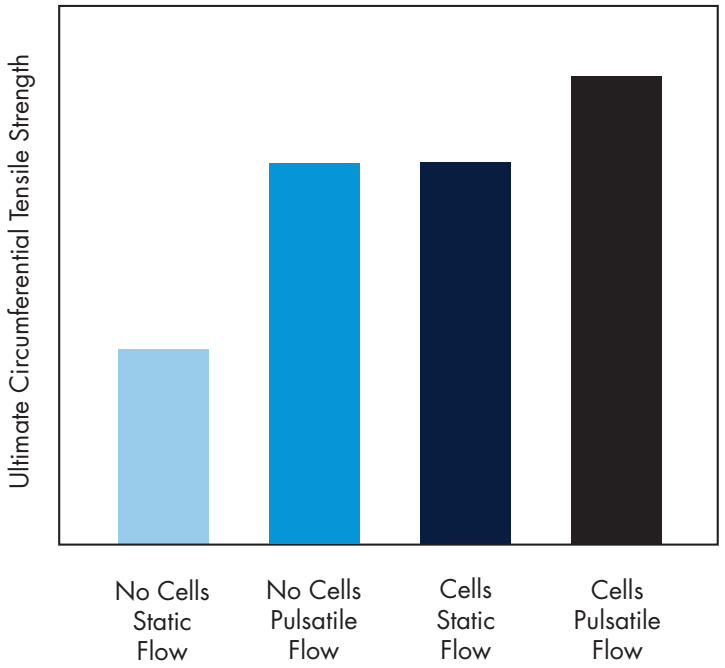
Optimized design gives you the freedom to focus on your research

- Perform simultaneous periodic loading experiments with supplemental chambers
- Rigid shafts are hollow to accommodate dynamic flow as well as precise loading of stiff samples
- Chamber and flow loop can be autoclaved, assembled, and sealed before transferring to the test frame

Versatile

- Loading a different sample type is as easy as changing fixtures
- Flow ports let you choose the flow loop that is right for your test

Increase airway strength and **promote** physiological **cellular alignment** by applying **dynamic circumferential strain***



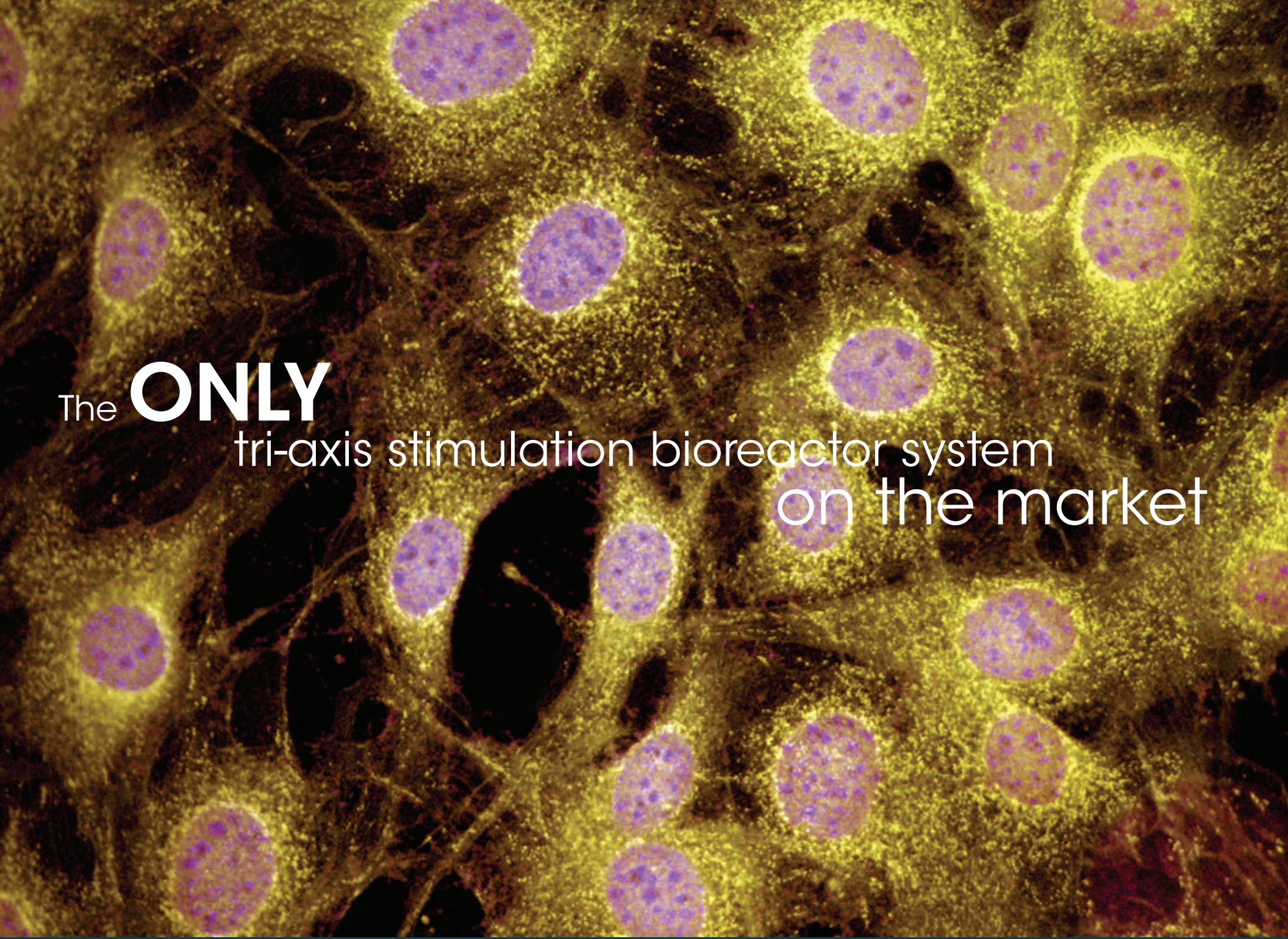
*CE Ghezzi, B Marelli, MB Donelli, A Alessandrino, G Freddi, and SN Nazhat. 2014. The role of physiological mechanical cues on mesenchymal stem cell differentiation in an airway tract-like dense collagen-silk fibroin construct. Biomaterials 35(24):6236-6247.

Single Specimen Mechanical Stimulation Bioreactors

MULTI-AXIS

BioDynamic® 5175
Axial/Torsion/Pulsatile
Test Instrument*

*Axial/Torsion and Axial/Pulsatile configurations also available


The ONLY
tri-axis stimulation bioreactor system
on the market

Multi-Specimen Mechanical Stimulation Bioreactors

Patented flexure design ensures equivalent loading to all samples

- Controlled deformation of all samples with a shared actuator
- Each chamber has its own force sensor for independent sample characterization

A high throughput, yet highly flexible solution

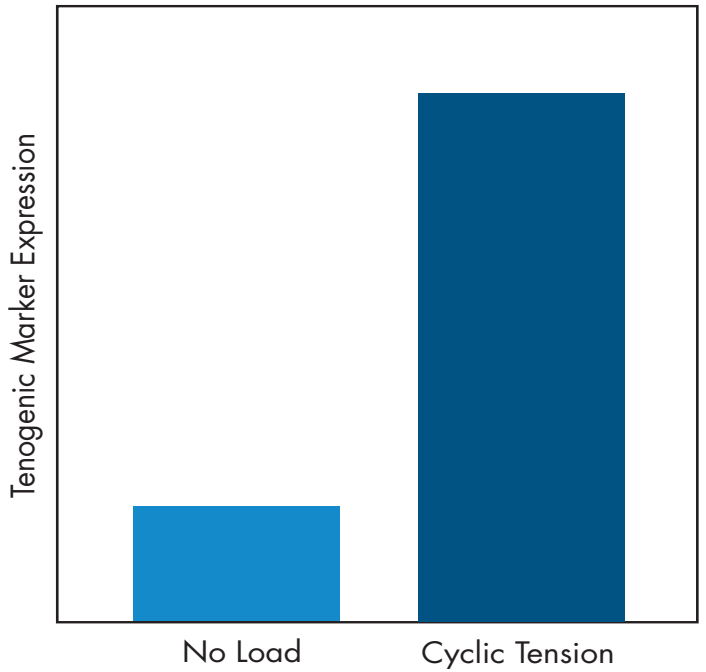
- Multiple chambers enable reproducible results with statistical relevance
- Individual or shared flow loop options so you can customize the number of experimental variables

BioDynamic® 5270*

4-Chamber Axial/Pulsatile Test Instrument

*Axial or Pulsatile configurations also available

Apply periodic **tensile** loading to **increase** expression of tenogenic **differentiation** markers in tissue engineered tendon*



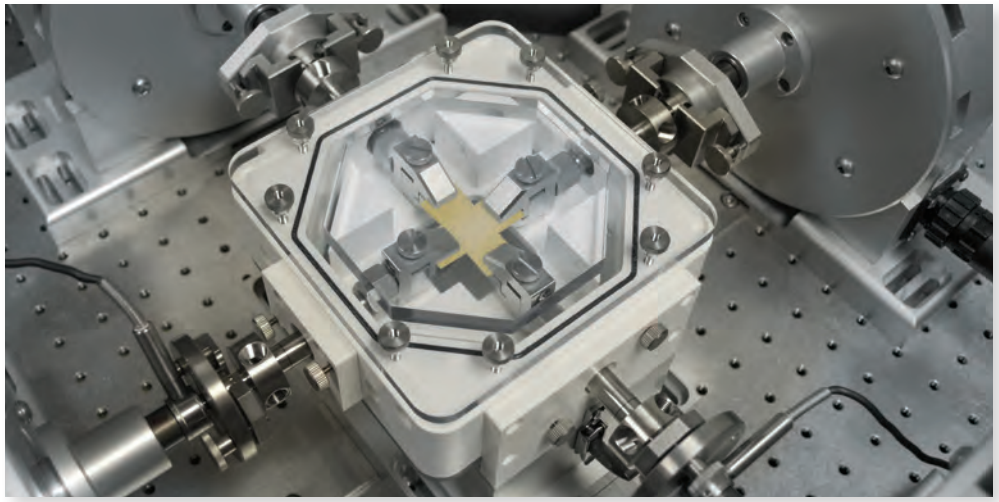
*JG Barber, AM Handorf, TJ Allee, and WJ Li. 2013. Braided nanofibrous scaffold for tendon and ligament tissue engineering. Tissue Engineering Part A 19(11-12):1265-1274.

Other Bioreactor Solutions

Need a system that goes

ElectroForce® 3200 Test Instrument with BioDynamic® Bioreactor

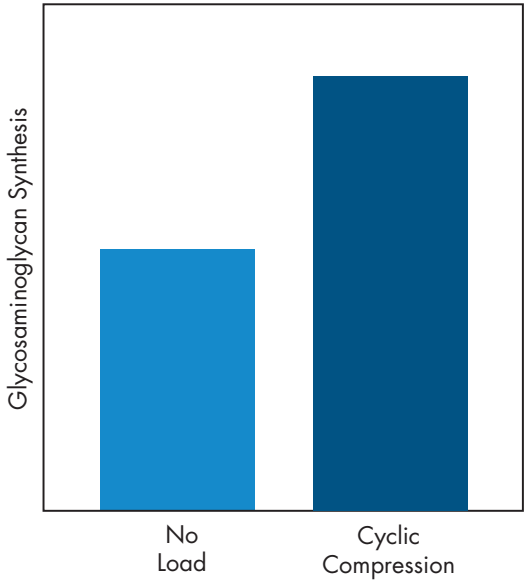
ElectroForce 5500 Test Instrument with Off-Axis Pulsatile Bellows



ElectroForce Planar Biaxial Test Instrument with Planar Biaxial BioDynamic Bioreactor

above and beyond tissue engineering?

Add BioDynamic chambers to standard load frame products and experience the full breadth of ElectroForce testing capabilities.



Apply cyclic **compression** to promote cartilage **regeneration** *

ElectroForce 5500 Test Instrument with 24-Well Plate Fixture

*N Peake, N Su, M Ramachandran, P Achan, DM Salter, DL Bader, AJ Moyes, AJ Hobbs, TT Chowdhury. 2013. Natriuretic peptide receptors regulate cytoprotective effects in a human ex vivo 3D/bioreactor model. Arthritis Research and Therapy 15(4):R76.

Accessories

4-Well Platens

ElectroForce® BioDynamic® test instruments can be outfitted with a variety of specimen fixtures, upgrade options and software modules to make your test yield the most biologically-relevant results.

Grips and Platens

- DMA Grips
- Tissue Grips
- BioDynamic Tensile Grips
- BioDynamic Compression Platens
  - Porous (40 µm and 100 µm)
  - Nonporous
- Porous Membrane Platens
- 4-Well Nonporous Platens

Fixtures and Chambers

- Barbed Fittings
- 3- and 4-Point Bend Fixture
- Multi-Specimen Fixtures
- Additional Bioreactor Chambers
- MRI-Compatible BioDynamic Chambers

Sensors

- Force/Torque
- Displacement/Rotation
- Strain
- Pressure
- Digital Video Extensometer
- Laser Micrometer

MRI-Compatible BioDynamic Chamber

The **Most Flexible** Control System Available

The WinTest® digital control system is a single, comprehensive package that provides an intuitive user interface, closed-loop waveform controls, and data acquisition.

- Powerful waveform generation tools to quickly create standard waveforms for basic stimulation, complex waveforms with block grouping, or user-imported non-standard waveforms
- Integrated data acquisition algorithms so a variety of data collection techniques can be utilized
- Advanced controls including multi-channel synchronization of phase and amplitude, and cross-channel compensation
- Calculated channels to provide real-time mathematical calculations of measured values
- Additional options include:
  - External Waveform Input
  - Dynamic Link Libraries
  - Dynamic Mechanical Analysis

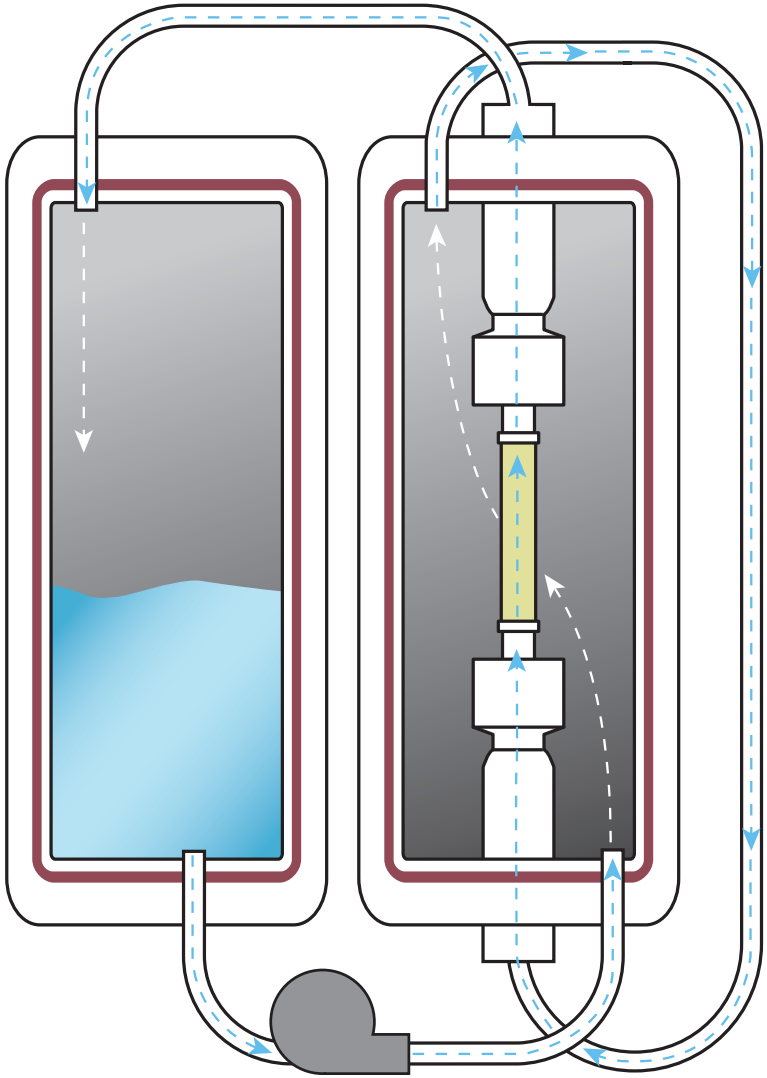
Industry-Leading Sales & Support

TA Instruments' leadership position results from the fact that we offer the best overall product in terms of technology, performance, quality, and customer support. While each is important, our demonstrated commitment to after-sales support is a primary reason for the continued loyalty of our customers. To provide this level of support, TA Instruments has assembled the largest worldwide team of field technical and service professionals in the industry. Others promise good service. Talk to our customers and learn how TA Instruments consistently delivers on our promise to provide exceptional service.

With direct support staff in **24 countries** and **5 continents**, TA Instruments can extend its exceptional support to you, wherever you are.

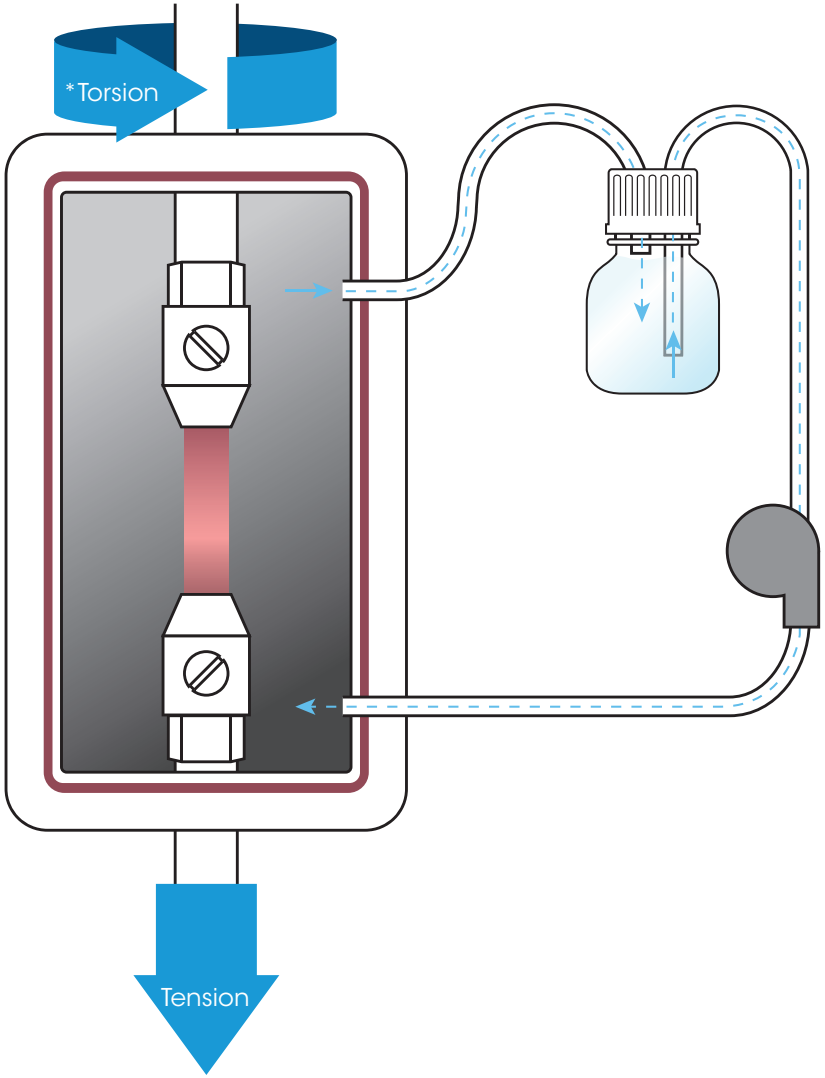

APPLICATIONS EXPERTISE
ABOVE & BEYOND SUPPORT™
CALIBRATION

BioDynamic® Flow Loop Diagrams



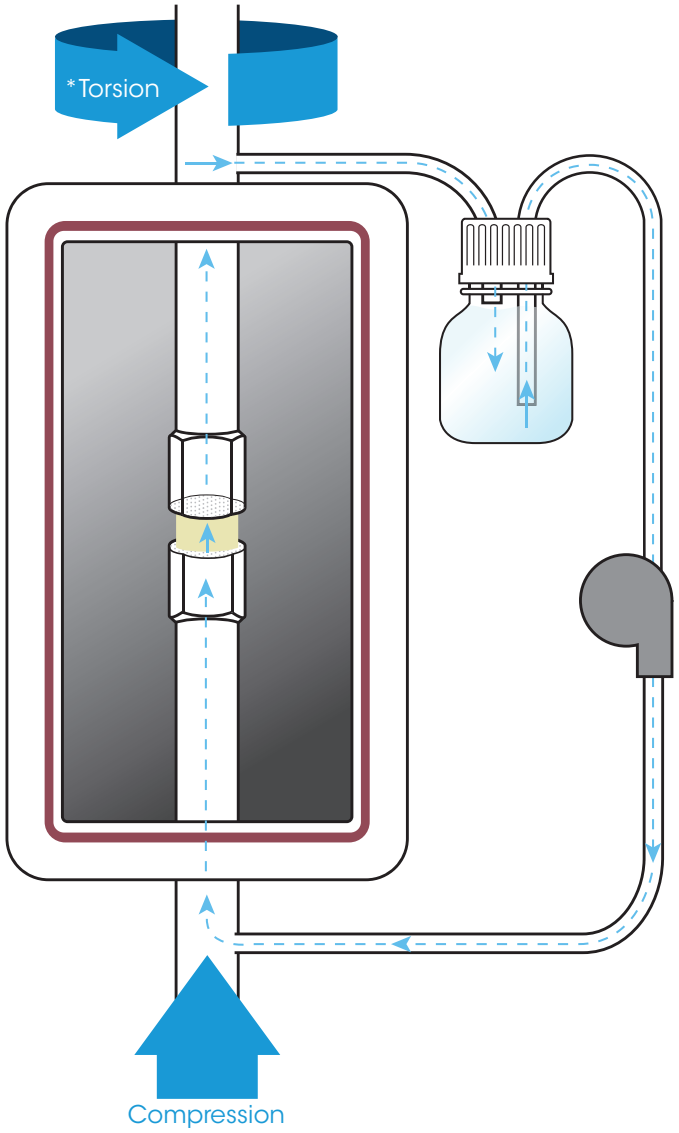
3DCulturePro®

Flow around and through tubular sample



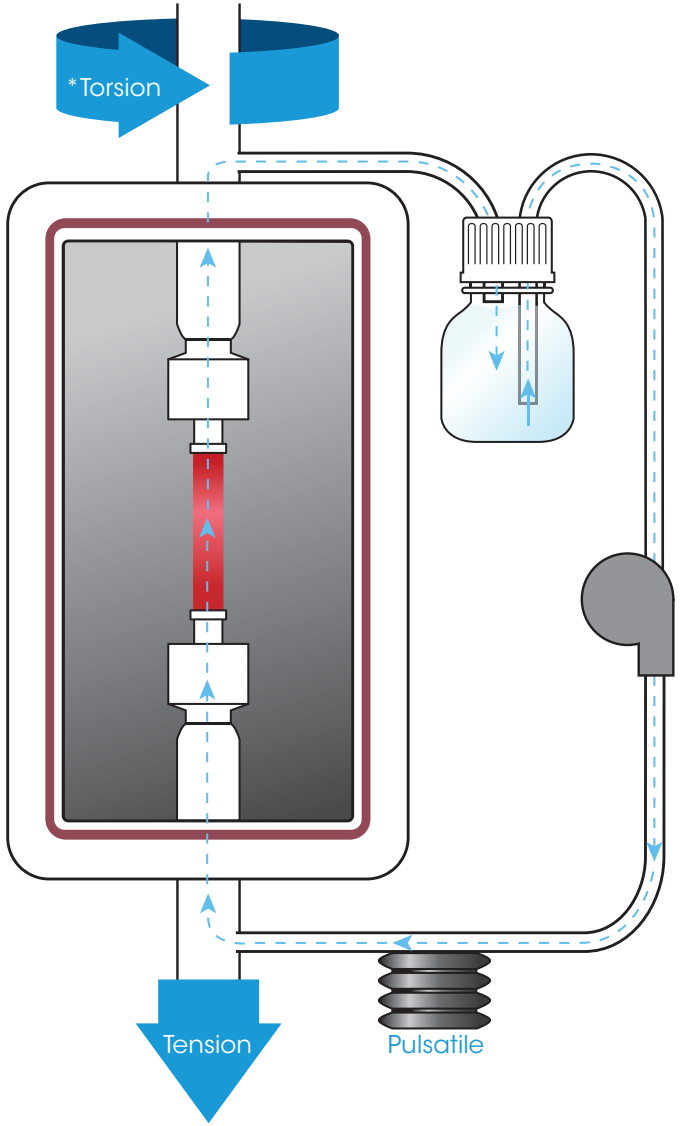
BioDynamic 5110/5115* /5210

Flow around tensile sample



BioDynamic 5110/5115*/5210

Flow through compressive sample



BioDynamic 5170/5175*/5270

Flow through pulsatile sample

Mechanical Stimulation Bioreactor Specifications

	BioDynamic® Pulsatile Test Instrument	BioDynamic 5110/ BioDynamic 5115* Test Instrument	BioDynamic 5170/ BioDynamic 5175* Test Instrument
No. of Chambers	1	1	1
Max. Force	•	± 200 N	± 200 N
Max. Displacement	•	± 6.5 mm	± 6.5 mm
Min. Displacement Increment	•	0.001 mm	0.001 mm
Max. Frequency	•	20 Hz	20 Hz
Max. Deformation Rate	•	740 mm/s	740 mm/s
Max. Pressure	2000 mm Hg	•	2000 mm Hg
Max. Pulse Volume	8.8 mL	•	8.8 mL
Max. Frequency	20 Hz*	•	20 Hz*
Max. Torque	•	± 2.8 Nm (*BioDynamic 5115)	± 2.8 Nm (*BioDynamic 5175)
Max. Rotation	•	± 30° (*BioDynamic 5115)	± 30° (*BioDynamic 5175)
Max. Frequency	•	20 Hz (*BioDynamic 5115)	20 Hz (*BioDynamic 5175)
Pump Type	Gear	Peristaltic	Gear
Flow Range	17-1760 mL/min	0.1 – 280 mL/min	17-1760 mL/min

— Not Available

• Upgrade Available

*Maximum achievable frequency will vary depending on test conditions.
Specifications are subject to change.

	BioDynamic 4-Chamber Pulsatile Test Instrument	BioDynamic 5210 Test Instrument	BioDynamic 5270 Test Instrument
No. of Chambers	4	4	4
Max. Force	•	± 200 N (± 50 per Chamber)	± 200 N (± 50 per Chamber)
Max. Displacement	•	± 6.5 mm	± 6.5 mm
Min. Displacement Increment	•	0.001 mm	0.001 mm
Max. Frequency	•	15 Hz	15 Hz
Max. Deformation Rate	•	350 mm/s	350 mm/s
Max. Pressure	2000 mm Hg (500 mm Hg per Chamber)	•	2000 mm Hg (500 mm Hg per Chamber)
Max. Pulse Volume	6.0 mL	•	6.0 mL
Max. Frequency	20 Hz*	•	20 Hz*
Max. Torque	—	—	—
Max. Rotation	—	—	—
Max. Frequency	—	—	—
Pump Type	Gear	Peristaltic	Gear
Flow Range	17-1760 mL/min	0.36 – 36 mL/min	17-1760 mL/min

AMERICAS

New Castle, DE USA
Lindon, UT USA
Saugus, MA USA
Eden Prairie, MN USA
Chicago, IL USA
Montreal, Canada
Toronto, Canada
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São Paulo, Brazil

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