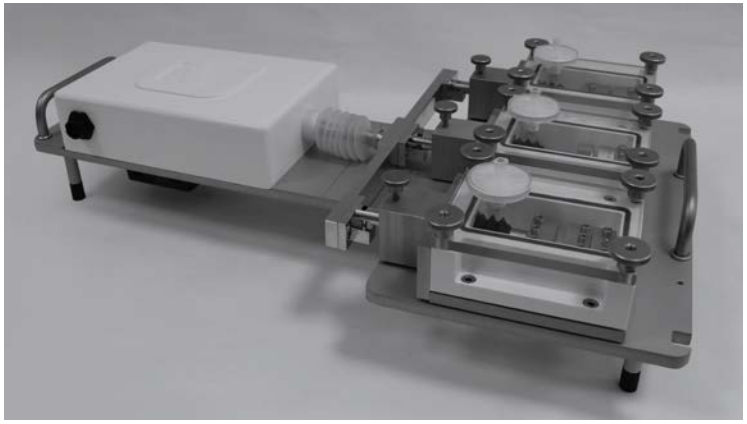
don whitley scientific

Tissue Engineeering Bioreactors & Microfluidics



01 History of Ebers

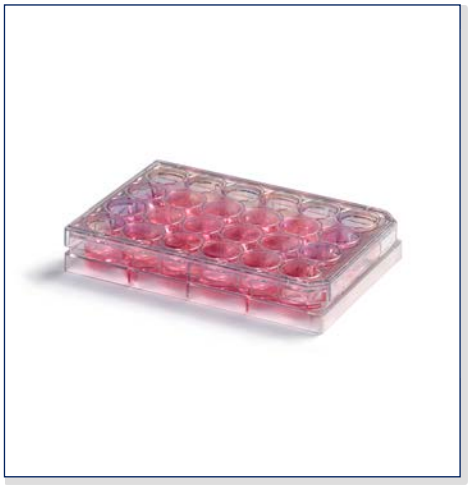
EBERS stems from the Group of Structural Mechanics and Materials Modelling (GEMM) of the University of Zaragoza, Spain. Engineers, mathematicians, physicists, biologists and medical doctors have grouped together to create a highly multidisciplinary research structure.

With special emphasis on bioreactors and culture chambers for tissue engineering, EBERS develops, manufactures and commercialises devices for research in cell culture. Bioreactors try to reproduce in-vitro some of the conditions that cells experience in-vivo by using two different approaches: the application of controlled flow rates or the direct deformation of the scaffolds in which cells are seeded.

EBERS has been distinguished with multiple national and international awards, recognising its business potential and culture of innovation.

Don Whitley Scientific's relationship with EBERS has grown over the years and we provide a range of products in the UK that have the potential to be used inside, alongside and in conjunction with the Whitley Hypoxystation.

ebers
tissue engineering bioreactors



Our greatest assets are our satisfied customers...

"The TC-3 software is so easy to use that I was confident setting up and performing my own experiments after just a single afternoon of training."

***Dr. Nidal Khatib**, post-doctoral research associate in the Developmental Biomechanics group, Imperial College London.*

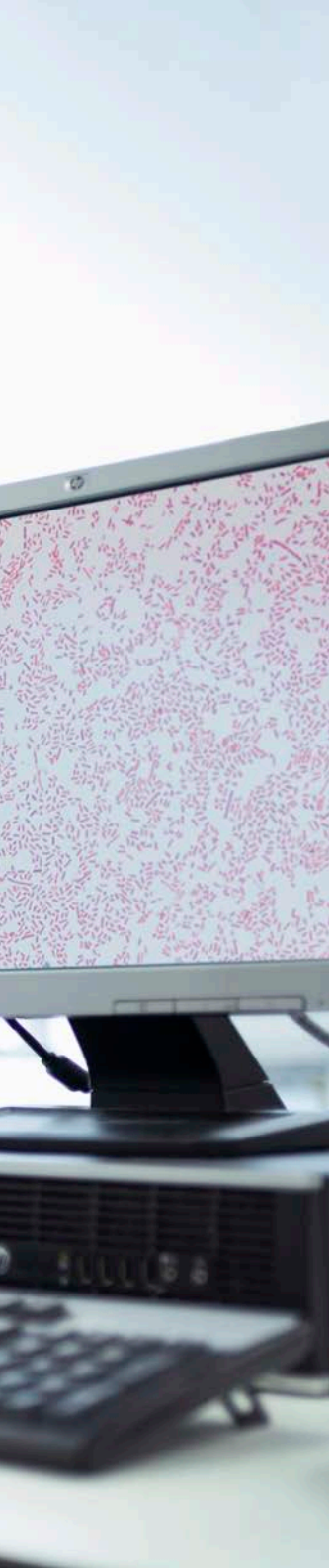
03

Customized Design Service

In order to overcome the difficulties posed by highly diversified tissue engineering research, EBERS offers a custom design service. This allows EBERS to develop specific components to meet the needs of each individual experimental set-up, through the design and manufacture of new culture chambers and devices.

Don Whitley Scientific has sold more EBERS equipment with user-centric customisations than without. These customisations range from the relatively minor, such as the reshaping of a sample grip or the addition of an extra perfusion port to a culture chamber, to the much more significant, such as a re-design of controlling software to ensure the equipment performance matches user need.

If a product doesn't fit your requirements exactly, we encourage you to get in contact with us to discuss any changes you may require with our technical staff



Our Credentials 04

Don Whitley started his career in microbiology and haematology laboratories, before moving into the sale of laboratory products. This experience helped him to develop novel ideas for improving the working life of scientists through the use of labour-saving equipment and automated solutions, leading to the formation of Don Whitley Scientific Limited in 1976.

We continue to design, develop and manufacture our products in the UK and have been granted patents for many of our innovations for cultivation of mammalian cells under physiologically appropriate conditions of normoxia or hypoxia.

Over the years, DWS has partnered with like-minded UK and overseas manufacturers to make their complementary products available to our customers. One of these companies is EBERS Medical Technology SL, who develop equipment for cell and tissue culture. They also have an expertise in developing bespoke culture chambers for tissue engineering.

This product line has recently been enhanced by the introduction of our internal HEPA filtration system, which combines precise atmospheric control with cleanroom conditions for cell culture.

Our product range has been sold in over 50 countries through our worldwide network of distributors.

For more information on any of our products or services, please contact us: +44 (0)1274 595728 or sales@dwscientific.co.uk

Top left: Don Whitley, Founder, receiving his honorary doctorate.
Bottom left: The test room at our premises in West Yorkshire, UK.

05 Perfusion Culture Bioreactors

TEB500 Bioreactor

The TEB500 is a cell culture bioreactor that provides the ideal conditions for growing and developing tissue cultures under accurately controlled flow conditions. It has the functionality of a CO_2-O_2 incubator but incorporates an integrated double peristaltic pumping system. This stand-alone bioreactor integrates all the required functionality for an cell/tissue culture experiment under flow conditions with easy manipulation of flow circuits, simple and reliable experimental setups; powerful flow control – the complete solution for cell culture under flow conditions.

FEATURES

- Bi-gas incubation system: standard CO_2 and O_2 control allows generating hypoxic culture conditions with a front access port for the introduction of tubing or wires.
- Double top door: ideal for building and handling flow circuits.
- Fully integrated pumping systems: only the pumpheads are located inside the bioreactor chamber so no risk of overheating or contamination.
- Powerful flow system: independent control of 2 x 4-channel pumpheads with manual, program or dynamic seeding modes of operation.
- PC control interface: data logging and graphic display features plus optional remote operation via WiFi from a PC or mobile device.
- Front panel display: for easy control of atmospheric conditions.

TEB1000 Bioreactor

The TEB1000 provides the ideal conditions for growing and developing tissue cultures under accurately controlled flow conditions. It has the functionality of a CO_2 incubator but incorporates an integrated double peristaltic pumping system. The TEB1000 Master Unit has the flexibility to work with an unlimited number of tissues, conditions and biomaterials to extend your range of possible experiments.

FEATURES

- Digital control system with touchscreen interface for ease of use.
- The tissue culture package provides the necessary transparent, 3D, disposable chambers and racking systems to allow you to grow cells on porous scaffolds, under perfusion conditions, and observe their progress.
- Seed cells under perfusion conditions with the TEB1000 and a special racking system.
- A vascular package is also available with reusable, glass culture chambers designed to be used with vessels, stents and grafts of different sizes.

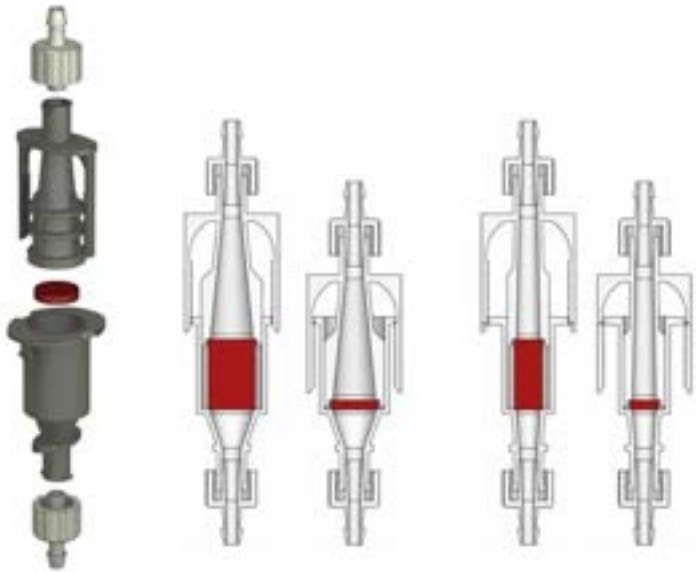
Peristaltic & Syringe Pumps

Don Whitley Scientific can provide peristaltic pumps with a range of functionalities and capabilities. All available pumps have working conditions of 5 - 40°C and <80% humidity, and are all controlled through a membrane keypad with pump speed shown on a digital LCD display.

Multi-channel syringe pumps are also available, please enquire for further details.

Peristaltic pump options:

- Single or multiple channels
- Enhanced manual control through analogue auto-control signal input for speed control, and a digital TTL or remote switch input to control start/stop and direction
- Auto-restart for mains failure recovery and timer control
- Keypad locks to protect settings
- Colour coded double segment manifold tubing
- Zero maintenance, quiet brushless DC motor



Scaffold
ø 10 / L 2-10

Scaffold
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P3D chambers

P3D chambers are transparent vessels for 3D cell culture under perfusion conditions. They are disposable, ready-to-use scaffold holding chambers.

P3D chambers provide a cost-effective simple solution to grow cells on porous scaffolds under perfusion conditions. They allow you to seed and culture your scaffolds in the same chamber, thus reducing scaffold manipulation and minimising the contamination risk.

AVAILABLE IN TWO SIZES:

- P3D6: Scaffold diameter 5 - 7 mm. Scaffold height 1 to 13mm.
- P3D10: Scaffold diameter 9 - 11 mm. Scaffold height 1 to 13mm.

09 Mechanical Stimulation Bioreactors

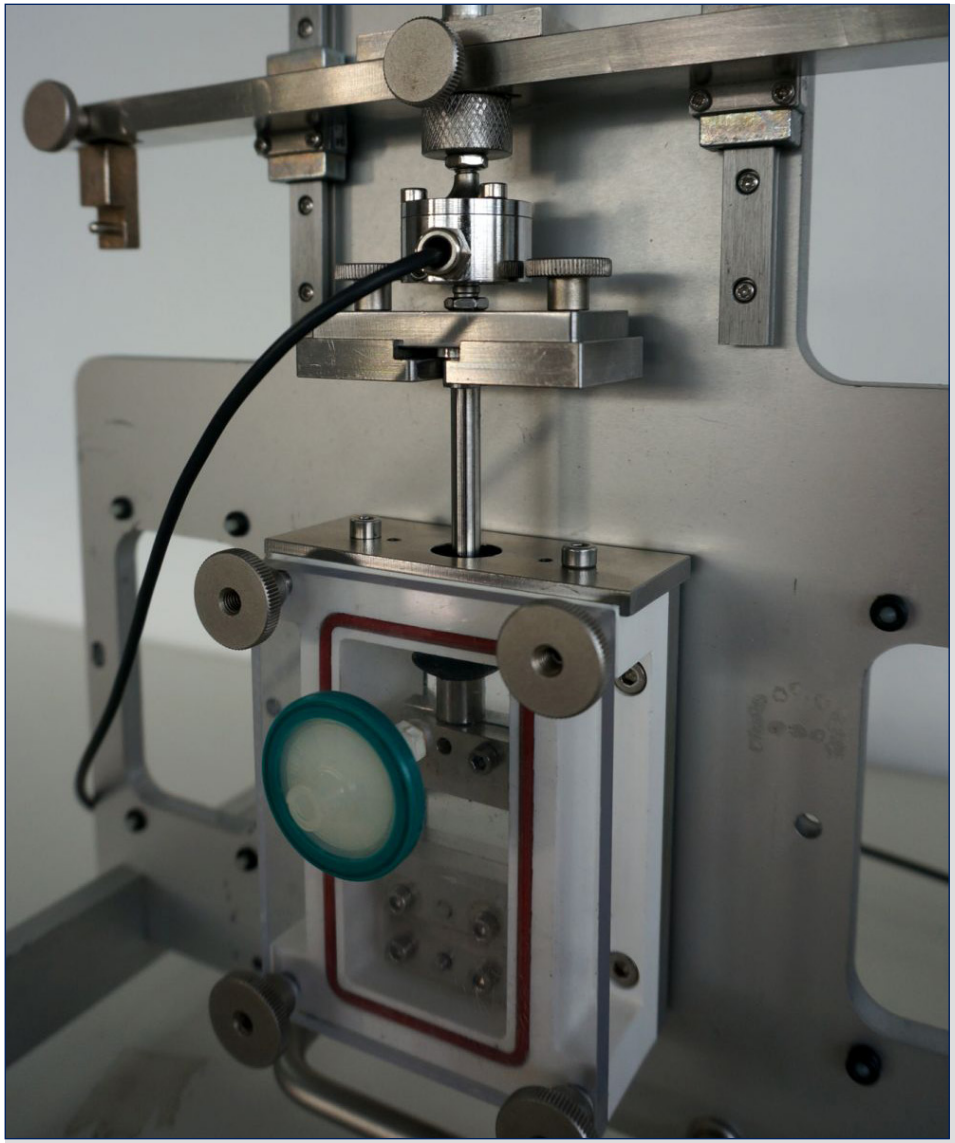
TC-3 Bioreactor

The TC-3 Bioreactor is a simple, easy-to-use, system that allows mechanical stimulation of samples in long-term culture with user-defined loading profiles. The system is designed with simplicity and versatility in mind; all physical set up of the machine is done with allen keys and manual screws, and sample grips are easily interchangeable to allow a quick and easy switch from tensile to compressive loading. The TC-3 is lightweight and fits easily into most standard incubators.

The TC-3 is highly customisable as required. Previous units have been sold with custom grips, chambers and software.

FEATURES

- Interchangeable grips allow users to change between compressive and tensile loading with ease.
- Individual grips can be designed/altered to fit specific scaffolds upon request.
- Capable of running up to 20 samples simultaneously.
- As well as uni-axial loading, the TC-3 is also capable of long-term culture of samples under hydrostatic pressure.
- All media contacting components are fully autoclavable.
- Able to run in horizontal configuration to create air-liquid interfaces.
- Chambers can be removed for microscopy in-situ, meaning samples don't need to be removed from culture for imaging.



TC-3F Bioreactor

The TC-3F is the next generation of TC-3 Bioreactor. Equipped with force measurement capability, the TC-3F is able to mechanically characterise samples in tension and compression, either during long term cell culture, or as an inexpensive stand-alone uni-axial testing machine. The TC-3F does not require extensive training on complex software to be used effectively, and can be easily changed between compression and tension. The machine is run from a standard laptop computer through an easy-to-use software interface. The TC-3F provides the features of a materials testing machine adapted to long term cell culture.

FEATURES

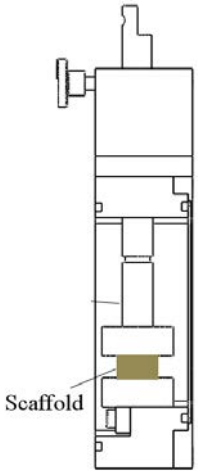
- Is suitable for materials testing and/or long term cell culture under mechanical loading.
- Can use one, two or three simultaneous samples.
- Has a maximum force measurement capacity up to 100N.
- Runs from easy-to-use and intuitive control software.
- Has grips compatible with a wide range of sample shapes.
- Can easily interchange between tensile and compressive axial loading.

11 | TC-3 Grips

Compression Grip

This grip is designed for use with the TC-3 for the culture of scaffolds of varying geometry under compressive loads, or the application of compressive forces to model culture systems.

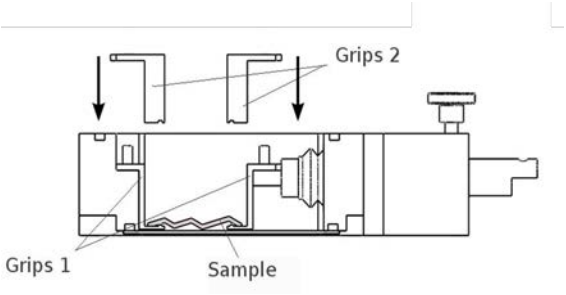
Useful Diameter: 22mm



Plane Grip

This grip is designed for use with the TC-3 for the culture of thinner samples such as skin or membranes in tension, and is also suitable for creating air-liquid interfaces.

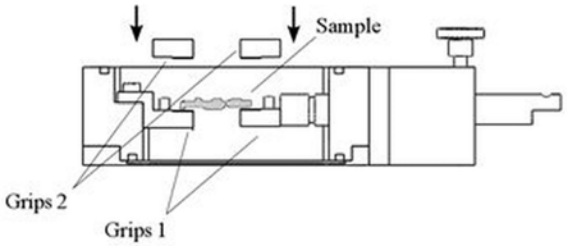
Useful Diameter: 35mm



Tension Grip

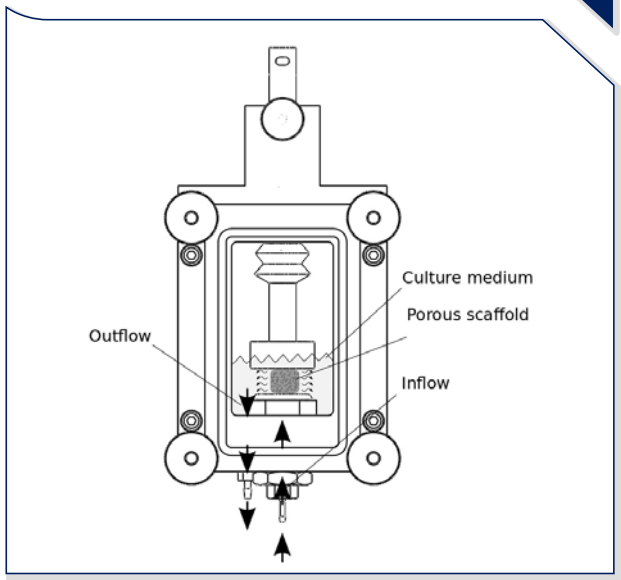
This grip is designed for use with the TC-3 for culture of thicker samples such as ligaments and tendons in tension.

Useful Diameter: 30mm



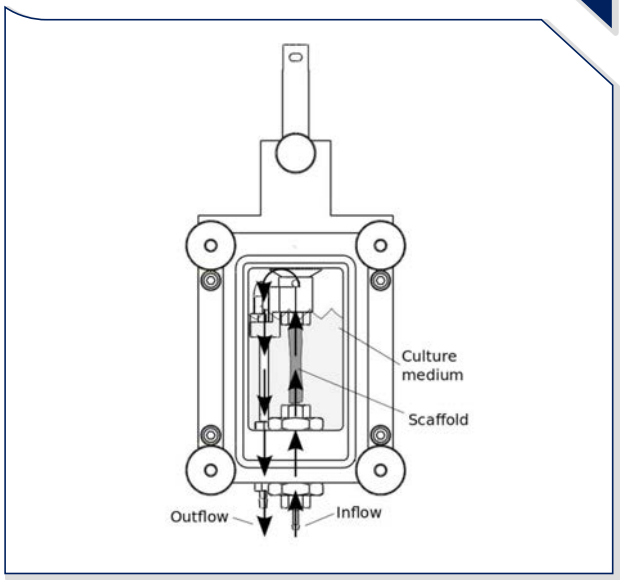
Compression / Perfusion Grip

This chamber combines the compression grips with perfusion culture. The bottom compression plate is also the media inlet, allowing media to be perfused through the centre of the scaffold, ensuring a more even media distribution and turnover throughout the scaffold, allowing viable culture of larger constructs in 3-dimensions.



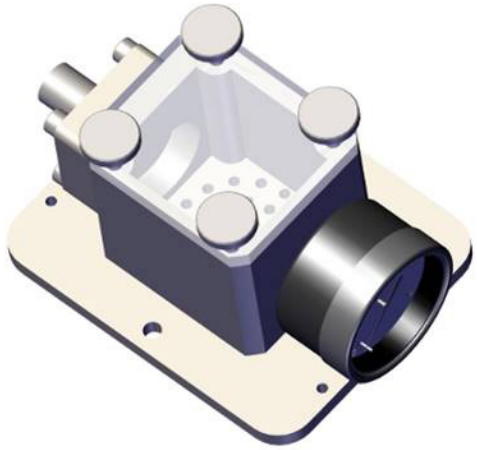
Tension / Perfusion Grip

This chamber is designed to culture hollow tubular scaffolds in tension. The grips holding the scaffold also act as media inflow/outflows, creating uni-directional media flow. This also allows for perfusion of one type of media through the centre of the scaffold and a second type of media in the chamber and contacting the outside of the scaffold.



Hydrostatic Pressure Chamber

Designed to be used with the TC-3 uni-axial actuation system, this chamber can apply hydrostatic pressure up to 4 bar. The chamber is autoclavable and gas transfer is optimised through a specialised membrane. Digital and analogue pressure gauges are available.

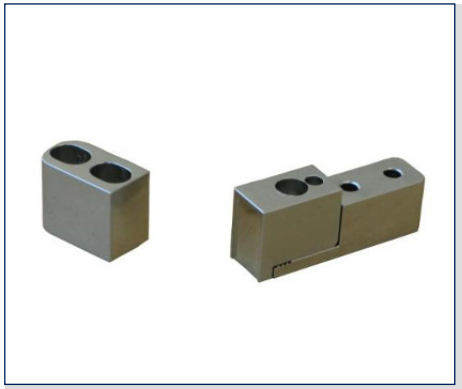


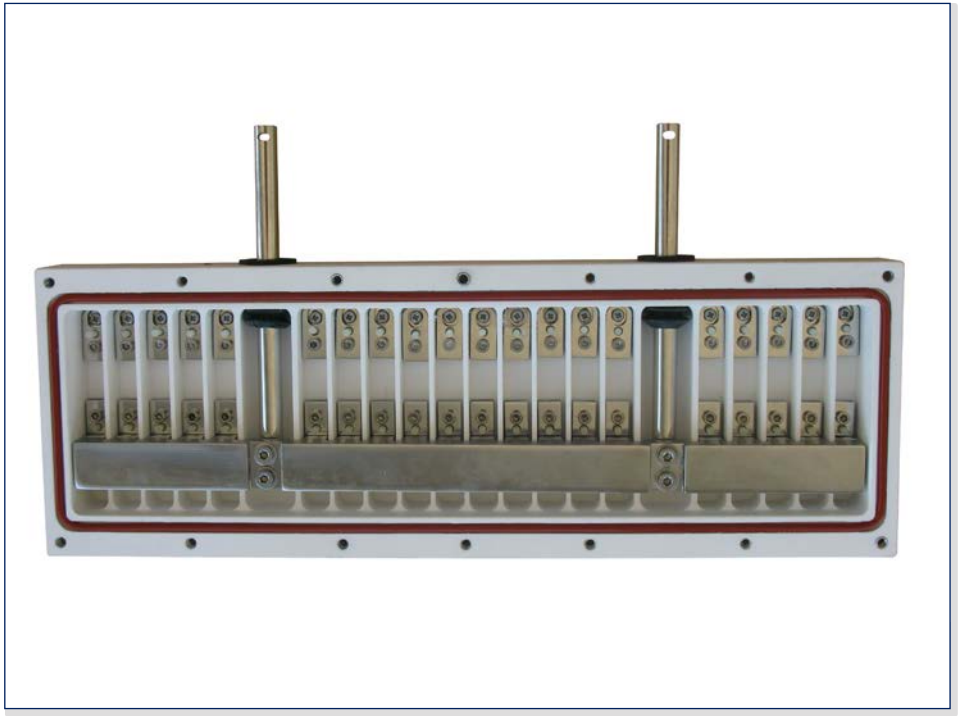
Multi-cavity tension & compression chamber

The multi-cavity chamber is designed to hold up to 20 samples at the same time for the application of tension and/or compression loads.

The distance between the grips can be modified individually in order to adapt the length between grips to the specific dimensions of each substrate or scaffold. This is a key aspect of the chamber design since it is usually difficult to have substrates with identical dimensions.

All components of the chambers that come into contact with culture media are autoclavable or disposable.





FEATURES

- The multi-cavity tension grips are designed for the application of tensile loads on planar substrates and samples. The TC-3 can be configured in either vertical or horizontal mode when using these grips
- The multi-cavity compression grips are designed for the application of compressive loads. It is advisable to configure the TC-3 system in vertical mode when using these grips to avoid sample slip.

Electrical Stimulation Package

TC-3 Electrical Stimulation package

Both the TC-3 and TC-3F can be used in conjunction with the Electrical Stimulation Package. You can now stimulate your samples with electrical pulses of defined length or trains of pulses of defined length, frequency and duration, and synchronise the electrical stimulation with mechanical stimulation in a way that suits your experiments. Combining this pack with the TC-3F force measurement software allows users to measure mechanical forces applied through the constructs as the TC-3 applies deformation and electrical stimulation. The electrical stimulation package can also be combined with a number of other features, such as perfusion of the culture chamber.

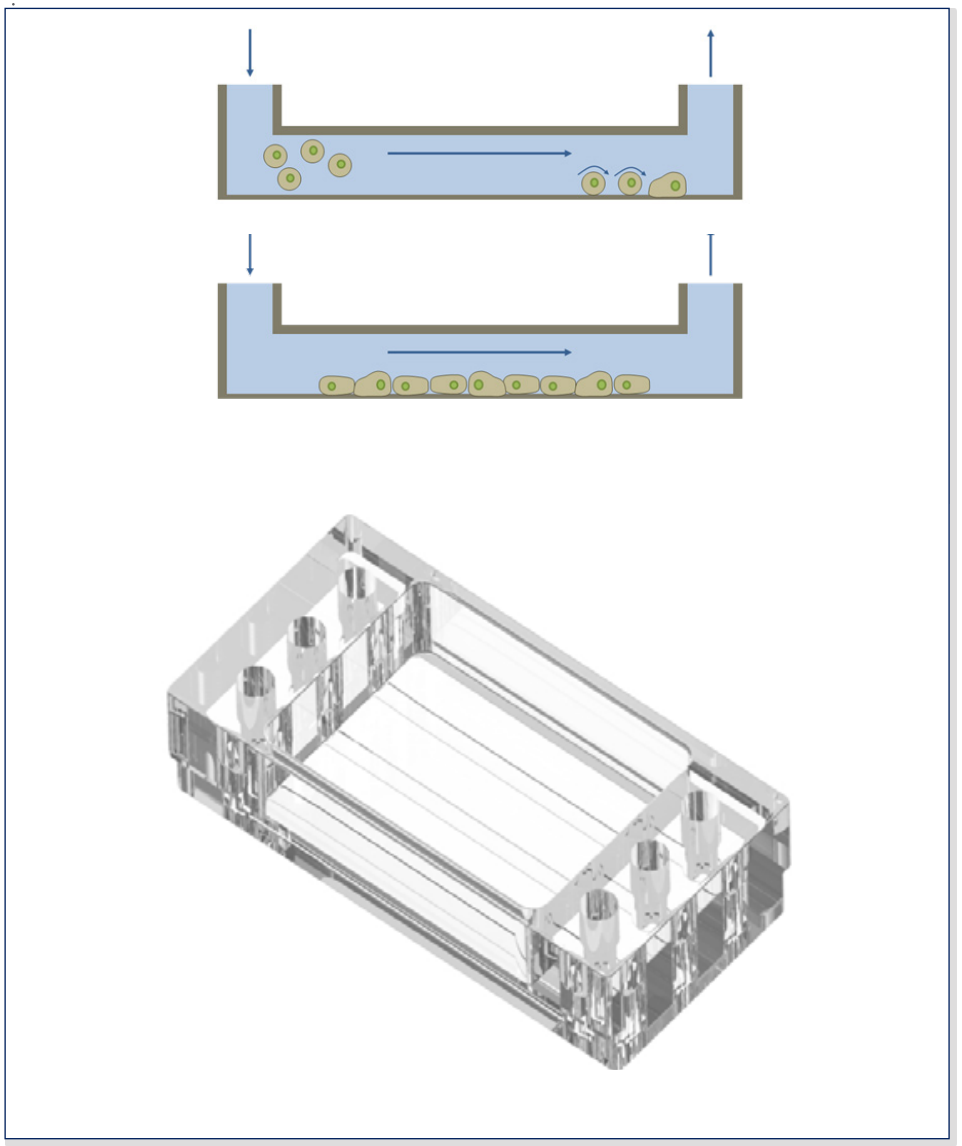
FEATURES

- Stimulate samples with electrical pulses of defined length or a pulse train of defined pulse frequency, pulse length, and train duration.
- Supplied with a laboratory powerpack as standard, but can also be used with user's own electrical input if desired.
- Apply the same electrical stimulation to all three TC-3/TC-3F chambers.

15 | Microfluidic Devices

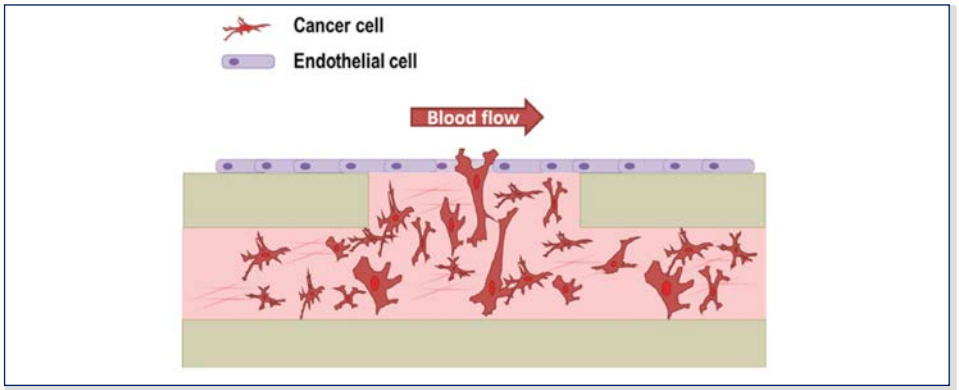
Be-Flow

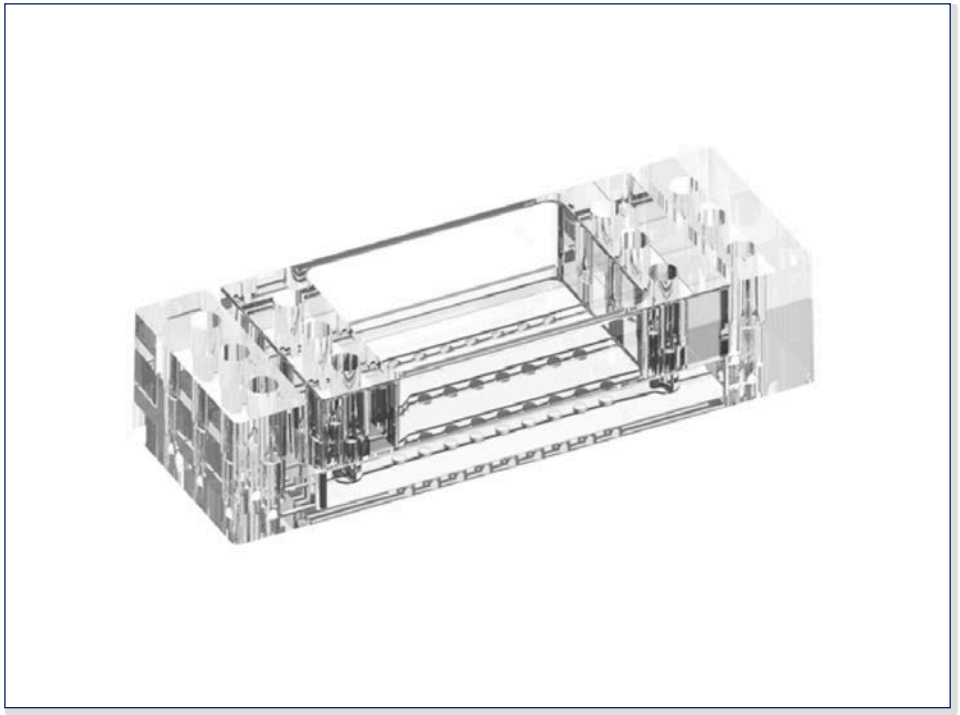
BE-FLOW allows the user to perform cell-based assays under perfusion, and is especially suited to the in-vitro simulation of physiological environments involving flow and shear stress mechanical stimulation. Bespoke chips can also be considered dependent on your requirements.



FEATURES & APPLICATIONS:

- 3 channels allow triplicate experiments on a single chip
- Compatible with any laboratory pumping system.
- Allows for vast reductions of media and supplement required for experiments
- Excellent optical properties, with high transparency and low auto-fluorescence, allows real time imaging through microscopy
- Example applications include:
    - Live cell imaging under flow-derived shear stress
    - Rolling and adhesion assays of suspended cells such as platelets, leukocytes and monocytes on substrates such as adhesion proteins or confluent cell monolayers
    - Mimicking flow conditions in blood vessels
    - Long term culture of adherent cells under mechanical stimulation





Be-Flow2D3

Be-Flow2D3 is a versatile microfluidic device that consists of three independent channels, each connected by wells with an upper channel. It is possible to introduce cells seeded in a hydrogel into the lower part of the device, with the gel rising right up to the interface with the upper channel. It is then possible to plant epithelial or endothelial cells that grow in 2D on top of the hydrogel interface, and apply a flow through the upper channel to reproduce physical stimuli. In this simple way, it is possible to recreate a common blood capillary: a tissue zone (3D cells), a vascular zone (the endothelial cells forming the capillary) and the bloodstream (the upper channel flow).

FEATURES & APPLICATIONS:

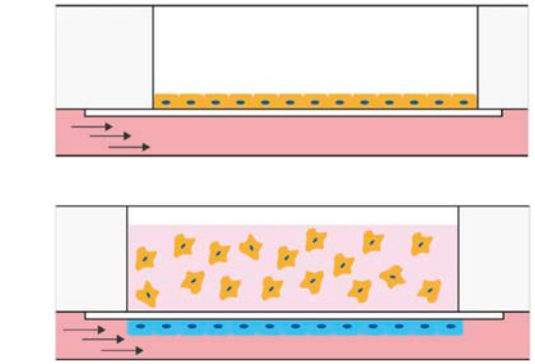
- 3 channels allow triplicate experiments on a single chip
- Compatible with any laboratory pumping system
- Allows for vast reduction in media and supplement required for experiments
- Excellent optical properties, with high transparency and low auto-fluorescence, allows real-time imagine through microscopy
- Example applications include:
    - Immune system in vitro modelling
    - Vascular-atheroma plaque formation
    - Cancer cell invasion
    - Epithelial adhesion

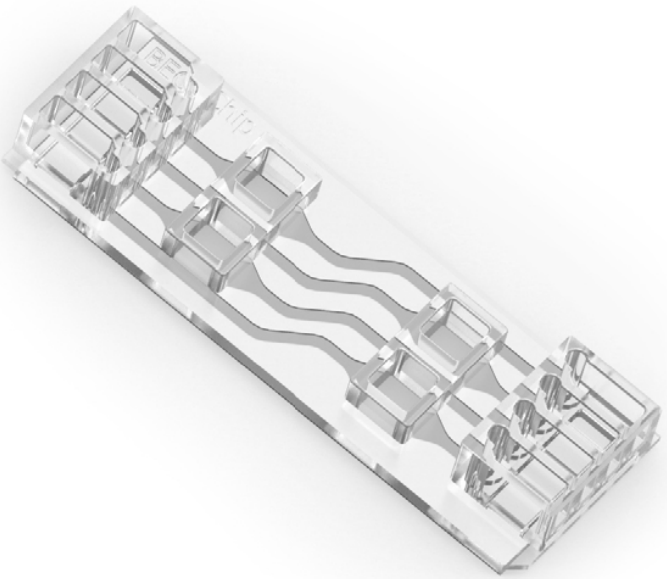
Be-Transflow

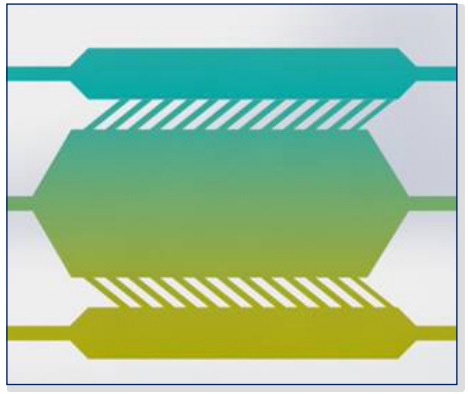
BE-TRANSFLOW is a versatile microfluidic device for cell culture under biomimetic conditions. This product integrates flow systems with traditional transwell inserts, with an upper well sitting on top of a lower channel, separated by a porous membrane. This allows 2D/2D or 2D/3D contactless co-culture in combination with flow culture, allowing in-vitro¬ simulation of a wide range of tissues.

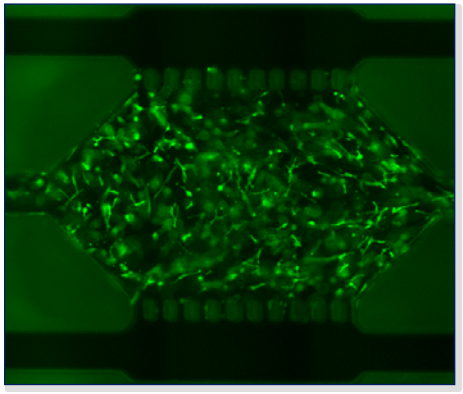
FEATURES & APPLICATIONS:

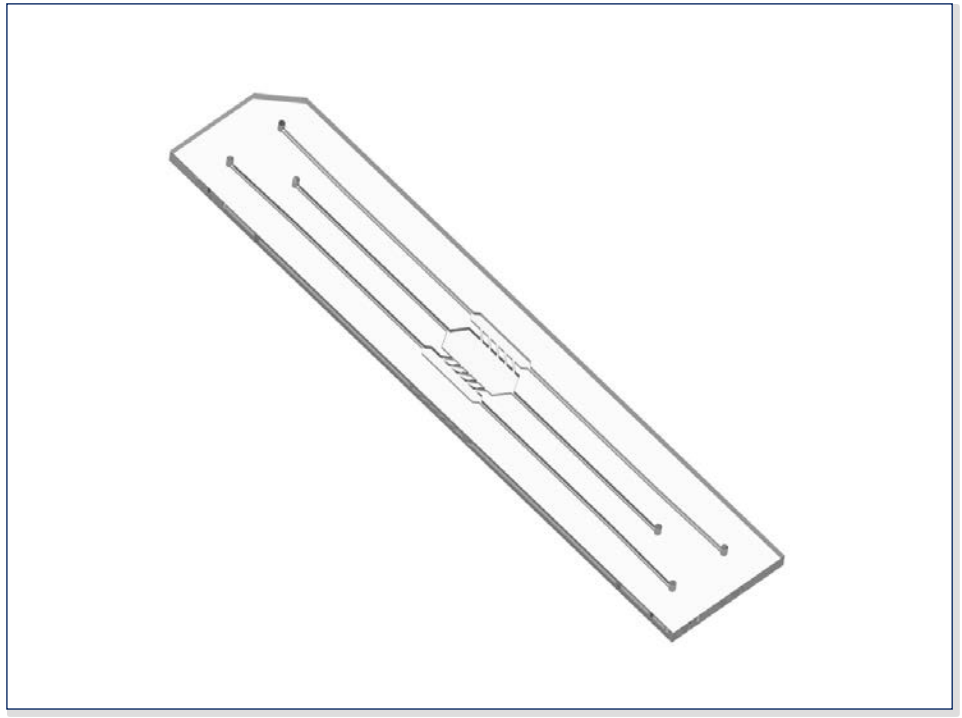
- 4 independent wells allows for 4 experiments on a single device
- Allows for vast reductions of media and supplement required for experiments
- Excellent optical properties, with high transparency and low auto-fluorescence, allows real time imaging through microscopy
- Example applications include:
    - Immune system *in-vitro* model
    - Drug transport/penetration assays
    - Vascularatheroma plaque formation
    - Epithelial adhesion











Be-Gradient

BE-GRADIENT consists of a culture chamber fed by two separate media channels, one at each side of the chamber, allowing shear stress free flow culture in order to generate long term, stable gradient profiles of soluble molecules and dissolved oxygen. Suitable for use with 2D adherent cell cultures, or in 3D using hydrogels.

FEATURES & APPLICATIONS:

- 2 independent wells allows for 2 experiments on a single device
- Allows for vast reductions of media and supplement required for experiments
- Excellent optical properties, with high transparency and low auto-fluorescence, allows real time imaging through microscopy
- Example applications include:
  - Chemotaxis of adherent and non-adherent cells
  - In vitro simulation of a tumour microenvironment
  - Migration assays
  - Angiogenic sprouting
  - Modulation of cell behaviour by oxygen concentration
  - Axon guidance

19 | Other Tissue Culture products

Whitley H35 Hypoxystation

The H35 Hypoxystation creates hypoxic and anoxic conditions within a controlled and sustained workstation environment. It is ideal for cell and tissue culture researchers wanting to accurately control oxygen in 0.1% increments up to 20%; carbon dioxide in 0.1% increments up to 15%; and relative humidity up to 80% - provides flexibility in your research and confidence in your results. Applications for this instrument include cancer research, neurology and cardiovascular research, as well as a many other types of cell culture work.

FEATURES:

- Built-in rapid airlock to ensure samples can be transferred into the workstation atmosphere as soon as possible (only takes 60 seconds).
- Colour, touchscreen control panel for ease of use and for visual display of parameters such as oxygen level, carbon dioxide level, temperature, humidity, and airlock cycle status.
- Available with removable front to facilitate thorough cleaning and the transfer of bulk samples or larger pieces of equipment for use in the workstation.
- Ethernet-enabled for remote access to touch screen.
- Available with fully automatic humidification system so you can add moisture AND maintain a sterile environment.
- Fully integrated gas control avoids bulky add-on systems and reduces the need for additional bench space.

Whitley Media Conditioner

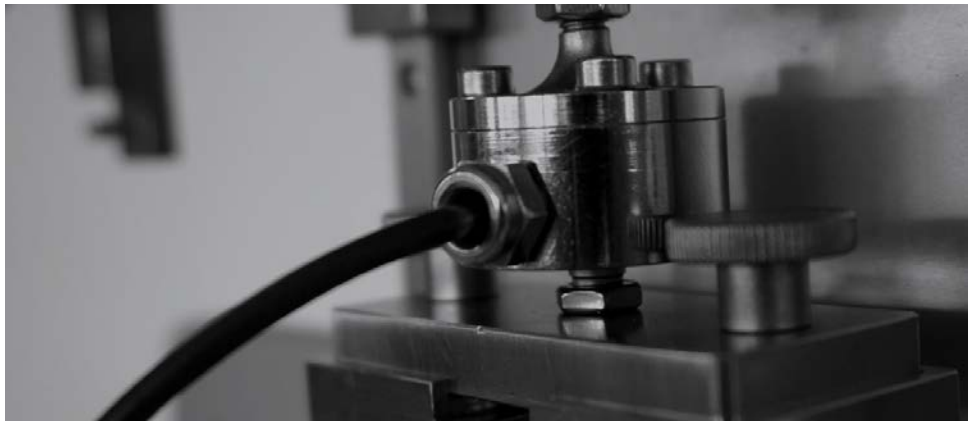
Now you can equilibrate media rapidly – and ensure even greater accuracy in your research.

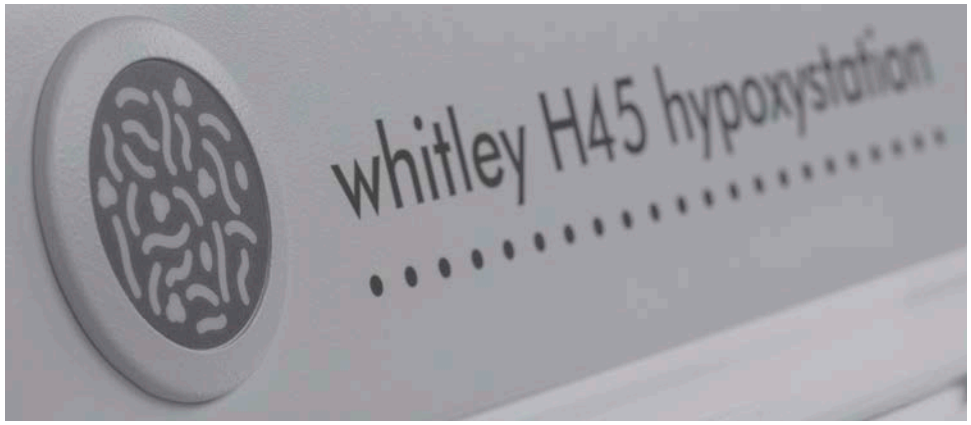
The Whitley Media Conditioner can equilibrate up to 400 ml of liquid media in about 60 minutes*. The device fits perfectly into a Whitley Hypoxystation airlock. This allows easy transfer into the chamber environment.

FEATURES

- A compact device for use inside a Whitley Hypoxystation.
- This is a fast, flexible system that will save you a considerable amount of time.
- Improve outcomes in your research by ensuring your media is perfectly equilibrated.
- The device fits perfectly into the airlock of a Whitley Hypoxystation for easy transfer into and out of the chamber environment.

** Based on currently available data. Patent applied for.*





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