Single-Use customised fermenter

Scalable platform for microbial fermentation

CerCell

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World first configurable Single-Use-Fermenter

What do I get?

Choose your own design =
fully configurable SUF

Scalable platform =
choose from 2 to >75 litre Vessel Volume

Outstanding performance =
>1,500 rpm capacity

Manufactured entirely from
mono-component rigid plastics

- BactoVessel is available in OD110 mm size for bottom drive on Magnetic-Stirrer-Table (MST) or in the Bio-block
- BactoVessel is available in OD130, OD150, OD200 with Single-Use-Jacket for Head-Plate-Drive (HPD) or Magnetic-Stirrer-Table (MST) accepting most servo motors
- BactoVessel available in OD110, OD130, OD150, OD200, OD250 comes with Head-Plate-Drive (HPD) accepting most servo motors
- BactoVessel is soon available in serious size, OD400 with Strong-Head-Plate-Drive (SHPD)

Configuration

Shown a few of the 2,000 different components from the **Configurator Tool** able to satisfy any request

Customised 5.7 litre SUF for Head-Plate-Drive next to the Re-Usable-Jacket for cooling prior the installation.

BactoVessel

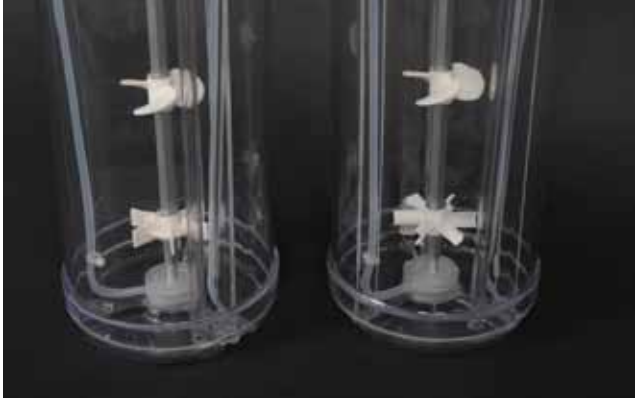
Specification

Basic specifications for BactoVessel are:

- Polycarbonate and Nylon components (no multi-component plastic foil!)
- Number of standard PG13.5 ports according to the SUF diameter
- 6 different diameters and 4 different height
- Turbine(s) for bi-directional rotation / up-flow combined axial / radial fluid circulation
- The SUF bearings designed >1,500 rpm for one week fermentation process
- Baffled vessel for combined axial vortex mixing and donut shape flow pattern
- Designed for Newtonian fluids with max viscosity of 50,000 cP (similar to your preferred stiff, cold good morning yogurt!)
- Designed for 50 mBar operating pressure

Fully configurable BactoVessel´s are created by selecting various optional components via the Configurator Tool:

- Several vessel heating / cooling options such as integrated or re-usable heat exchanger
- Various aeration methods; micro pore sparger, micro pore L-spargers, ring hole spargers, L-spargers, head space gas exchange
- Several different fluid In&Out methods and exhaust methods to select from
- A range of sensors, Single-Use-Sensor (SUS), liquid level / foam sensors
- Optionally operating pressure up to 500 mBar for OD110, OD130 and OD150
- Optionally operating pressure up to 500 mBar for OD200 - OD250 requires a cover cage in combination with RUJ
- Delivered high precision E-beam (32 kGy) irradiated in dual polyester foil bags
- All components in media contact are ISO10993, FDA approved or USP class VI certified materials.



Two identical BactoVessel OD150 mm integrating 3 baffles, ring sparger and Rushton and Smith turbines. The two turbines performs very different!

Agitation in BactoVessel

Turbines

Unlimited range of turbines

BactoVessel facilitate a range of different radial mixing turbine principles: Rushton, Jacob, Smith, Hjort and Bakker:

- Outer Diameter, OD mm: 40, 50, 60, 70, 80, 90, 100 and 120
- Number of blades are 6 or 8 depending on principle
- Blade shapes: flat, symmetric half circle, symmetric concav, asymmetric concav
- Jacob´s flat blade angled in 75 degree from vertical

Height of blades is fixed according to the turbine diameter. Dimension of turbine and blade designed selectable from the **Configurator Tool**. If one or more axial mixing Marine impellers is required in the BactoVessel such is available in a selectable diameter, 3 blade, 16 degree blade angled design.

OD130 x 420 mm BactoVessel customised to end-user requirement integrating 3 baffles, ring sparger, dual In&Out, HPD drive and two specific Rushton turbines.

Baffles

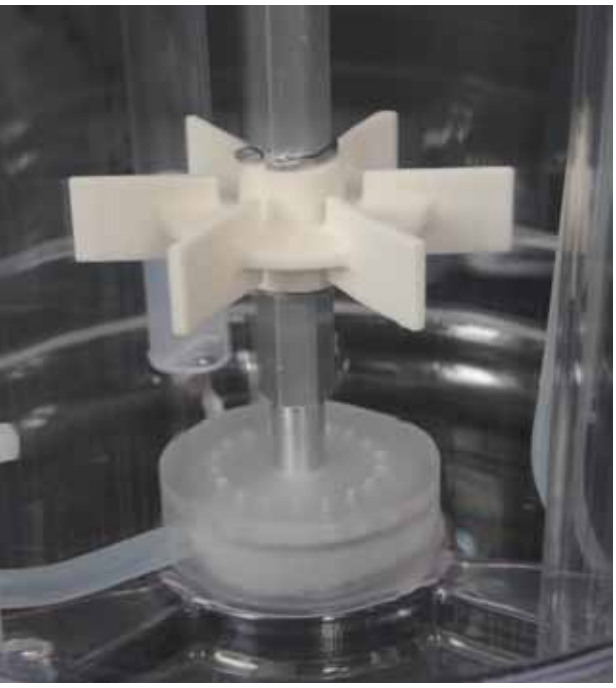
Baffles are obstructing vertical arranged vanes or elongated plates inside the vessel needed to stop the radial swirl inside the fermenter and convert the rotational flow to axial mixing. Without baffles, the tangential velocities coming from any turbine(s) causes the entire fluid mass to spin creating a central vortex. Baffles, so to speak, increase the friction to the vessel inner wall surface. BactoVessel baffles are straight flat plates vertically and perpendicular oriented close to the inner side of the vessel attached to and extending from the bottom up to above liquid surface.

Number of baffles in BactoVessel range from 3 to 6 depending on the fermenter diameter. The baffle width (B1) is typically T/10 - T/12 of the vessel inner diameter (T1). Baffles are located with distance of T/72 – T/50 from the wall.

Aeration in BactoVessel

The Rushton 100 % radial flow pattern turbine are a most cost effective design with performance generally limited by pockets or cavities, which cling to the back of the blade at high gas flow rates and/or RPM. Rushton cause cavitation, considerable streamlining and power draw reduction. When gas flow gets too high, the pockets can bridge between blades, resulting in flooding and severe mechanical instability. Rushton RT8 has the highest un-gassed Power Number of any common turbine.

Smith turbines is a high efficiency agitator for very high gas dispersion applications. Characterized by symmetrical curved pipe sections mounted to a round disc resulting in low Power Number and increased efficiency. This particular Smith model ST6 has half the un-gassed Power Number compared to the Rushton turbine.



BactoVessel facilitate aeration / gas injection through a series of 0.5 mm holes arranged in a circle below the primary turbine integrated as a part of the vessel bottom. Number of holes depending on the turbine diameter or choices through the **Configurator Tool**.

Ring sparger

Since oxygen is sparingly soluble in water, it's one of several growth-limiting factor in fermentations. Though dealing with aerobic microbial applications it helps that the cells, bacteria, yeast, etc are almost indestructible facilitating high RPM, such as up to >1,500 RPM with BactoVessel.

Top class kLa values

Two photos show a OD150x320 mm BactoVessel equipped with the advanced OD 60 Smith, 6 blades turbine design plus Marine impeller, 3 baffles, 1 nl/min WV gas injection.

- At 0 RPM under static condition
- At 1000 RPM. Its worth to notice the limited foam generation even at such high RPM. Head space is in general free of foam

Exhaust

Single-Use-Gas-Cooler are available in three sizes and combines inner borosilicate glass tube for excellent heat transfer and outer PC tube and cooling liquid connections. All transparent tubes allow the user to inspect the functionality.

Large size – in design phase. Max 100 nl/min/37° gas volume capacity.

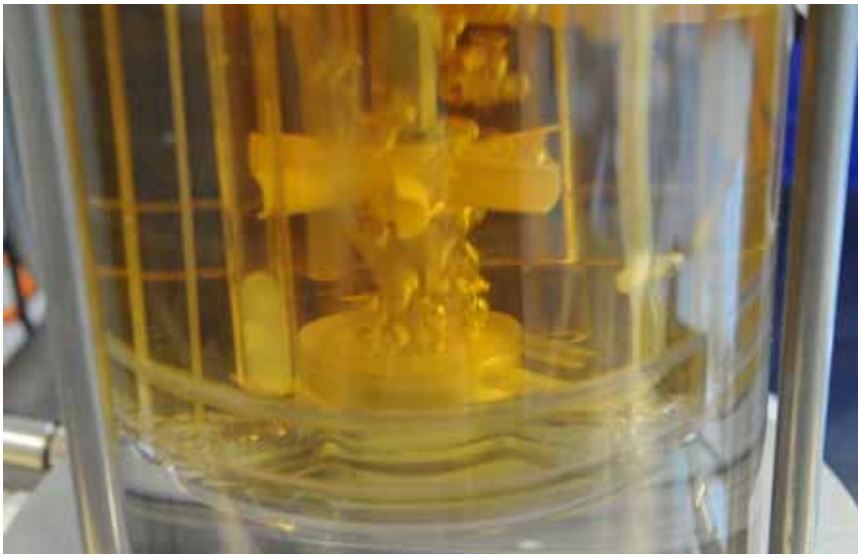
Configuration via the **Configurator Tool**

Small size – ID/OD 8/12 x 270 mm glass tube, lower end inlet and opposite outlet end fitted with ID/OD 10/14 mm silicone hose, outlet holding one or more 26 cm^2 surface area sterile filter. Cooling area 68 cm^2 suitable for max 2 nl/min/37° gas volume capacity.

Medium size – ID/OD 24/30 x 300 mm glass tube, lower end inlet ID/OD 18/22 mm silicone hose, and outlet fitted with ID10/14 mm silicone hose piece and 400 cm^2 surface area filter. Glass tube filled with Raschig 6x6 mm glass tube elements. Cooling area 500 cm^2 suitable for max 20 nl/min/37° gas volume capacity. Cooling liquid in/outlet being G1/8" for ID 6 mm hose connection.

Revolutions

This Smith symmetrically arranged curved (half pipe) blade design from the 1980s is able to handle increased injected gas volume. Can disperse twice the gas compared to the Rushton before flooding. Does not experience as great a power drop-off due to gas loading compared to the Rushton turbine. Recommended combined with an up pumping Marine impeller.



The CellVessel bioreactor use the same In & Out system specification as the BactoVessel.

Sensors and sampling

Unlimited possibilities in connections

Even the shown photo is a CellVessel bio-reactor the In&Out system for BactoVessel share the same principles and specifications. Via the **Configurator Tool** you can choose any combination of hoses, connectors for fluids passing In&Out of the BactoVessel head plate. As In&Out range of accessories is based on the PG 13.5 plug any wish is possible to fullfil

Sampling

Much more information available on www.cercell.com

Single-Use-Sensors

CerCell
CERCELL.COM

Single-Use-Sensors (SUS) offer many advantages

Express installation

Benefits:

- Integrated SUS reduce contamination risk
- Saves hours of prep time and labor, as no autoclaving or sterilisation is needed
- Enables SUS setup right on the bench top – no biosafety cabinet / hood needed for operation
- No autoclaving facility is needed
- Choose SUS via **Configurator Tool**

DO Single-Use-Sensor

- Non-invasive DO well for VisiFerm™. Pre-installed with SUS cap integrated to transparent PC tube.
- Extends DO sensor life, as sensor is never autoclaved
- DO sensor designed with digital signal communication that fits most PCS

pH Single-Use-Sensors

- Pre-installed 6 month dry storage tolerant pH SUS such as OneFerm or FermProbe
- Classical dimension pH sensor with extended shelf lifetime offering months of operation
- Classical pH signal fits any PCS
- Available combined with °C analouge output for dual digital signal communication via ARC module

ARC moule for SUS

- Pre-installed pH SUS OneFerm VP6 designed for connection to ARC analogue/digital module
- Available combined with °C analouge output for dual digital signal communication via ARC

Bio mass sensors

- Capacitive sensing technology allows precise on-line monitoring of the cell mass, viable cell density as well as cell physiological state.
- Users can also track cell cycle changes, model apoptosis, and predict protein titer all in real time

BactoVessel in RUJ

Water conveying Process-Control-System (PCS) benefit from the RUJ heat exchanger for BactoVessel. The RUJ design add significant support facilitating the servo motor mounted on the head plate (HPD). RUJ is further required for SUF operating pressure up to 500 mBar.

OD150x320 BactoVessel designed with turbine and impeller. SUF designed for microbial application where exothermal microbial reaction requires cooling.

The RUJ mounted with a 5.7 litre VV SUF with 2.5 litre WV are able to removed ~20 watt / litre media power. The RUJ allow fast turn-over time and highest possible exchange of energy. Shown with Rectus 21 couplings for direct connection to BioStat set of orange hoses.

Preparation

BactoVessel SUF weigth is less than 1/10 of the glass/steel STR of comparable volume. Anyone can easily tumble the SUF in a safe way.

Reduced turn-around time

The BactoVessel concept is to move weight from the STR, Stirred-Tank-Reactors made from glass / Stain-less Steel to "fixed" components. The traditional jacketed Stirred-Tank-Reactors has with 5.7 litre VV typically a weight of 18 kilo. Not really easy to handle!

The BactoVessel SUF is kept as light as possible. The 5.7 litre BactoVessel SUF weigth is less than 2 kilo! All the weigth is moved to the fixed component – RUJ!

Heating & cooling with Re-Usable-Jacket

For water conveying Process-Control-System (PCS) CerCell offer a stand-alone Re-Usable-Jacket (RUJ) accessory to insert the SUF. This jacket is an efficient heat exchanger and an advanced option for SUF OD110 – 250 mm and in 225, 320 and 420 mm height. A flexible O-ring seal between the removable SUF top flange and support ring allow simple replacement of the SUF. Such SUF are equipped with head-plate flange as selected in the **Configurator Tool**.

Specifications for RUJ:

- The RUJ is one of many accessories found on www.cercell.com/commerce
- Operating temperature 5-60°C
- Max jacket operating pressure 400 mBar – RUJ equipped with a spring loaded over-pressure, system protection valve set at 500 mBar
- Recommended water flow 1 litre/min per litre/SUF WV
- Two G3/8" female thread for In/Out adapters: OD10 barb or GL18 male glass thread (similar to UniVessel and others) or Rectus 21 couplings (similar to Biostat setup)
- Weight ranging 5-10 kilo depending on size, the weight facilitates stable arrangement on desktop.
- The transparent rigid plastic tube material gives excellent process view.

Proud **Production Manager** with BactoVessel in RUJ

Water connections

Heating / cooling with Single-Use-Jacket

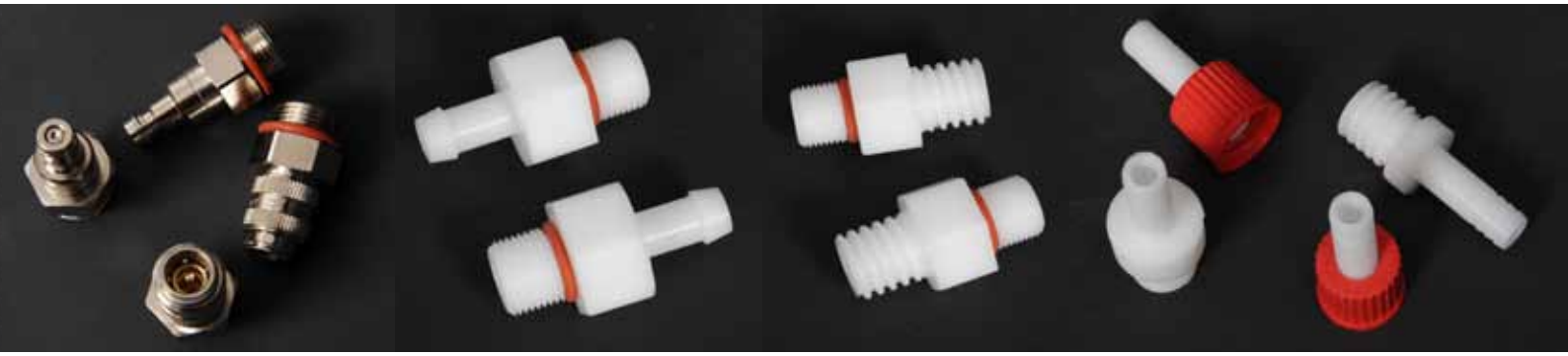
16.4 litre VV CellVessel (OD250x320) via **Configurator Tool** equipped with SUJ. The two female threaded G3/8" connections are visible on the right side of the SUF.

Water connection

For water conveying Process-Control-System (PCS) the optional integrated Single-Use-Jacket (SUJ) heat exchanger is an efficient option for the BactoVessel fermenter family. Allow the use of MST up to 13.3 litre SUF size.

Specifications:

- Selected via the **Configurator Tool**
- Operating temperature 5 - 60°C heating / cooling water
- Recommended max operating pressure is 500 mBar
- Burst pressure at 20°C is <1 Bar
- Recommended cooling flow 1 litre/min/ WV
- Standard two G3/8" female thread connections on jacket
- Adapters available as accessory: G3/8" to OD10 barb, G3/8" to GL18 male glass thread adapter like UniVessel, G3/8" to Rectus 21 male/female kit
- The transparent rigid self supportive plastic material gives excellent process view.

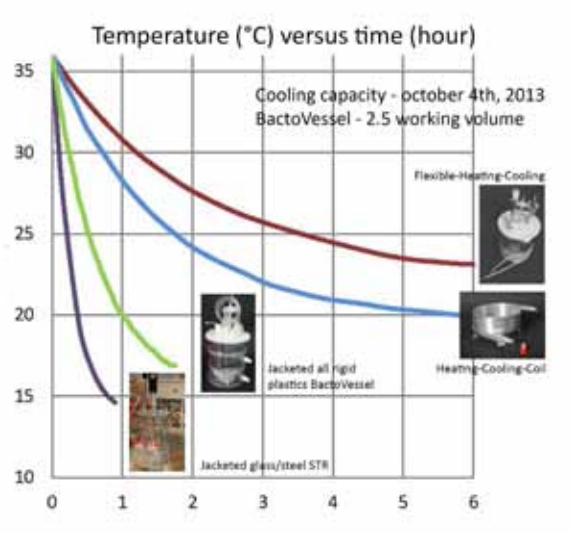


From left to rigth:
Rectus 21 to G3/8" couplet kit, G3/8" to OD10 barb kit, G3/8" to GL18 glass thread kit, hose adapters to GL18 kits

BactoVessel with SUJ

Cooling as with glass

Heat exchange



1. FHC – Flexible-Heating-Cooling element wrapped around the SUF with 5.5 litre VV, 2.5 litre WV, removed power ~5 watt / litre media

2. Aluminium RHS coil encapsulating the SUF with 5.5 litre VV, 2.5 litre WV, removed power ~10 watt / litre media

3. Integrated Single-Use-Jacket on SUF with 5.5 litre VV, 2.5 litre WV, removed power ~20 watt / litre media

4. Integrated jacket on UniVessel STR - glass/steel, removed power ~25 watt / litre media

BactoVessel equipped with SIngle-Use-Jacket and female G3/8" threaded connections for a variety of adapters.

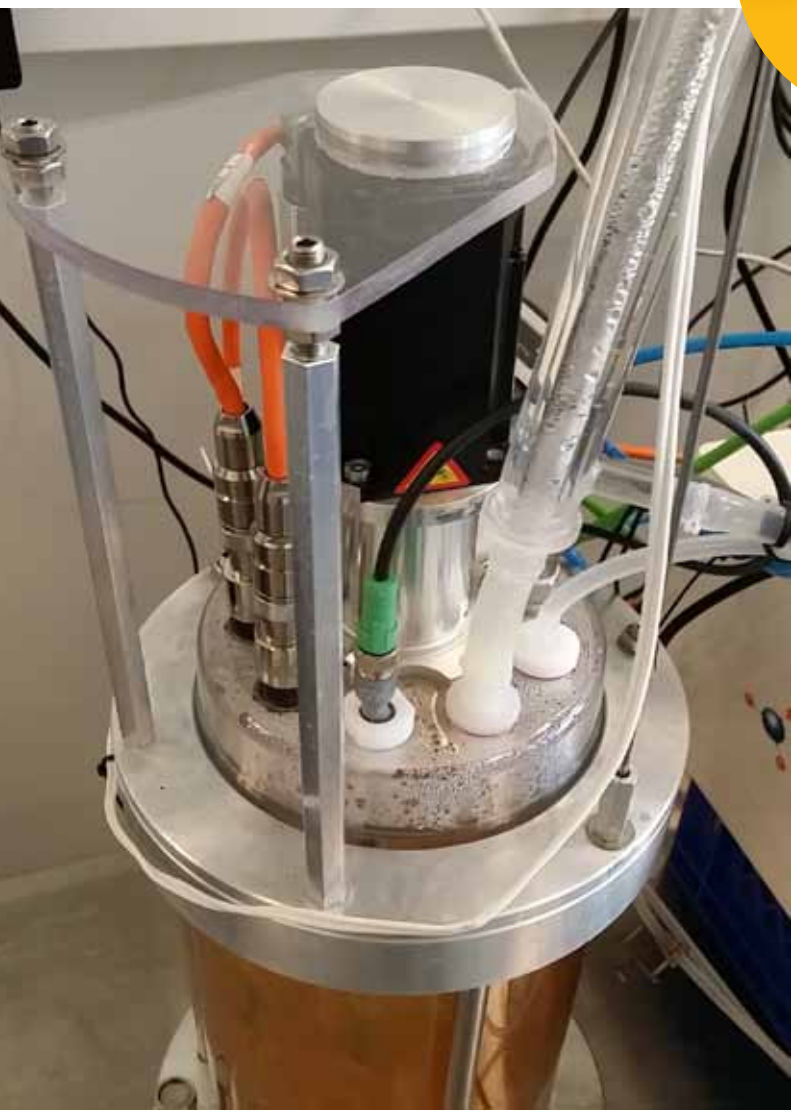
5.7 litre VV BactoVessel via **Configurator Tool** equipped with SUJ

Agitation methods

HPD drive

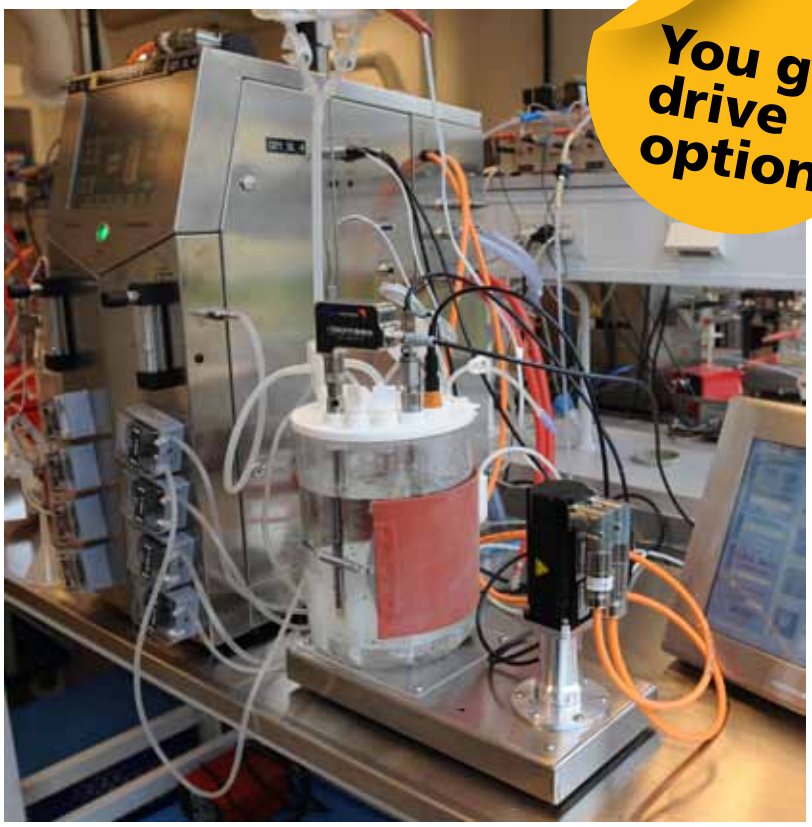
- Head-Plate-Drive (HPD) for BactoVessel SUF offer coupling / adapter kits to servo motors from Applikon, Biostat, DasGip, BJ, NBS, Solaris, Finesse, BBI-biotech and other PCS servo motors
- Re-usable servo motor adapters easily attached to the OD30 mm HPD centre bearing on the BactoVessel head plate
- For high loads a motor stand is helpful

Use you own PCS



BactoVessel 5.7 litre facilitating Smith turbine and Marine impeller operating at 1,500 RPM mounted in Re-Usable-Jacket, RUJ equipped with servo motor support and Sky-Support for the gas-cooler and exhaust filter.

Kollmorgen AKM23D servo motor driving via HPD in Biostat setup a 5.7 litre BactoVessel submersed in a RUJ



Kollmorgen AKM23D servo motor driving MST in Biostat setup

Most servo motors facilitate these adapters.

MST driving in this case a 3.0 litre CellVessel bioreactor. Fully independent of the particular PCS servo motor. The MST adapter, seen to the left, takes care of this isssue.

MST drive

- Magnetic-Stirrer-Table (MST) Stainless Steel construction featuring long life and silent running toothed rubber belt on aluminium sprockets, two lifetime sealed double-row ball bearings
- MST rotor (under the SUF or SUB) is equipped with 12 permanent magnets and able to transfer >100 watt power depending on the particular servo motor capacity
- Dim: 390x180x50 mm, weight is 5,7 kilo
- For BactoVessel with SIngle-Use-Jacket, SUJ

SUF products

Our "Configurator Tool" can help you design a SUF to your User-Requirement-Specification.

BactoVessel sizes to select from						
Vessel diameter, OD mm	110	130	150	200	250	400
Number of PG13.5 ports	7	7	9	10	10	12
Turbine diameter, OD mm	40-50	50-60	50-70	80-100	100-120	100-150
Vessel Volume, litre						
225 mm	2.1	3.0	4.1			
320 mm		4.2	5.7			
420 mm				13.3	21.0	
500 mm						
600 mm					29.5	75.6

Thank you for your time browsing this leaflet

Much more information available on www.cercell.com

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