1. Introduction:

The Biobench Advanced series are compact bioreactors / fermenters with autoclavable glass vessels with a volume of 0.5 to 15 liters. The Biobench series is designed by Kbiotech, built and tested at our company in order to be ready for use after delivery and installation. The Biobench series is based on decades of experience gained by our staff in the design of bioreactor and fermenter construction, from the autoclavable laboratory version up to sip (sterilizable in place) stainless steel 316L systems.

2. Technology

The uniqueness of the Biobench Advanced series lies in its modular design, consisting of a Control Unit and a Slave Unit. This is a flexible system that can be extended with additional modules to create a network that can control up to 12 Biobench Advanced plus series vessels. The instrument can be upgraded on specific customer request even after installation, keeping the instrument's performances in good time and up-to-date.

Additional options include:

- Management of the vessel RWET temperature with vessel water recirculation.
- External chiller.
- Addition of sensors and controls in addition to pH, OD and T ° (eg biomass, exhaust gas analysis, density sensors, Redox sensors, etc.).
- Monitoring of the culture volume weight with precision balance to work in feedbatch or continuous.
- LED vessel lighting module (Photobioreactor) with day / night cycles.
- Tangential flow filtration module (TFF), tangential filtration downstream processing.

3. System

The Kbiotech fermenters and bioreactors of the Biobench series present all the requirements for today's life science applications.

The "network bench" technology allows the operator to control multi vessels with a single user interface.

The systems of the Biobench Advanced series do not require the presence of an integrated PC panel even if available on request, the operator is able to create recipes, monitor, and edit set-points of a crop, save trends and data directly from their PC . The connection of the different modules through Ethernet cables

allows a free arrangement of the modules within the work space, allowing the control of the cultivation remotely.

The Stop button allows the interruption of cultivation at any time while safeguarding the cultivation in progress.

3.1. Control unit

The Control Unit of the Biobench Advanced series was designed on the cRIO technology platform.

National Instrument's "CompactRIO" controllers provide high performance to execute advanced algorithms with deterministic response times and low latency. Take advantage of the latest heterogeneous computing and computation technologies that include ARM-based Xilinx Zynq SoCs, quad-core Intel Atom processors and Xilinx Kintex-FPGA FPGAs. In addition, they take advantage of decades of leadership in the acquisition of high quality measurement signals with measurement-specific conditioning, insulation included, and industrial I / O.

The recipe cascade is processed by Bioflex software, a software developed on the Labview platform, which is the basic setting for automatic process control.

The loop control consists of three elements: probe / sensor, controller, and actuator.

Based on information from the sensor, the controller generates a control signal to the actuator, which maintains the parameter at its nominal value.

The control fails if one of the elements in the loop fails to the settings of the PID control regulator (proportional constant, integral and derivative). If the PID constants are not correct, the control signal may be too weak for the parameter to not reach the set point; at the other extreme, the controller can respond too strongly to small errors, indicating the actuator to oscillate between high and low values.

The performance of the cRio exceeds all these setting limitations typical of traditional Plc, facilitating the operator in the formulation of the cascade.

The Biobench Advanced Series Control Unit is also equipped with an internal gas mixing module, which can be configured with manual or electronic flow meters (MFC, Mass Flow Controller) as an option.

Each Control Unit is able to manage up to 4 gases, typically Air, O2, CO2 and N2. The rear panel is equipped with quick couplings for incoming and outgoing gas lines as well as pressure gauges to visualize the incoming gas pressure.

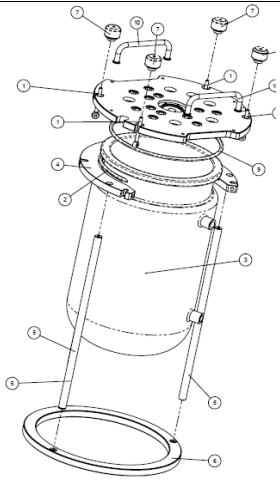
It is possible to choose between four exterior paint colors when ordering: pearl gray, green, blue, red, satin stainless.

The Control Unit includes in the standard supply all the connections required for probes, sensors, mixer motor and optional accessories (eg scale).

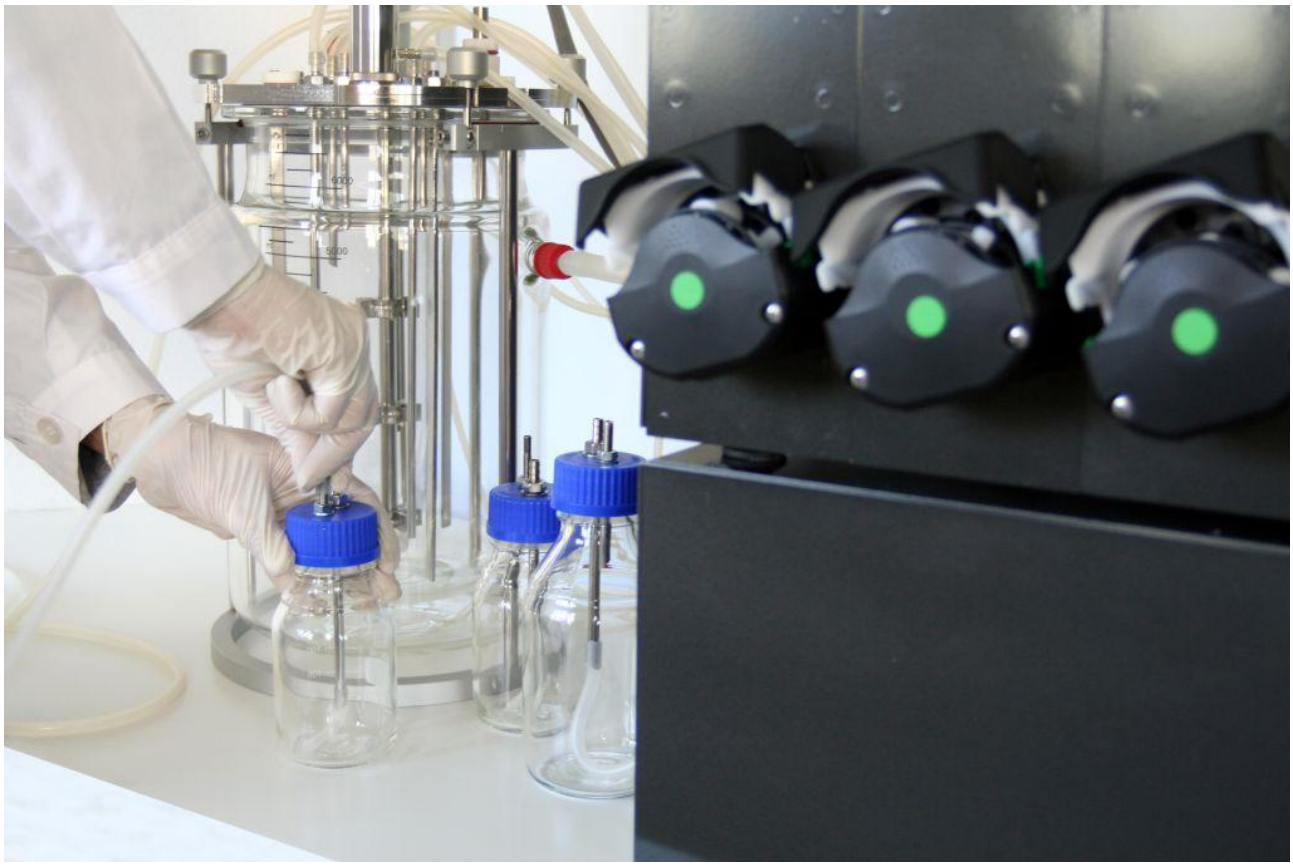
3.2. Slave unit

The Biobench Advanced Series Slave Unit includes the Wet unit for vessel temperature control and on the front panel up to four peristaltic pumps selectable in order between analog and digital.

The Wet unit allows the vessel to be thermostatically controlled by means of solenoid valves driven by the central unit, the water inlet for cooling, while the heating is controlled with a silicone heating band with protection towards the operator to be positioned around the vessel.

	
Heating the Vessel using a heating band	Exploded view of a Vessel with recirculation

When ordering, it is possible to choose between the vessel thermostat in the WET version or the RWet version, with water recirculation in the vessel's jacket. The heating system and the recirculation pump are integrated into the module.



The Wet and the RWet are designed to provide, for the addition of a closed-circuit chiller (optional) that allows a quick cooling of the vessel in addition to reducing the discharge of water and therefore of its consumption.

Wet and RWet include safety devices to avoid the risk of over-temperature and over-pressure in the circuit.

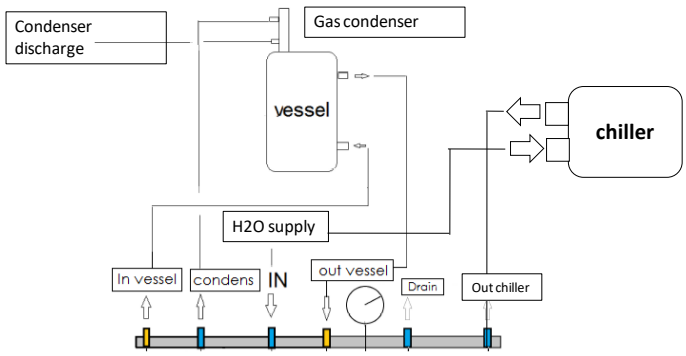


Diagram of a circuit Rwet with chiller

On the front panel, it is possible to choose between analogue, variable speed peristaltic pumps or digital peristaltic pumps at fixed speeds; these pumps can be used with different diameters of silicone pipes 3x6 - 4x6 - 3x8 mm according to the needs of flow rate and dosing accuracy.

To obtain maximum precision in the flow, Bioflex provides the weighing procedure on the calibration page.

Four peristaltic pumps on the front panel

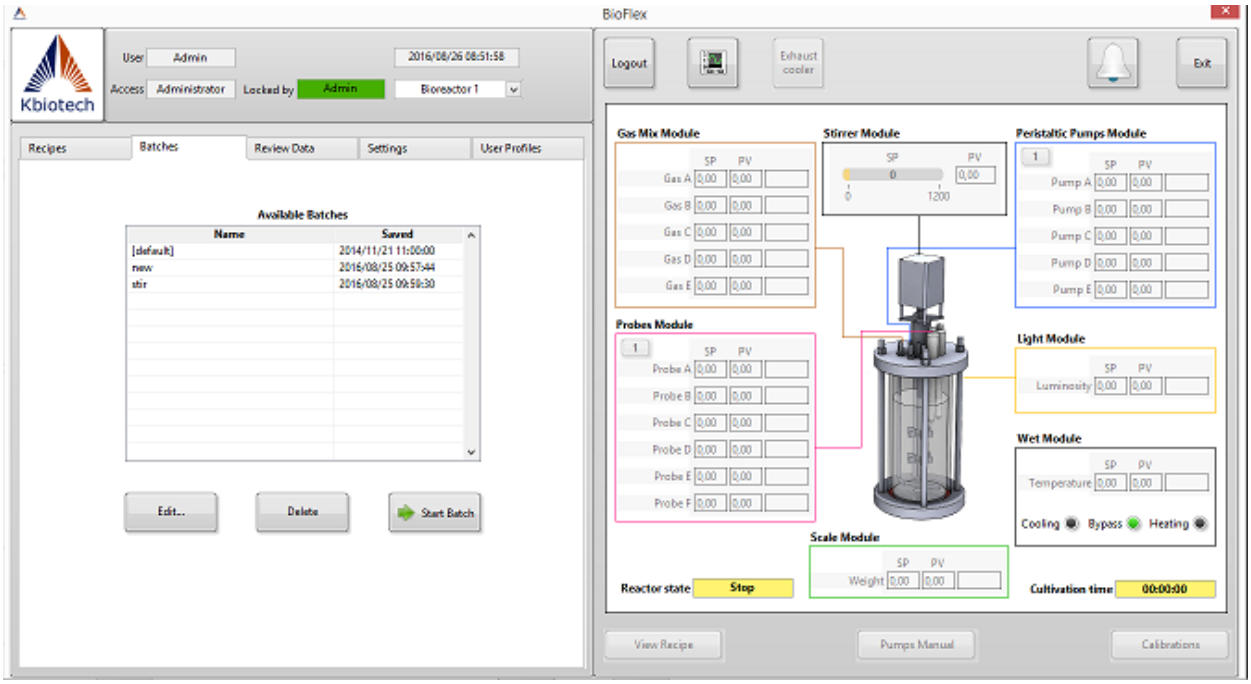
3.3. Operating Unit

The Bioflex software developed entirely by Kbiotech allows a complete control of the Biobench systems, the acquisition and export of data, the management of the cultivation in the vessel. It is possible to set all the parameters necessary for cultivation through a Recipe, which can easily be modified or duplicated; configured a Cascade (Cascade) the instrument will respond in real time to changes in the process values set and displayed by Sinottico (Synoptic).

It is possible to make calibrations of the pumps, probes and sensors for a greater accuracy of reading process parameters, in fact in the control of a bioprocess, the calibration usually refers to establish a correspondence between the output of a probe and the current value of what the probe is measuring.

Other features are:

- Password protection and different access levels
- Control through the operator's PC, with the availability of a 15 "or 21" touch screen Pc panel (option)
- Database of recipes and configurations
- Logical and intuitive design of all operating menus
- Bidirectional OCP communication with optional SCADA software
- Export of data as a .csv file via USB port, or direct exchange through the OCP interface
- Web-based remote service
- Remote license-free access with VNC client through Ethernet connection, from every device and operating system



Bioflex software interface

3.4. QVessel / JQVessel

The Vessels of the QVessel series are available in different volumes and with different ratios between height and width, to allow optimal cultivation of both micro-organisms and cells.

The vessels are also available in the JQVessel version, which includes an external jacket for water recirculation for thermostatation of the crop.

316L stainless steel headplate equipped with doors for housing all the probes and accessories necessary for cultivation.

The compact dimensions and the construction materials used, makes the QVessel series compatible with sterilization in laboratory autoclaves.

The table shows the available versions. Other sizes are available on request.

QVessel-JQ Vessel Models

Total volume	**0,5 L**	**2 L**	**3 L**	**5 L**	**7 L**	**10 L**
Min working volume	100 mL	200 mL	500 mL	800 mL	1,2 L	1,2 L
In. Dim/ratio	1,5:1	1,5:1	1,5:1	1,5:1	1,5:1	1,5:1
Large (mm)	78	120	140	160	186	201
High (mm)	116	180	210	250	280	320
Headplate diameter	160	200	250	280	320	320

Port	2x M12 5x M22 1x stirrer	4x M12 4x M15 6x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer

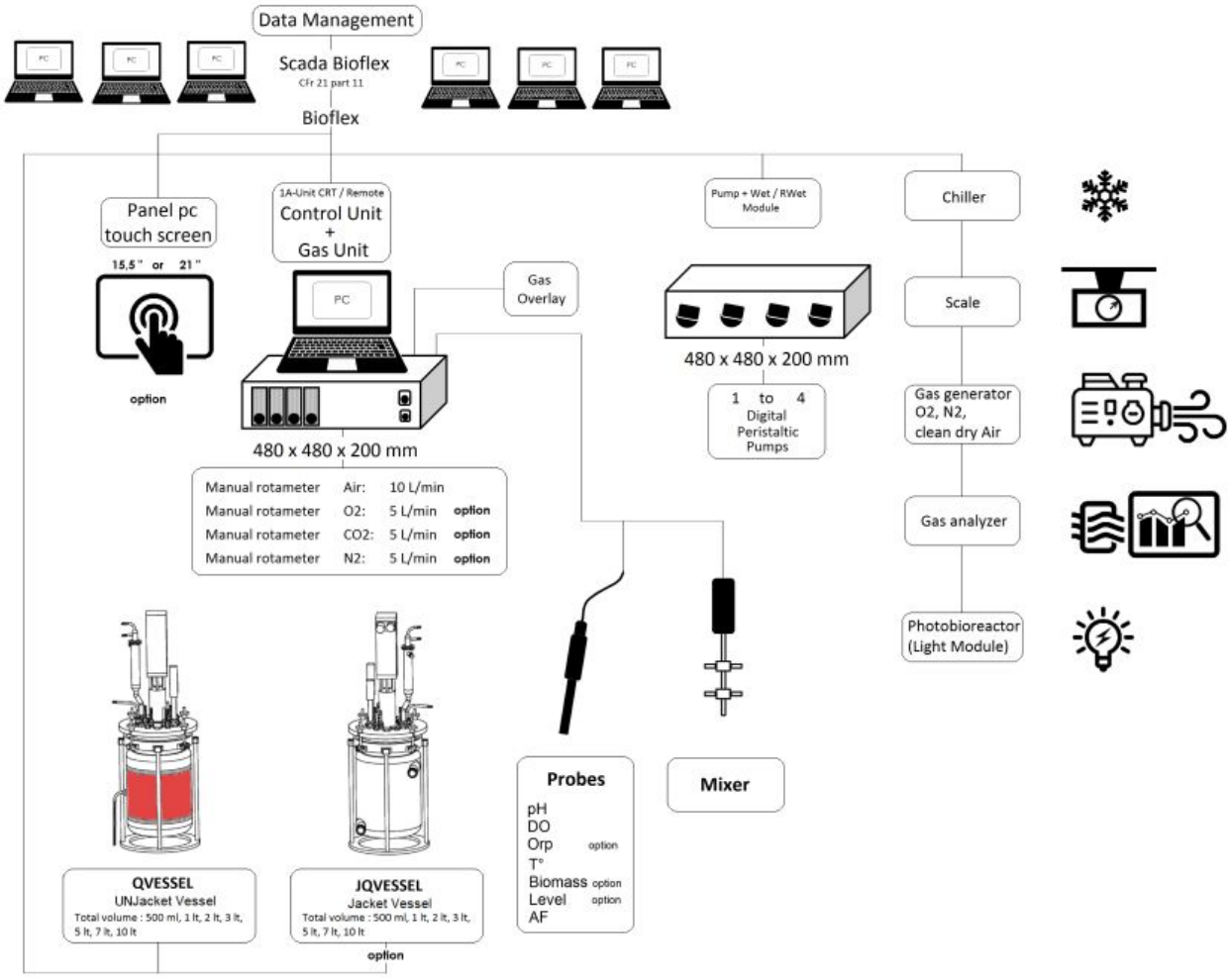
Total volume	**1 L**	**3 L**	**5 L**	**7 L**	**10 L**	**15 L**
Min working volume	200 mL	400 mL	800 mL	1,0 L	1,2 L	1,2 L
In. Dim./ratio	2,5;1	2,5;1	2,5;1	2,5;1	2,5;1	2,5;1
Large (mm)	78	120	140	160	186	201
High (mm)	200	275	335	360	400	500
Headplate diameter	160	200	250	280	280	320
Port	2x M12 5x M22 1x stirrer	4x M12 4x M15 6x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer	4x M12 4x M15 9x M22 1x stirrer

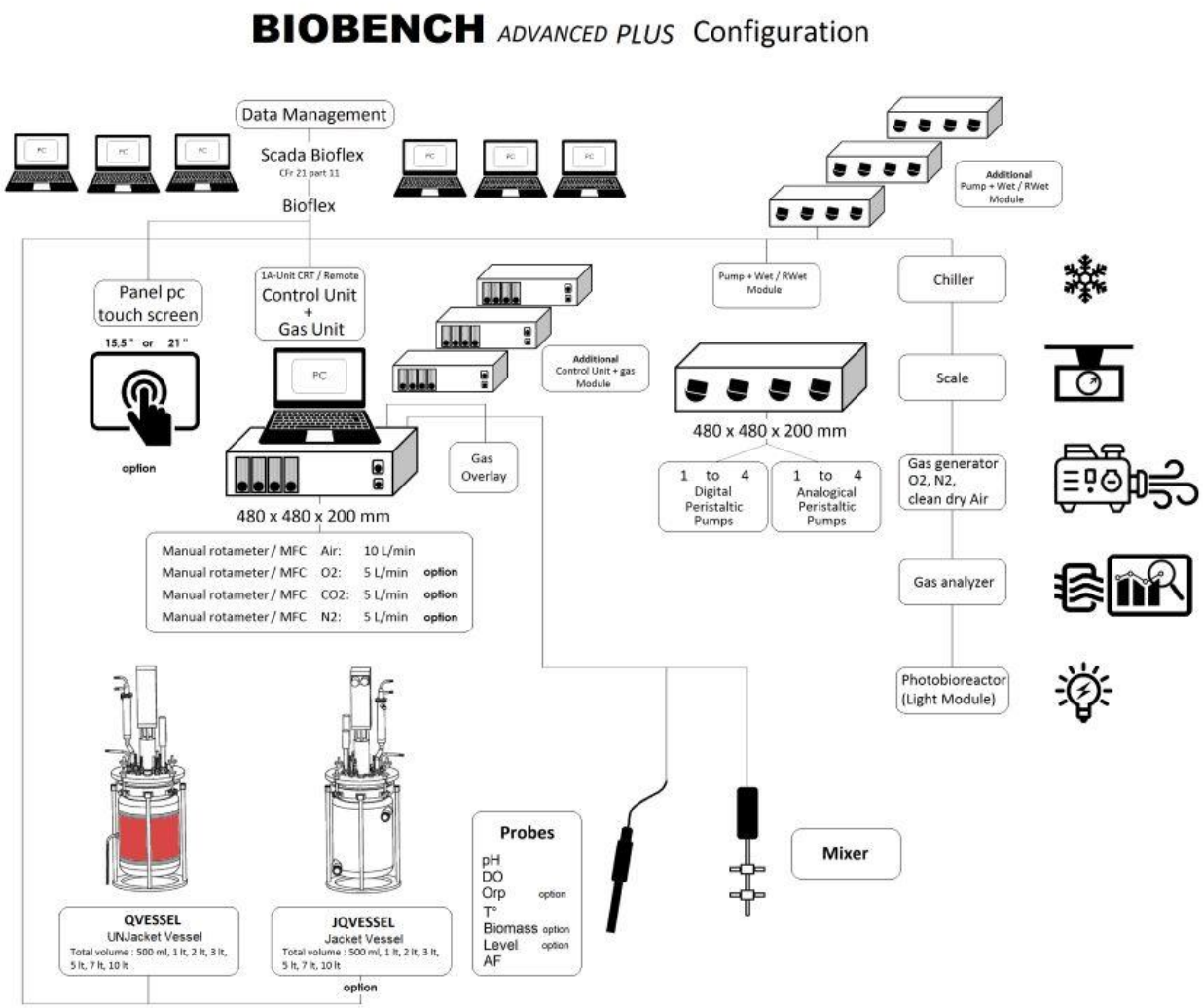
4. Security

All Biobench systems are designed for aseptic microorganism cultivations at S1 level.All electrical components are protected from splashes of water at all the sides.The Control Unit module is equipped with LED indicator, to monitor the connection status, to report the malfunction of internal components, the emergency status and the power supply of the instrument.

5. Configurations schemes:

BIOBENCH *ADVANCED* Configuration





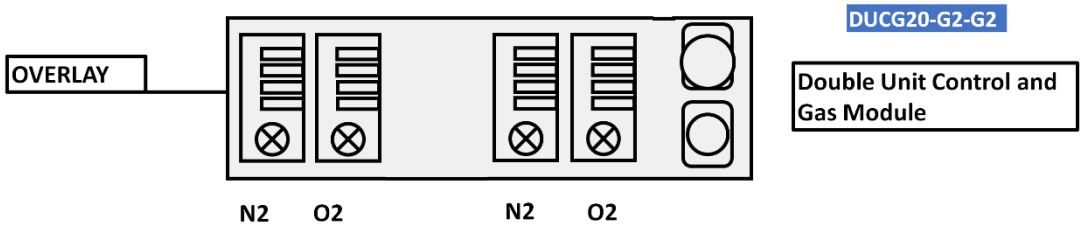
6. Biobench Technical Specifications (System for 2 Vessel 3lt -5lt)

The following are the technical characteristics of the proposed Biobench Series systems.

6.1. Control Unit and Slave Unit specifications

PART NO	QTY	CONTROL UNIT SPECIFICATIONS FOR**VESSEL A+ B**
DUCG20-G2-G2		Biobench DUCG – Double Unit Control and Gas Module 2 Rotameters + 2 Rotameters
	1	Stainless steel frame, external case in coated anodized aluminum; designed for easy access to electronic components in a small space. The rear panels have fans that ensure the cooling air flow of the internal components.
	1	CPU - NI CompactRIO programmable automation controller combined with real time / FPGA technology.
	3+3	Rotameters housing in Plexiglass, precision +/- 5%.
	1+1	Carrying capacity O2 0,2 – 1,5 L/min

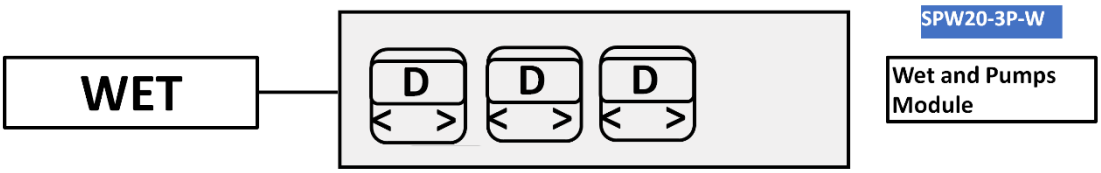
	1+1	Carrying capacity CO2 0,2 – 1,5 L/min
	1+1	Carrying capacity Air 0,5 – 5,0 L/min
	3+3	Pressure gauges for network gas
	1+1	Network gas connection
	1+1	Sparger gas connection
	1+1	Gas Overlay connection
	1+1	Manual valve to regulate the flow of gas between Sparger / Overlay
	1	220V 50Hz electrical outlet with on/off switch
	2	F type electric socket
	2	Connection to the PCETH RJ45
	2	Data connection to D-Sub 37pin female Slave Unit
	1+1	19 Pin Motor Plug Mixer Connection
	3+3	Connection 4-20 mA -
	6+6	Connection 4-20 mA - ModBus
	1	Status Indicator Led (Rear panel)
	1	Emergency stop button (frontpanel)
	1	Restart button (frontpanel)
	2	Power cable slave
	1	Power cable 220V
	2	D-sub male/female37 pin data cable
	2	SFTP ETH data cable cat. 6
	1	Biobench user manual
	1	Factory Test and Control (FTC) documentation
		Dimensions: 200x480x480 (h x l x d), weight 30kg
		Power supply 220V, 50Hz, power consumption 10 Amp.
		In accordance with CE



PART NO	QTY	SPECIFICATIONS SLAVE 1 FOR**VESSEL A**
SPW20-3P-W		Biobench SPW - Slave 4 pumps and wet module
	1	Stainless steel frame, external case in coated anodized aluminium; designed for easy access to electronic components in a small space. The rear panels have fans that ensure the cooling air flow of the internal components.
	4	Digital peristaltic pumps, selectable gradient from 1 sec. At 99.99.99, flow: 1 - 60 ml / min
	1	220V 50Hz electrical outlet with on/off switch
	1	F type electric socket
	1	Data connection to D-Sub 37-pin female Slave Unit
	1	Connection of heating band 48V
	1	Wet "Water heating control" module t ° amb> 80 C °
	1	Water pressure gauge
	1	Quick connection of mains water / chiller
	1	Quick vessel connection
	1	Quick connection to gas condenser
		dimensions: 200x480x480 (h x l x d), weight: 24kg

PART NO	QTY	SPECIFICATIONS SLAVE 2 FOR**VESSEL B**
SPW20-3P-W		Biobench SPW - Slave 4 pumps and wet module
	1	Stainless steel frame, external case in coated anodized aluminium; designed for easy access to electronic components in a small space. The rear panels have fans that ensure the cooling air flow of the internal components.
	4	Digital peristaltic pumps, selectable gradient from 1 sec. At 99.99.99, flow: 1 - 60 ml / min
	1	220V 50Hz electrical outlet with on/off switch
	1	F type electric socket

	1	Data connection to D-Sub 37-pin female Slave Unit
	1	Connection of heating band 48V
	1	Wet "Water heating control" module t ° amb> 80 C °
	1	Water pressure gauge
	1	Quick connection of mains water / chiller
	1	Quick vessel connection
	1	Quick connection to gas condenser
		dimensions: 200x480x480 (h x l x d), weight: 24kg



Qty.2 Slave module

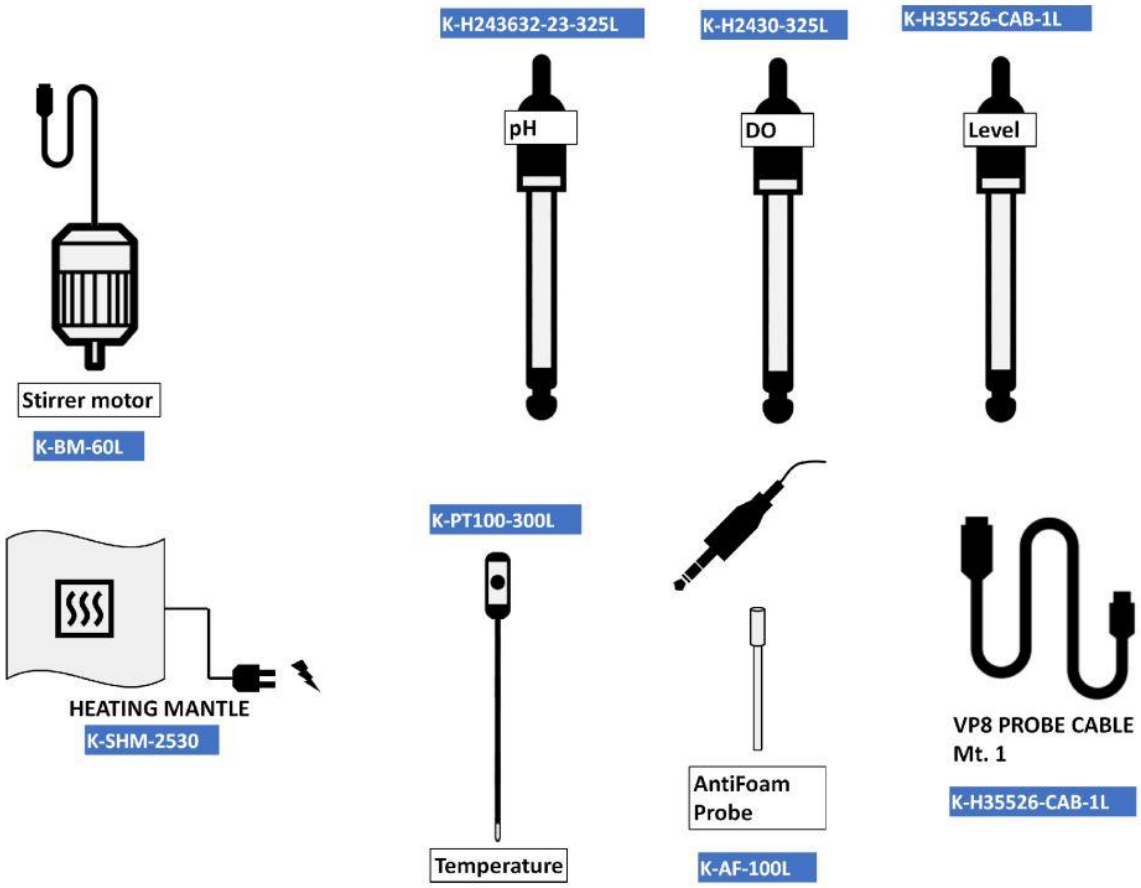
6.2. Probes and accessoriesspecifications

PART NO	QTY	PROBE AND COMPONENTSSPECIFICATIONS FOR **VESSEL A**
K-BM-60L	1	Brushless motor for stirrer shaft, F coupler included, 60 mm flange, adjustable speed 5-1200 rpm, selectable 1 rpm, cable length 1.5 m
K-H2430-325L	1	Oxyferm series Arc Hamilton DO Sterilizable sensor range 0-100%, modbus communication, length 325 mm, for M22 door
		Exensor based on electrochemical oxygen reduction
K-H243632-23-325L	1	Easyferm bio HB Arc Hamilton sterilisable pH sensor, modbus communication, length 325 mm, for M22 door
		Sensor with combination electrode, potential pH measurement with respect to a reference, measurement range 1-14, accuracy 0.01
K-PT100-300L	1	Kbiotech series PT 100 temperature sensor, length 300 mm
		Sensor range 0-100 ° C - precision 0.1 ° C current signal (4 -20 mA), cable length 1.5 mt
K-AF-100L	1	KbiotechAntiFoam, conductivity sensor, a sterilizable pole in 316 L stainless steel, maximum length 100 mm, adjustable for height, cable length 1.5 m.
K-DLM-35		Sterilisable 316 L stainless steel capacitive level probe, current signal (4-20 mA),

		cable length 1.5 m, for M22 port
K-H35526-CAB-1L	2	Data cable for VP8 probes with 1meter width
K-SHM-365200W350	1	Silicone heating band 48V 350W - 365x200mm, cable length 1500mm, 8mm silicone foam layer, 110 ° C thermal protection

PART NO	QTY	PROBE AND COMPONENTSSPECIFICATIONS FOR **VESSEL B**
K-BM-60L	1	Brushless motor for stirrer shaft, F coupler included, 60 mm flange, adjustable speed 5-1200 rpm, selectable 1 rpm, cable length 1.5 m
K-H2430-325L	1	Oxyferm series Arc Hamilton DO Sterilizable sensor range 0-100%, modbus communication, length 325 mm, for M22 door
		Exensor based on electrochemical oxygen reduction
K-H243632-23-325L	1	Easyferm bio HB Arc Hamilton sterilisable pH sensor, modbus communication, length 325 mm, for M22 door
		Sensor with combination electrode, potential pH measurement with respect to a reference, measurement range 1-14, accuracy 0.01
K-PT100-300L	1	Kbiotech series PT 100 temperature sensor, length 300 mm
		Sensor range 0-100 ° C - precision 0.1 ° C current signal (4 -20 mA), cable length 1.5 mt
K-AF-100L	1	KbiotechAntiFoam, conductivity sensor, a sterilizable pole in 316 L stainless steel, maximum length 100 mm, adjustable for height, cable length 1.5 m.
K-DLM-35		Sterilisable 316 L stainless steel capacitive level probe, current signal (4-20 mA), cable length 1.5 m, for M22 port
K-H35526-CAB-1L	2	Data cable for VP8 probes with 1meter width
K-SHM-365200W350	1	Silicone heating band 48V 350W - 365x200mm, cable length 1500mm, 8mm silicone foam layer, 110 ° C thermal protection

Qty. 2 X components



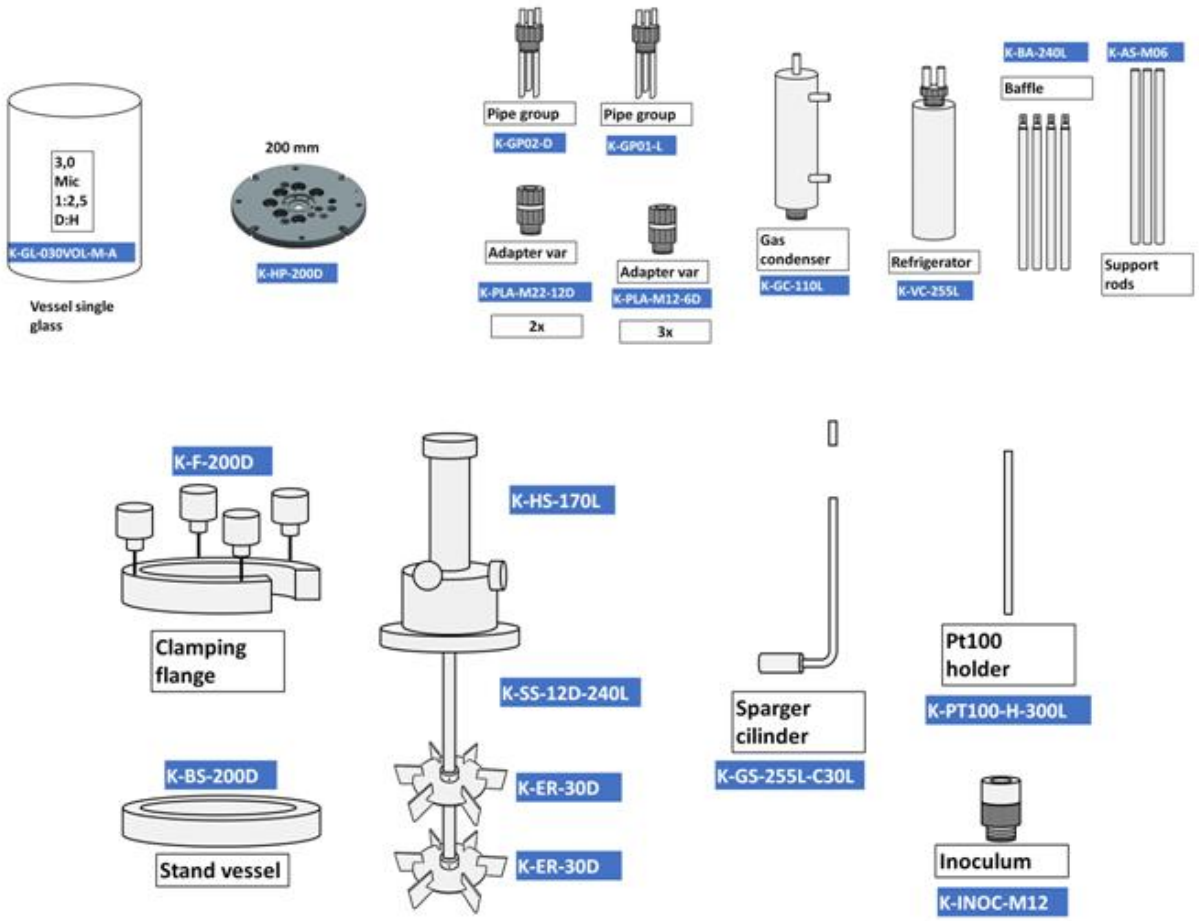
6.3. SpecificheQVessel

PART NO	QTY	SPECIFICATIONS **VESSEL A**
K-GL-030VOL-M-A	1	IQVessel in Inox 316 L for microbiology
		Ratio H: L - 2.5: 1
		total volume - minimum volume of work - internal dimensions
		3 liters - 400 ml - 130x250 mm
K-HP-220D	1	316L stainless steel headplate, polished <0.5µ, diameter 220 mm, n ° 12 M12 ports, n ° 6 M22 ports, n ° 1 mixer door, total n ° 19 doors
K-HS-170L	1	Holder for stirrer included n ° 3 knobs + coupler M, length 170 mm
K-SS-12D-240L	1	Stainless steel 316 L stainless steel stirrer shaft, polished <0.5µ, diameter 12 mm, length 235 mm
K-ER-50D	2	Polished 316 L stainless steel propellers, Rushton type, 50 mm diameter
K-BA-240L	4	Stainless steel 316 L breakwaters, length 220 mm
K-PLA-M22-12D	2	Variable height probe / tube adapter (nipple assembly + clamping bushing),

		internal diameter 12 mm, for M22 door
K-PLA-M12-6D	3	Variable height probe / tube adapter (nipple assembly + clamping bushing), internal diameter 6 mm, for M22 door
K-GC-110L	1	Condenser in stainless steel 316 L polished <0,5µ for exhausted gas, including quick connection for overhead pipe, length 110 mm, for M22 door
K-PT100-H-240L	1	316 L stainless steel pipes polished <0.5µ for PT100 support, length 240 mm
K-GS-240L-C30L	1	316L stainless steel pipes polished <0.5µ for sparger, length 240 mm, Cilinder type, length 30 mm
K-GP01-L	1	Pipe 1 group with ring, for M22 door
		316 L stainless steel pipes polished <0,5µ length 35 mm for acid solution addition
		316L stainless steel pipes polished <0.5µ lenght 35 mm for basic solution addition
		316L stainless steel pipes polished <0.5µ length 35 mm for anti-foam solution addition
K-GP02-D	1	Pipe 2 group, for M22 door
		316L stainless steel pipes polished <0.5µ mm 240 mm for collection
		Pipes in 316 L stainless steel polished <0.5µ length 120 mm by addition
		316L stainless steel pipes polished <0.5µ length 35mm for overlay
K-INOC-M12	1	Adapter with sterilisable silicone separator for inoculation (septum base + cap), for M12 door

PART NO	QTY	SPECIFICATIONS**VESSEL B**
K-GL-050VOL-M-A	1	QVessel in 316L for cells
		Ratio H: L - 1.6: 1
		total volume - minimum volume of work - internal dimensions
		5 liters - 600 ml - 160x260 mm
K-HP-260D	1	316L stainless steel headplate, polished <0.5µ, diameter 260 mm, n ° 9 M12 ports, n ° 8 M22 ports, n ° 1 mixer door, total n ° 18 doors
K-HS-170L	1	Holder for stirrer included n ° 3 knobs + coupler M, length 170 mm
K-SS-12D-240L	1	Stainless steel 316 L stainless steel stirrer shaft, polished <0.5µ, diameter 12 mm, length 240 mm

K-EM-50D	2	Polished 316 L stainless steel propellers, Marine type, 50 mm diameter
K-BA-240L	4	Stainless steel 316 L breakwaters, length 240 mm
K-PLA-M22-12D	2	Variable height probe / tube adapter (nipple assembly + clamping bushing), internal diameter 12 mm, for M22 door
K-PLA-M12-6D	3	Variable height probe / tube adapter (nipple assembly + clamping bushing), internal diameter 6 mm, for M22 door
K-GC-110L	1	Condenser in stainless steel 316 L polished <0,5µ for exhausted gas, including quick connection for overhead pipe, length 110 mm, for M22 door
K-PT100-H-240L	1	316 L stainless steel pipes polished <0.5µ for PT100 support, length 240 mm
K-GS-245L-R50L	1	316L stainless steel pipes polished <0.5µ for sparger, length 245 mm, ring type, length 50 mm
K-GP01-L	1	Pipe 1 group with ring, for M22 door
		316 L stainless steel pipes polished <0,5µ length 35 mm for acid solution addition
		316L stainless steel pipes polished <0.5µ lenght 35 mm for basic solution addition
		316L stainless steel pipes polished <0.5µ length 35 mm for anti-foam solution addition
K-GP02-D	1	Pipe 2 group, for M22 door
		316L stainless steel pipes polished <0.5µ mm 250 mm for picking
		Pipes in 316 L stainless steel polished <0.5µ length 120 mm by addition
		316L stainless steel pipes polished <0.5µ length 35mm for overlay
K-INOC-M12	1	Adapter with sterilisable silicone separator for inoculation (septum base + cap), for M12 door

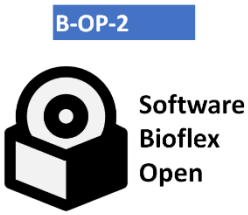


6.4. Specifications software and start Up

PART NO	QTY	SPECIFICATIONSFOR **VESSEL A + B**
	1	Pc Notebook Touch screen 15,6 “
B-OP-2	1	Bioflex open software **two** systems license
		In addition to all the features of the Bioflex start software, it can control up to 2 Vessel in real time, possibility of further options.
		Superior performance in data acquisition and export, and vessel management.
		Possibility to set all the parameters for cultivation through Recipe (Recipe)
		Recipes easily editable and duplicable
		Complete cascade settings (Cascade), auto - tuning of the system following set point changes.
		Setting the cultivation duration and the Batch delay
		Calibrations of pumps and probes

		Different levels of access for operators
		Real-time monitoring and setting of cultivation parameters via a synoptic interface
		User manual included

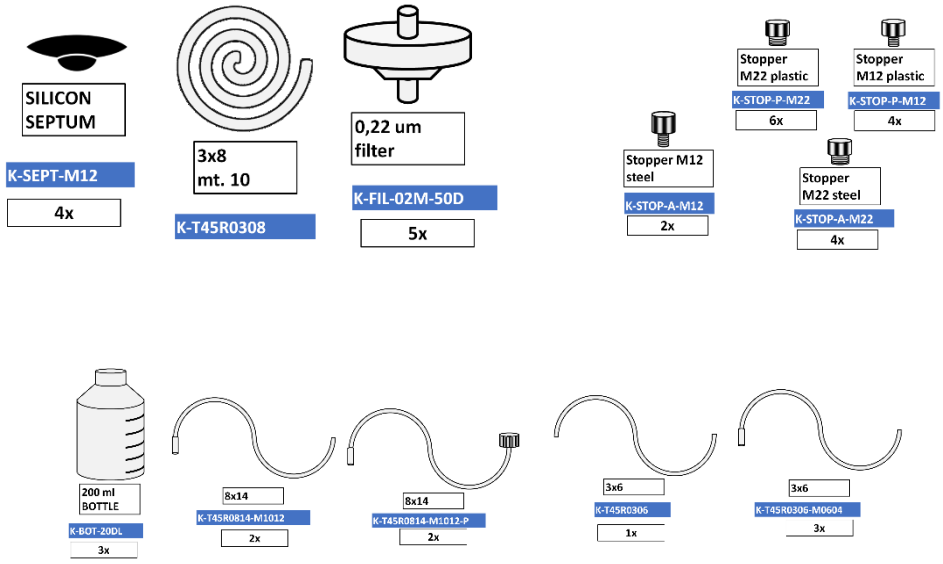
INST		Installation and training at the customer, 3 working days, 1 technician, travel costs excluded
RES		Technical assistance resolution time, 2 working days



6.5. Starter kit

PART NO	QTY	SPECIFICATIONSFOR**VESSEL A + B**
K-BOT-20DL	3+3	200 ml graduated bottle in pyrex glass for reagents, equipped on the sampling adapter cap in 316L stainless steel
K-T45R0308	1+1	3x8 silicone hose (10 meters) (for peristaltic pumps)
K-T45R0814-M1012	2+2	Silicone hose 8x14 + 1x metal pin 10x12 mm (1.5 m) (for mains water - Drain)
K-T45R0814-M1012-P	2+2	Silicone hose 8x14 + 1x metal pin 10x12 mm, 1x red plastic screw connection (1.5 m) (IN-OUT vessel)
K-T45R0306-M0604	3+3	Silicone hose 3x6 + 1x metal plug 6X4 mm (1.5 m) (for condenser, sparger, overlay)
K-T45R0306	1+1	3x6 silicone hose (1.5 m) (condenser outlet)
K-FIL-02M-50D	5+5	Teflon filters 0.2 µm, diameter 50 mm, reusable
K-SEPT-M12	4+4	Seperum in sterilizable silicone

K-STOP-A-M12	2+2	Stainless steel 316 L polished cap, for M12 door
K-STOP-A-M22	4+4	Cap in 316 L polished stainless steel, for M22 door
K-STOP-P-M12	4+4	Plastic cap, for M12 door
K-STOP-P-M22	6+6	Plastic cap, for M22 door



6.6. Supply Conditions

Packaging: Included

Shipping: not included

Delivery Date: 120 days from receipt of order

Installation and accessory services: not included,. It does not include furnishings, plant engineering and / or building work and anything else required to connect the utilities to the equipment in question, such as Electricity, Air, Gas, H2O, Drains, Steam.

3 days training included for our company.

Warranty: 1 year from shipping

Spare parts availability - availability: We guarantee spare parts that ensure functionality for at least 5 years.

Total of Supply: