

NLF – At a glance

Bioengineering NLF essentials

General

- Stainless steel vessel, double wall and bottom
- Large list of options
- Design similar to production fermentors allows easy scale up of process later on
- Several degrees of automation available: from manual valve setting to semi or full valve automation
- Fully automated cleaning in place available with central connection points for CIP supply and return
- Design completely according to cGMP available
- Full documentation for QA and validation available

Bioengineering NLF for microbial culture

- In situ sterilization, full
- High performance agitator
- High oxygen transfer rate by one or more gas lines

Bioengineering NLF for cell culture

- In situ sterilization, empty or full
- Low shear force agitation system adapted for cell culture
- Efficient and careful aeration system with several gas lines

Configurations and specifications

Module Options

- Minimal equipment
- Option
- Not possible

Vessel and agitation		Microbial	Cell	Restrictions
Double wall stainless steel pressure vessel	In situ sterilizable double wall vessel in stainless steel 316L. With longitudinal viewing glass, side ports DN25 in the upper (headspace) and lower vessel wall. Dished bottom with ports for agitator and drain valve	•	•	
	Stainless steel lid 316L with sterile pressure gauge, lamp for vessel illumination	•	•	
Vessel insulation	Stainless steel insulation jacket, rigidly welded on to the vessel, filled with high temperature resistant mineral wool	◦	◦	
Surface of product wetted parts electropolished and 0.64 µm instead of 0.8 µm	Product wetted surfaces of vessel and peripheric components are electropolished and have a surface roughness of Ra 0.64 µm	◦	◦	
Baffles	4 baffles stainless steel 316L	•	•	
2 Rushton impellers	6-blade rushton impellers, 2 pieces, for radial mixing, height adjustable	•	-	Not together with rotor filter
3 Rushton impellers	6-blade rushton impellers, 3 pieces, for radial mixing, height adjustable	◦	-	Not together with rotor filter
Marine impeller	Marine impeller, for axial mixing, height adjustable	-	•	
Pitched blade impeller	Pitched blade impeller for axial mixing, height adjustable	-	◦	
Airlift/draught tube	Draught tube insert for axial turnover of liquid ether by airlift or by stirrer	◦	◦	
Vibrating stirrer plate type A (upwards)	Mixing plate with conical bores providing upwards flow by vertical vibration	◦	◦	Not together with other drives
Vibrating stirrer plate type B (downwards)	Mixing plate with conical bores providing downwards flow by vertical vibration	◦	◦	Not together with other drives
Bottom drive with mechanical seal, belt transmission. High rpm range (100–1500 rpm)	Bottom drive with double mechanical seal, belt transmission, socket and platform with wheels. Shaft speed range 100–1500 rpm	•	-	Not together with other drives

		Microbial	Cell	
Bottom drive with mechanical seal, belt transmission. Low rpm range (20–300 rpm)	Bottom drive with double mechanical seal, belt transmission, socket and platform with wheels. Shaft speed range 20–300 rpm	◦	•	Not together with other drives
Top drive, direct, with mechanical seal	Top drive on vessel lid with mechanical seal, vessel on socket and platform with wheels	◦	◦	Not together with other drives
Glycerol overlay	Glycerol overlay of mechanical seal	•	•	
Steam condensate overlay	Steam condensate overlay of mechanical seal	◦	–	
Bottom drive magnetically coupled, belt transmission. High rpm range	Bottom drive magnetically coupled, belt transmission, socket and platform with wheels. Shaft speed range 100–1200 rpm for 16 L and 19 L vessels, 100–900 rpm for 30 L vessels	◦	–	Not together with other drives
Bottom drive magnetically coupled, belt transmission. Low rpm range	Bottom drive magnetically coupled, belt transmission, socket and platform with wheels. Shaft speed range 20–300 rpm	◦	◦	Not together with other drives
Top drive, direct, for vibrating stirrer plate	Top drive on vessel lid, to generate vertical vibration of a mixing plate	◦	◦	Not together with other drives

Temperature circuit and sterilization		Microbial	Cell	Restrictions
Full sterilization	Sterilization of full vessel, in situ	•	–	
Empty sterilization	Sterilization of empty vessel with steam, in situ	–	•	Not together with simple valve automation, not with ceramic filters. Requires closed bottom drain valve
Full and empty sterilization	Both full or empty sterilization of vessel, in situ	◦	◦	Not together with simple valve automation, not with ceramic filters. Requires closed bottom drain valve
Electrical heating, heat exchanger for cooling water	Temperature circuit for sterilization and cultivation, connected to double wall. Electrical heater for heating, heat exchanger for cooling	•	◦	3-phase power supply required
Heat exchangers for steam and cooling water	Temperature circuit for sterilization and cultivation, connected to double wall. Steam heat exchanger for heating, additional heat exchanger for cooling	◦	•	
BioVap	Small bench top steam generator for steam sterilization of peripheric components	◦	◦	
Steam generator for heating	Steam generator for full or empty sterilization of fermentor vessel	◦	◦	

Aeration		Microbial	Cell	Restrictions
Ring sparger	Aeration tube with ringsparger for efficient and careful submerged aeration	•	◦	
Sinter sparger	Aeration tube with sintermetal microsparger for efficient submers aeration also with low gas flow	–	•	
Aeration tube	Submerged aeration by aeration tube. The tube tip aims directly for the impeller providing efficient dispersion of bubbles.	◦	◦	
Bubble free aeration, needle connection	Stainless steel basket with coiled silicone hose for bubble free gas transfer	–	◦	Separate inlet gas filter required
Bubble free aeration, SteriCap	Stainless steel basket with coiled silicone hose for bubble free gas transfer. Gas connected by SteriCap	–	◦	Separate inlet gas filter required

		Microbial	Cell	
Inlet ceramic filter with needle connection. Exhaust ceramic filter, sterilizable with vessel	Ceramic gas inlet filter in stainless steel housing, autoclavable, to be connected to fermentor system after in situ sterilization. Ceramic exhaust gas filter in stainless steel housing, in situ sterilized together with fermentor system	○	○	Not together with empty sterilization, not with any valve automation, not with advanced CIP functionality
Inlet autosterile filter, ceramic. Exhaust ceramic filter, sterilizable with vessel	Ceramic gas inlet filter in stainless steel housing, type autosterile filter, in situ sterilized together with fermentor system. Ceramic exhaust gas filter in stainless steel housing, in situ sterilized together with fermentor system	●	○	Not together with empty sterilization, not with advanced CIP functionality. Not together with any surface aeration
Membrane filter inlet, sterilizable with vessel. Membrane filter exhaust, sterilizable with vessel	Membrane gas inlet filter in stainless steel housing, in situ sterilized together with fermentor system. Membrane exhaust gas filter in stainless steel housing, in situ sterilized together with fermentor system. Both filter housings with connections for integrity testing	○	●	
2 inlet membrane filters for submerge and surface aeration, sterilizable with vessel. Membrane filter exhaust, sterilizable with vessel	2 membrane gas inlet filters in stainless steel housings, 1 for submersed and 1 for head space aeration, in situ sterilized together with fermentor system. Membrane exhaust gas filter in stainless steel housing, in situ sterilized together with fermentor system. Both filter housings with connections for integrity testing	○	○	Not together with simple valve automation
1 gas line, air, manual	1 gas supply line for air, manual flow adjustment. Aeration rate max. 2 vvm	●	-	
1 gas line, air, FIC	1 gas supply line for air with thermal mass flow meter/controller. Aeration rate max. 2 vvm	○	-	
4 gas lines, air, O ₂ , N ₂ manual, and CO ₂ tacted	4 gas supply lines for air, O ₂ , CO ₂ and N ₂ , manual flow adjustment. CO ₂ line with solenoid valve controllable by pH controller. Aeration rate max. 0.1 vvm for air, O ₂ and N ₂ , 0.05 vvm for CO ₂	○	●	
4 gas lines, air, O ₂ , N ₂ and CO ₂ , FIC	4 gas supply lines for air, O ₂ , CO ₂ and N ₂ , flow adjustment by thermal mass flow meter/controller. Aeration rate max. 0.1 vvm for air, O ₂ and N ₂ , 0.05 vvm for CO ₂	○	○	
2 gas lines, air and O ₂ , manual, submers	2 gas lines for submerge supply of air and O ₂ , manual flow adjustment. Aeration rate max. 2 vvm for air and 1 vvm for O ₂	○	○	
2 gas lines, air and O ₂ , FIC, submers	2 gas lines for submerge supply of air and O ₂ , flow adjustment by thermal mass flow meter/controller. Aeration rate max. 2 vvm for air and 1 vvm for O ₂	○	○	
2 gas lines, air and N ₂ , manual	2 gas lines for submerge supply of air and N ₂ , manual flow adjustment. Aeration rate max. 2 vvm for air and 1 vvm for N ₂	○	-	
2 gas lines, air and N ₂ , FIC	2 gas lines for submerge supply of air and N ₂ , flow adjustment by thermal mass flow meter/controller. Aeration rate max. 2 vvm for air and 1 vvm for N ₂	○	-	
2 gas lines, air and O ₂ , manual, surface	2 gas lines for submerge supply of air and O ₂ , manual flow adjustment. Aeration rate max. 0.1 vvm	-	○	
2 gas lines, air and O ₂ , FIC, surface	2 gas lines for submerge supply of air and O ₂ , flow adjustment by thermal mass flow meter/controller. Aeration rate max. 0.1 vvm	-	○	
Condenser, steel	Exhaust gas condenser stainless steel, incl. closing and adjustment valve for cooling water	○	○	
Exhaust gas heater, steam	Stainless steel double wall tube in the exhaust gas line, steam heated	○	○	

Addition/Transfer		Microbial	Cell	Restrictions
Bottom drain valve	Steam sterilizable, dead leg free harvest valve	•	•	Not together with empty sterilization and not with advanced CIP functionality
Bottom drain valve with sterile case	Steam sterilizable, dead leg free harvest valve with removable sterile case	◦	◦	Not together with empty sterilization and not with advanced CIP functionality
Bottom drain valve, closed with bottle (sampling)	Steam sterilizable, dead leg free harvest valve with sampling bottle for fully closed sampling or harvest	◦	◦	Necessary for empty sterilization and advanced CIP functionality
Dip tube, fix, for needle	Stainless steel dip tube for needle connection	◦	◦	
Dip tube, fix, for SteriCap	Stainless steel dip tube for SteriCap connection	◦	◦	
Dip tube, fix, sterile cross	Stainless steel dip tube with sterile cross connection	◦	◦	Not together with simple valve automation
Rotor filter on stirrer shaft	Rotor filter sieve on top driven stirrer shaft for cell free harvest through hollow shaft	–	◦	Not together with simple valve automation, not together with bottom drives and not with all magnetic drives
Rotor filter with separate drive shaft (10, 20, 30, 40 or 75 µm)	Rotor filter sieve on separate top driven shaft for cell free harvest through hollow shaft. Allows different speed of filter sieve and bottom driven stirrer	–	◦	Not together with simple valve automation, not together with long-shaft bottom drives
Rotor filter package bypass (10, 20, 30, 40 or 75 µm)	Rotor filter sieve for cell free harvest through hollow shaft, built in an external stainless steel housing as part of a bypass-loop connected to the bioreactor vessel. Allows sterile disconnection and re-connection of the rotor filter system during cultivation	–	◦	Not together with simple valve automation
Fixed bed	Stainless steel insert basket for carriers to immobilise cells. With central tube for radial media supply, minimising substrate and oxygen gradients. Incl. bypass loop and connections for addition of fresh media and for harvest	◦	◦	Not together with simple valve automation, not together with long shaft bottom drives, not with any top drive or rotor filter
W1 pump	Peristaltic pump with fixed speed. For dosing or harvesting	•	•	Number of pieces to be specified
W2 pump	Peristaltic pump with variable speed. For precise dosing. Incl. PID controller for speed control, profile mode, display of consumption	◦	•	Number of pieces to be specified
Hypodermic needle, incl. bottle with lid, filter, hose	Autoclavable hypodermic stainless steel needle, glass bottle with cap and sterile filter. For sterile connection to fermentor after sterilization	•	•	Number of pieces to be specified
Double hypodermic needle	Autoclavable double hypodermic stainless steel needle for sterile connection of 2 hoses to 1 lid port of fermentor after sterilization	◦	◦	Number of pieces to be specified
Injection valve, incl. bottle with lid, filter, hose	Stainless steel manual injection valve assembly, in situ steam sterilizable. For repeated sterile connection of dosing line to fermentor. Incl. glass bottle with cap and sterile filter	◦	◦	Number of pieces to be specified
SteriCap, incl. bottle with lid, filter, hose	Stainless steel SteriCap valve incl. glass bottle with cap and sterile filter. The pre-autoclaved unit will be connected to fermentor prior to vessel sterilization.	◦	◦	Number of pieces to be specified
Sterile cross, incl. bottle with lid, filter, hose	Stainless steel sterile cross valve assembly, in situ steam sterilizable. For repeated sterile connection of dosing line to fermentor. Incl. glass bottle with cap and sterile filter	◦	◦	Number of pieces to be specified. Not together with simple valve automation
Sampling tube with needle, hose, clamp	Stainless steel sampling tube mounted on lid. With needle, silicone hose and hose clamp for sterile sampling	◦	◦	
Sampling valve basic	Steam sterilizable, dead leg free sampling valve	◦	◦	
Sampling valve with sterile case	Steam sterilizable, dead leg free sampling valve with removable sterile case	◦	◦	
Closed sampling valve, bellow type, with bottle	Steam sterilizable, dead leg free sampling valve, incl. sampling bottle 250 mL. For fully closed sampling	◦	◦	

		Microbial	Cell	
CIP, only spray ball, removable	Stainless steel CIP spray ball to be introduced temporarily in fermentor vessel. For easy cleaning of vessel interior	○	○	For vessel cleaning only
CIP with central connection points CIPS-CIPR	CIP functionality with spray ball for vessel cleaning, with flow through cleaning of exhaust gas and gas supply line, dosing and harvest valve assemblies. With 1 central CIP supply and -return connection	○	○	Only together with full valve automation, SCADA and closed bottom drain valve, not together with ceramic filters or fixed bed

Control system		Microbial	Cell	Restrictions
Agitation speed control by FI	AC motor controlled by frequency inverter	●	●	
Agitation speed control with speed sensor and FI	AC motor controlled by frequency inverter, incl. precise detection of stirrer shaft speed	○	○	
Temperature	Temperature measurement and control. Sterilizable temperature probe (Pt100) in vessel side port	●	●	
Temperature measurement, peripheral	Temperature measurement by sterilizable temperature probe (Pt100) in piping	○	○	Number of pieces to be specified. Usually at inlet gas and exhaust gas filters, at bottom drain valve and at addition lines with sterile crosses or injection valves
pH	Measurement and control of pH value. Sterilizable pH probe	●	●	
pO ₂	Measurement and control of dissolved oxygen (pO ₂). Sterilizable amperometric pO ₂ probe. Cascade control possible	○	○	
1st antifoam/level probe	Conductive probe in vessel lid port, controlling foam or liquid level. Height adjustable	○	○	
2nd antifoam/level probe	Additional conductive probe in vessel lid port, controlling foam or liquid level. Height adjustable	○	○	In addition to a 1st probe, usually for level control in addition to foam control
Platform scale under vessel for level control	Platform scale with load cells under fermentor system for weight measurement and control of liquid in vessel	○	○	
Scale for dosage	Scale for weight measurement and control of liquid in bottles. E. g. for consumption measurement of correction media	○	○	Number of pieces to be specified
Pressure indication/control	Measurement and control of vessel pressure. Incl. sterilizable pressure transmitter and control valve	○	○	
Foamkill	Mechanical foam separator to be installed in the fermentor lid, stainless steel 316L. AC motor, fixed speed, with manual on/off switch or foam probe controlled. The foam separator prevents foam from entering the exhaust gas line.	○	-	Not together with any top drive. 16 L and 19 L will have a smaller type of autosterile filter if together with foamkill
Foamkill with cyclone	Mechanical foam separator with cyclone for further increased separation efficiency. To be installed in the fermentor lid, stainless steel 316L. AC motor, fixed speed, with manual on/off switch or foam probe controlled. The foam separator prevents foam from entering the exhaust gas line.	○	-	Not together with any top drive. 16 L and 19 L will have a smaller type of autosterile filter if together with foamkill
High foam alarm control	Conductive probe in exhaust gas line, detecting foam and preventing it to enter the exhaust filter by switching of gas supply and stirrer of fermentor	○	○	Only in addition to an antifoam/level control
Exhalizer (O ₂ and CO ₂ exhaust concentration)	Compact gas analyzer to measure O ₂ and CO ₂ concentration in the exhaust gas	○	○	Only together with universal analog in control or with I/O box and SCADA
Turbidity indication/control	Measurement and control of optical density. Incl. sterilizable optical turbidity probe	○	○	
Redox indication/control	Measurement and control of redox value. Incl. sterilizable Redox (ORP) probe	○	○	

		Microbial	Cell	
Universal analog in signal indication/control	Indication and control of any external 4–20 mA signal	○	○	
I/O box (only together with SCADA)	Interface unit for connection of external measurement signals and control elements. Package with analog and digital in- and outputs. All inputs and outputs can be easily configured with BioSCADA, allowing to add external equipment at any time. The I/O-module requires a SCADA system.	○	○	Not together with local display IFM control system, not possible without SCADA
IFM single controllers, all with local displays for operation	Integration of all measurements in control loops is done by single controllers, each one in an individual slide-in unit incl. display	●	●	Not together with SCADA (only as an upgrade later on), but possible with BioLogg. Not possible with full valve automation, not possible with advanced CIP functionality
IFM single controllers to be combined with SCADA, partially with local displays	Integration of measurements in control loops is done by single controllers, except mass flow of gases, foam or level control (if selected). These signals are connected directly with the mandatory SCADA system for display and control. Each of the single controllers is placed in an individual slide-in unit incl. display.	○	○	Only together with SCADA
IFM controllers to be combined with SCADA, all without local displays	Integration of measurements in control loops is done by controllers without local displays, all connected by bus with the mandatory SCADA system for central display of data, recording and setpoint control	○	○	Only together with SACDA
Simply automated sterilization by IFM temperature controller	Full sterilization of vessel together with inlet and exhaust gas filters is automated by a standard sequence actuating pneumatic valves. This functionality is also accessible without a SCADA system.	○	○	Not together with empty sterilization, not with filters connected by needle, not with separately sterilized filters, surface aeration, rotor filters, fixed bed, sterile crosses or advanced CIP functionality
Full valve automation by SCADA	All functions available with the fermentor configuration selected are fully automated by pneumatically actuated valves controlled by SCADA based automation sequences. The BioSCADA system is mandatory.	○	○	Only together with SCADA
BioSCADA Lab software package. Installed and ready to use, if together with PC	<p>BioSCADA Lab process control system for one or several fermentor units together</p> <p>BioSCADA Lab is giving access to all functions of the subordinated hardware controllers as input of setpoints, PID parameters. It enables visualisation and recording of all measurement data.</p> <p>Trends, process data visualization, 2D and 3D bar charts</p> <p>Display of consumption rates of actuators (valves, pumps)</p> <p>Graphically supported programming of cascades and profiles</p> <p>Alarm and warning management</p> <p>Batch processing: start and stop of batch jobs</p> <p>Input and display of offline data</p> <p>Real-time data recording, MS Excel compliant, scalable data recording interval and sensitivity. Export, external online calculation in Excel, re-import and display of data possible</p> <p>Programming of recipes</p>	○	○	Not together with IFM controllers exclusively with local displays
BioLogg software package	<p>Software for visualisation and recording of all measurement data of one or several fermentor units together on a PC or laptop</p> <p>Trends, process data visualization, 2D and 3D bar charts</p>	○	○	Not together with IFM controllers without local displays
PC with monitor and keyboard	PC to run BioSCADA Lab or BioLogg software. Software selected is ready to use.	○	○	Only together with SCADA or BioLogg software

		Microbial	Cell	
1 x 230 V, 50–60 Hz (Europe, Asia)	Fermentor system designed for 1-phase power supply 1 x 230 V, 50–60 Hz. Not possible with option electrical heating	○	●	Not together with electrical heating
1 x 110 V, 50–60 Hz (some regions of America)	Fermentor system designed for 1-phase power supply 1 x 110 V, 50–60 Hz. Not possible with option electrical heating	○	○	Not together with electrical heating
3 x 400 V, 50–60 Hz (Europe, Asia)	Fermentor system designed for 3-phase power supply 3 x 400 V, 50–60 Hz. Necessary together with option electrical heating	●	○	Only together with electrical heating
3 x 208 V, 50–60 Hz (some regions of America)	Fermentor system designed for 3-phase power supply 3 x 208 V, 50–60 Hz. Necessary together with option electrical heating	○	○	Only together with electrical heating

QA and maintenance		Microbial	Cell	Restrictions
QA documentation package 1	Documentation package providing basic documentation for quality assurance	○	○	
QA documentation package 2	Documentation package providing detailed and comprehensive documentation for quality assurance	○	○	
FAT documentation and performance by BioE, with or without customer	Factory acceptance test-protocols from Bioengineering AG, incl. performance of tests by Bioengineering AG also together with customer	○	○	Only together with QA documentation package 2
SAT documentation by BioE, performance by customer only	Site acceptance test protocols from Bioengineering, performance of tests by customer	○	○	Only together with QA documentation package 3
SAT documentation and performance by BioE	Site acceptance test protocols from Bioengineering, incl. performance of tests by Bioengineering AG together with customer	○	○	Only together with QA documentation package 4

Technical data

General	16 L	19 L	30 L
Ambient temperature Relative humidity (non-condensating)	5 ... 40 °C 85%		
Operating temperature (cultivation)	Max. 80 °C		
Operating temperature (sterilization)	Max. 130 °C		
Operating pressure	Max. 0 ... 2 barg 0 ... 29 psig		
Net weight [kg lbs], depending on equipment	273 600	275 605	286 630
Gross weight [kg lbs], depending on equipment, wrapped	Approx. 440 968	Approx. 450 990	Approx. 460 1012
Utility requirements, connections & consumption			
Power supply with electrical heating	CEE 7/7, 3 x 400 V, 50/60 Hz, 16A fused NEMA 5 ... 12, 3 x 208 V, 50/60 Hz, 15 A fused		
Power supply with steam heat exchanger	CEE 7/7, 1 x 230 V, 50/60 Hz, 10A fused NEMA 5 ... 12, 1 x 110 V, 50/60 Hz, 16 A fused		
Max. power consumption with electrical heating (3 x 208V) (3 x 400 V)	6000 6000 [W]		
Max. power consumption with steam heat exchanger (110 V) (230 V)	2000 2000 [W]		
Cooling water supply: connection max. flow pressure	Tri-Clamp 50.5 mm (2 inch) 9 L/min 2 ... 10 bara (28 ... 140 psia)		
Cooling water return: connection max. flow pressure	Tri-Clamp 50.5 mm (2 inch) 9 L/min 1 ... 9 bara (28 ... 140 psia)		
Average cooling water consumption during cultivation mode (with condenser)	Approx. 1 L/min		
Steam supply, NLF with steam heat exchanger: connection max. flow pressure	Tri-Clamp 50.5 mm (2 inch) Max. 6 kg/h 4 barg (58 psig)	Tri-Clamp 50.5 mm (2 inch) Max. 6 kg/h 4 barg (58 psig)	Tri-Clamp 50.5 mm (2 inch) Max. 7 kg/h 4 barg (58 psig)
Steam supply, NLF with electrical heating: connection max. flow pressure	Tri-Clamp 50.5 mm (2 inch) Max. 0.8 kg/h 1.5 ... 4 barg (22 ... 58 psig)		
Gas supply (dry, particle- and oil-free): connection pressure	Tri-Clamp 25 mm (1 inch) 2.5 ... 10 barg (36.3 ... 145.0 psig)		
Exhaust gas	Tri-Clamp 25 mm (1 inch)		
Gas consumption	Depending on process parameter, see above (Aeration)		
Instrument air supply (if any): connection pressure peak flow	Pneumatic push-in fitting 8/6 mm 6 ... 10 barg (85 ... 145.0 psig) Approx. 150 Ln/min		
Vessel			
Recommended working volume [L], max.	11	13	20
Recommended working volume [L], min.	2.6	2.6	4.9
Inner diameter [mm in]	200 7.87	200 7.87	250 9.85
Inner height [mm in]	510 20.08	610 24.02	684 26.93
Di/Hi	1:2.5	1:3.0	1:2.7
Process connections			
Upper side ports 25 mm	7	7	7
Lower side ports 25 mm	7	7	7
Lid process connection ports 19 mm	12	12	13
Lid process connection ports 42 mm	1	1	1
Motor type			
Motor type	AC		
Motor power [W]	1100		

Stirrer diameter, standard [mm]

Rushton impeller (2 x)	80	80	90
Marine impeller (1 x)	80	80	100
Pitched blade impeller (1 x)	115	115	115

Material vessel	316L
Material, lid and other product wetted steel parts	316L
Material, lateral viewing glas	Borosilicate
Surface, lid and other product wetted steel parts	Ra 0.8 µm (optional: 0.64 µm)
Material, polymer in contact with medium	EPDM, PTFE, silicone

Temperature control	16 L	19 L	30 L
Heating power (for NLF with electrical heater only) [W]	6000	6000	6000
Heating-up time 35–121 °C empty [min]	Approx. 6	Approx. 8	Approx. 8
Heating-up time 35–121 °C full [min]	Approx. 18	Approx. 20	Approx. 18
Cooling-down time 121–35 °C empty [min]	Approx. 8	Approx. 10	Approx. 8
Cooling-down time 121–35 °C full [min]	Approx. 15	Approx. 20	Approx. 20
Temperature control range with chilled cooling water [°C]	4 ... 150	4 ... 150	4 ... 150

Requirements for cooling water supply and return

Cooling water supply: connection pressure	Tri-Clamp 25 mm (1 inch) 2 ... 10 bara (28 ... 140 psig)
Cooling water return: connection pressure	Tri-Clamp 50.5 mm (2 inch) 1 ... 9 bara (28 ... 140 psig)
Type of external cooling water sytem	Closed loop or open to atmosphere

Aeration	16 L	19 L	30 L
Max. air flow rate, microbial cell [vvm]		2 0.1	
Max. oxygen flow rate, microbial cell [vvm]		1 0.1	
Max. nitrogen flow rate, microbial cell [vvm]		1 0.1	
Max. carbon dioxide flow rate, cell [vvm]		0.05	

In- and outlet filter	Ceramic, or membrane 0.2 µm pore size
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Addition/Transfer

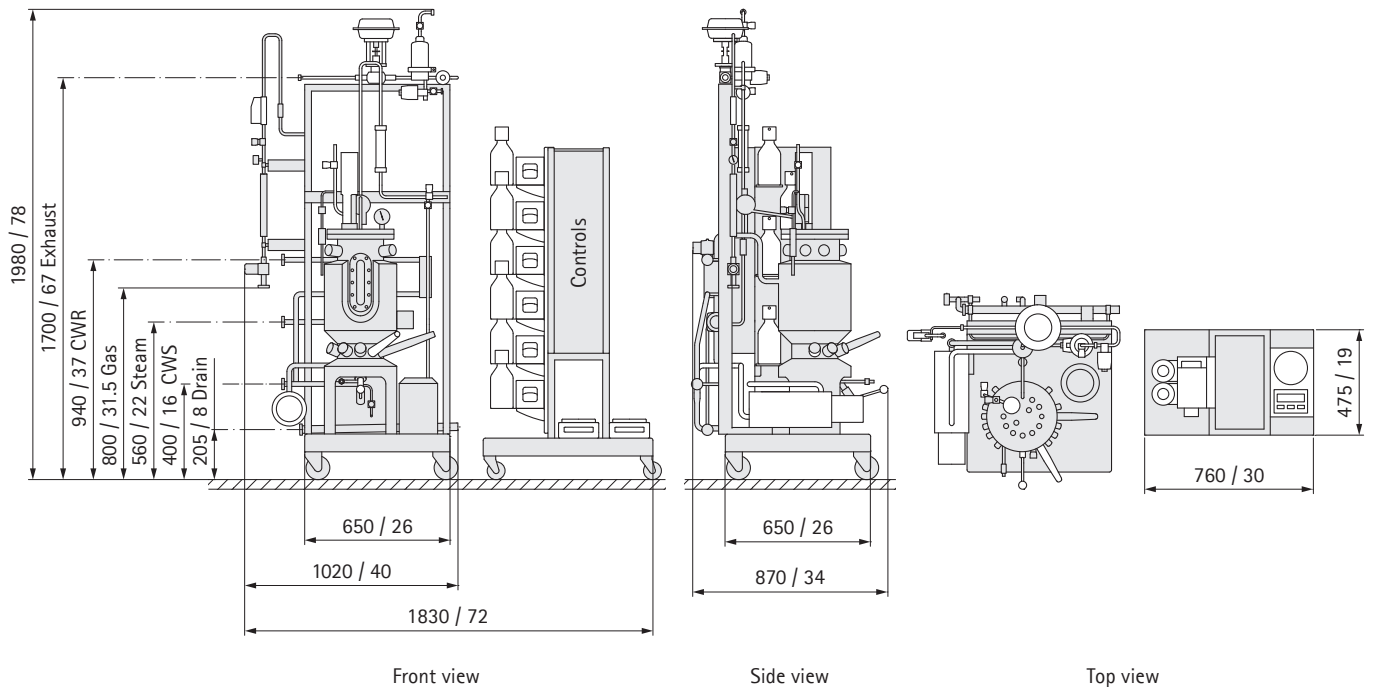
Peristaltic pumps	Peripex W1 (fix speed) and Peripex W2 (variable speed)
Fix speed: rpm flow rate hose Di 3.2 mm 7 mm	100 95 mL/min 350 mL/min
Variable speed: rpm flow rate hose Di 3.2 mm 7 mm	1 ... 100 (0)0.95 ... 95 mL/min (0)3.5 ... 350 mL/min

Storage bottles, volume [mL]	1000	1000	1000
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Control unit

Communication to PC/laptop	RS485/USB
Temperature, Pt100	0 ... 150 °C ± 0.1 °C
Stirrer speed controlled, microbial cell	100 ... 1500 rpm ± 2 rpm 20 ... 300 rpm ± 2 rpm
pH, gel electrode	2 ... 12 ± 0.05 pH
pO ₂ , amperometric	6 ppb to saturation ± [1% + 6 ppb]
Foam and Level, conductive on/off	On/off, reaction time
Pressure barg psig	0 ... 2 0 ... 28
Material control tower	Stainless steel AISI 304
Minimum requirements for external PC/laptop	
Processor RAM HD optical drive ports OS	PIII, 1.2 GHz 512 MB 20 GB CD USB 2.0 Windows 2000, XP, 7
Screen	Min. 15" color

Dimensions



Dimensions are given in mm and inch and represent maximal values. Depending on fermentor configuration dimensions can be also smaller. White parts of drawing represent variable areas according to selected options.