

0845-12e RALF (Type 2017)

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# RALF - At a glance

#### Bioengineering RALF essentials

#### General

- · Autoclavable small benchtop glass reactor
- · Versatile reactor system for numerous different applications
- Single as well as multiple systems
- · Wide variety of options available
- Installation, training and IQ/OQ service package available

### Bioengineering RALF Basic for microbial cultivation

- · Single wall vessel with heating pad and cooling finger
- 1 gas channel, pulsed
- 2 fixed speed peristaltic pumps
- · With agitation control, temperature control, pH control and DO control
- Incl. BioSCADA RALF for complete process automation and data acquisition, analysis and export

### Bioengineering RALF Basic for cell culture

- Single wall vessel with heating pad and cooling finger
- 3 gas channels, pulsed
- 2 fixed speed peristaltic pumps
- · With agitation control, temperature control, pH control and DO control
- Incl. BioSCADA RALF for complete process automation and data acquisition, analysis and export

### Bioengineering RALF Advanced for microbial cultivation

- · Single wall vessel with perfused baffles and heating circuit
- 1 gas channel, pulsed
- 2 fixed and 1 variable speed peristaltic pumps
- With agitation control, temperature control, pH control, DO control and foam/level control
- Incl. BioSCADA RALF for complete process automation and data acquisition, analysis and export

### Bioengineering RALF Advanced for cell culture

- · Double wall vessel with heating circuit
- 3 gas channels, pulsed
- 2 fixed and 1 variable speed peristaltic pumps
- With agitation control, temperature control, pH control, DO control and foam/level control
- Incl. BioSCADA RALF for complete process automation and data acquisition, analysis and export



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### Overview

	RALF for micr	obial cultivation	RALF for	cell culture			
Standard models	RALF Basic	RALF Advanced	RALF Basic	RALF Advanced			
Total volume [L]		2   3.7	5   6.7				
Geometry D <sub>i</sub> :H <sub>i</sub> 2 L   3.7 L   5 L   6.7 L [mm]		96:300   125:300	150:300   150:400				
Dimensions of sterilizable unit for autoclaving $w \times h$ [mm]		307–440	× 507–607				
Footprint w × d [mm]		512 × 0	679–723				
Ports (vessel lid) 2 L   3.7 L   5 L   6.7 L	15   18   19   19  DN04 connection tubes: 6   5   5   5  DN12 lid ports: 8   12   12   12  DN19 lid ports: 0   0   1   1  Agitator port: 1   1   1   1						
Vessel	Single v	vall vessel	Single wall vessel	Double wall vessel			
Controllers	Agitator speed, temperature, pH, DO	Agitator speed, temperature, pH, DO, foam	Agitator speed, temperature, pH, DO	Agitator speed, temperature, pH, DO, level			
Drive		Top drive mechanic	al seal, 20–1500 rpm				
Agitators	2 flat-blade	disc agitator	1 propell	er agitator			
Temperature control	Electrical heating jacket and cooling finger with solenoid valve for temperature control	Heating and cooling by per- fused stainless steel baffles connected to heating circuit with circulation pump, electri- cal heater and cooling water valve for temperature control	Electrical heating jacket and cooling finger with solenoid valve for temperature control	Heating circuit connected to double wall; with circulation pump, electrical heater and cooling water valve			
Aeration	Ring sparger, 1 pulsed	gas line (Air), condenser	Sinter sparger, 3 pulsed gas	lines (Air, O <sub>2</sub> , CO <sub>2</sub> ), condenser			
Pumps	2 fixed speed	2 fixed speed, 1 variable	2 fixed speed	2 fixed speed, 1 variable			
Dosing	2x bottle, immersion tube, cap and filter	3x bottle, immersion tube, cap and filter	2x bottle, immersion tube, cap and filter	3x bottle, immersion tube, cap and filter			
Sampling/harvest		Sampling syster	n with glass tube				
Configurable ports for external devices	1x RS232, 4x analog input	with controllers, freely configu 1 USB co	urable; 1x digital input; 4x anal onnection	og output; 1x digital output;			
Software/control	vare/control BioSCADA RALF						



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# Configurations and specifications

### Module options

- Minimal equipment
- Option
- Not possible

Vessel		RALF I	Basic	sic RALF Adva		
		2 L 3.7 L 5	L 6.7 L	2 L 3.7 L 5	L 5 L 6.7 L	
		Microbial	Cell	Microbial	Cell	
Single wall vessel	Autoclavable benchtop fermentor Single wall glass vessel with rounded bottom Stainless steel lid with DN12 lid ports and DN04 connection tubes Blind plugs DN12 Diaphragm port for inoculation	•	•	•	۰	
Double wall vessel	Autoclavable benchtop fermentor Double wall glass vessel with rounded bottom Stainless steel lid with DN12 lid ports and DN04 connection tubes Blind plugs DN12 Diaphragm port for inoculation	-	-	۰	•	
Baffles	4 baffles, stainless steel	•	٥	•	۰	
Direct drive with mechanical seal	Direct drive from top by brushless DC motor, with mechanical seal, 20–1500 rpm controlled speed	•	•	•	•	
Drive, magnetically coupled	Direct drive from top by brushless DC motor, magnetically coupled, 20–1500 rpm controlled speed	۰	٥	٥	۰	
Flat-blade disc agitator	2 flat-blade disc agitator, 6-blade, for radial mixing	•	٥	•	۰	
Propeller agitator	1 propeller agitator, for axial mixing	۰	•	۰	•	
Segment pitched blade agitator	1 segment pitched blade agitator, for axial mixing	۰	٥	۰	۰	

Temperature control			Basic	RALF Advanced			
		2 L 3.7 L 5	L 6.7 L	2 L 3.7 L 5	2 L 3.7 L 5 L 6.7 L		
		Microbial	Cell	Microbial	Cell		
Heating pad and cooling finger	Electrical heating jacket and cooling finger with solenoid valve for temperature control	•	•	-	-		
Heating circuit connected to perfused baffles	Heating and cooling by perfused stainless steel baffles connected to heating circuit with circulation pump, electrical heater and cooling water valve for temperature control	-	-	•	٥		
Heating circuit connected to double wall of vessel	Heating circuit with circulation pump, electrical heater and cooling water valve for temperature control	-	-	۰	•		

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Aeration		RALF	Basic	RALF Advance		
		2 L 3.7 L 5	L 6.7 L	2 L 3.7 L 5	L 6.7 L	
		Microbial	Cell	Microbial	Cell	
Aeration tube	Submerged aeration with sterile filter and check valve. The inlet gas is led to agitator blades for efficient dispersion of bubbles	٥	-	٥	-	
Ring sparger	Submerged aeration with sterile filter and check valve. Aeration tube with ring sparger for efficient and careful submerged aeration	•	٥	•	٥	
Sinter sparger	Submerged aeration with sterile filter and check valve. Aeration tube with sinter-metal microsparger for efficient submerged aeration also with low gas flow	<b>⋄</b>	•	۰	•	
MO gas supply: 1 gas supply line (gas 1)	1-channel gas supply unit. Pressure control valve, pressure gauge, rotameter for gas flow indication up to 2 vvm Air, needle valve and pulsed solenoid valve	•	۰	•	۰	
CE gas supply: 3 gas supply lines (gases 1, 2 and 3)	3-channel gas supply and mixing unit. Each channel with pressure control valve, pressure gauge, rotameter for gas flow indication up to 0.1 / 0.1 / 0.05 vvm Air / $0_2$ / $C0_2$ , needle valve and pulsed solenoid valve	۰	•	۰	•	
Freely configurable gas lines	1-6 gas lines can be individually configured for submerged or surface aeration and the following gases: Air, $O_2$ , $CO_2$ , $N_2$	٥	٥	٥	٥	
MFC instead of pulsed valve for gas lines	Each gas line can be individually equipped with a thermal mass flow controller to measure and control the air flow	۰	٥	٥	۰	
Non-standard flow rates for gas lines	For each gas line the flow rate can be freely configured. Selection is possible between the following maximum flow rates: 2, 5, 8, 16, 40, 100, 250 or 500 L/h	۰	۰	۰	۰	
Exhaust gas line, condenser	Ventilation via water cooled glass condenser and subsequent sterile filter. Adjustable water flow	•	•	•	•	

Addition/Transfer	lition/Transfer	RALF	Basic	RALF Advanced		
		2 L 3.7 L 5	5 L 6.7 L	2 L 3.7 L 5	L 6.7 L	
		Microbial	Cell	Microbial	Cell	
Immersion tube, height adjustable	Height adjustable immersion tube, stainless steel. DN06, for separate harvest	۰	٥	۰	٥	
Rotor filter package 20 μm	Open rotor filter with stainless steel sieve 20 $\mu$ m pore size, mounted on agitator shaft. Incl. foam/level probe with controller, immersion tube and GL45 bottle cap with sterile filter for cell free harvest	-	٥	-	٥	
Primary pump module 2x fixed speed	Pump module with 2 fixed speed peristaltic pumps, 130 rpm. Incl. 2 sets of hoses (D <sub>i</sub> 3.5 mm) and 2 hose clamps	•	•	۰	۰	
Primary pump module 2x fixed, 1x variable speed	Pump module with 2 fixed speed peristaltic pumps, 130 rpm and 1 variable speed reversible peristaltic pump, 0–130 rpm. Incl. 3 sets of hoses (Di 3.5 mm) and 3 hose clamps	٥	٥	•	•	
Secondary pump module 2x fixed speed	Additional pump module with 2 fixed speed peristaltic pumps, 130 rpm. 2 sets of hoses, 2 hose clamps	٥	۰	۰	۰	
Secondary pump module 2x fixed, 1x variable speed	Additional pump module with 2 fixed speed peristaltic pumps, 130 rpm and 1 variable speed reversible peristaltic pump, 0–130 rpm. Incl. 3 sets of hoses (D <sub>i</sub> 3.5 mm) and 3 hose clamps	٥	٥	٥	۰	
Additional pump	Additional stand-alone peristaltic pump with local and remote display and speed control, 1–100 rpm	۰	۰	۰	۰	
	Additional stand-alone peristaltic pump with local and remote display and speed control, 0.1–10 rpm	۰	۰	۰	۰	
	Additional stand-alone peristaltic pump with local and remote display and speed control, 0.03–3 rpm	۰	۰	۰	۰	

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		2 L 3.7 L 5 L 6.7 L		2 L 3.7 L 5	L 6.7 L
		Microbial	Cell	Microbial	Cell
Bottles incl. caps and filters, with mounting bracket	2 autoclavable glass bottles 250 mL, incl. GL45 screw cap with sterile filter and immersion tube, incl. mounting brackets to attach bottle to vessel	•	•	۰	۰
Bottles incl. caps and filters, with mounting bracket	3 autoclavable glass bottles 250 mL, each with GL45 screw cap and sterile filter, incl. mounting brackets to attach bottles to vessel	٥	۰	•	•
Sampling system	Sampling system with glass tube for hygienic sampling, incl. mounting bracket, incl. sampling tube stainless steel $D_i$ 3.5 mm. Autoclavable	•	•	•	•

Control unit		RALF I	Basic	RALF Ad	vanced
		2 L 3.7 L 5 Microbial	Cell	2 L 3.7 L 5 Microbial	L 6.7 L Cell
Agitation speed control	Measurement and control of agitation speed within 20–1500 rpm	•	•	•	•
Temperature control	Autoclavable temperature probe (Pt100) and temperature controller activating actuators of heating/cooling system	•	•	•	•
pH control	Autoclavable pH probe and pH controller activating actuators (base and acid pump, $\rm CO_2$ valves)	•	•	•	•
DO control	Autoclavable D0 ( $pO_2$ ) probe with D0 controller activating actuators and secondary controllers by configurable cascade control	•	•	•	•
Foam/level control	Conductive foam/level probe with controller activating dosing or harvest pumps	٥	۰	•	•
I/O package with additional interfaces and controllers	Package consisting of:  - 1x RS232 input, to universal PID controller  - 4x 4-20 mA input, to universal PID controller  - 1x USB connection  - 4x 4-20 mA outputs, freely configurable  - 1x digital output 24 V  All inputs and outputs are available on sockets at the control cabinet housing	•	•		•
BioSCADA RALF software package; installed, ready to use, if bought together with PC	1 system for up to 6 RALF. Runs with Windows system software. Without PC. Customized main operation screen for system visualization and control. Input of setpoints, process values, PID parameters for controllers. Trends and historic process data visualization with scalable timeframe. Display of calculated consumption rates of actuators. Programming of cascades and profiles. Calibration of inputs and outputs. Alarm management, event list. Batch processing. Programming of recipes; step sequence program	•	•	٠	٠
PC (laptop)	With installed BioSCADA RALF	٥	۰	٥	٥
Power supply: Europe, Asia	1x 230 V, 50/60 Hz	•	•	•	•
Power supply: parts of America	1x 110 V, 50/60 Hz	٥	٥	۰	۰



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Services	RALF I	Basic	RALF Advanced			
		2 L 3.7 L 5	L 6.7 L	2 L 3.7 L 5 L 6.7 L		
		Microbial	Cell	Microbial	Cell	
Installation, commissioning and training	Installation and commissioning of RALF units, including training of operation and maintenance procedures	۰	٥	٥	٥	
Installation, commissioning, IQ/ OQ and training	Installation and commissioning of RALF units, performance of IQ and OQ. Training of operation and maintenance procedures. Including handover of IQ/OQ-protocol, certificates and other documents (P&ID, bill of material, ELD, list of PID-control parameters, 2.1 material certificates, calibration certificate of mass flow meters, description of hygienic welding approach)	۰	o	۰	۰	

### Additional options

- Possible
- Not possible
- a Only possible without heated perfused baffles (possible with double wall vessel)
- b Only possible without heated perfused baffles (possible with double wall vessel) and no other additional probe
- c-1 additional probe possible, not in combination with another additional probe.
  - 2 additional probes possible in combination with double wall vessel without perfused baffles

Vessel		RALF	Basi	С	RA				
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Flat-blade disc agitator, 6-blade, $\rm D_{\rm o}$ 40 mm, for mounting on a 12 mm shaft. Stainless steel 316L	٥	۰	٥	۰	۰	۰	۰	٥	30209
Flat-blade disc agitator, 6-blade, $\rm D_{\rm o}$ 48 mm, for mounting on a 12 mm shaft. Stainless steel 316L	٥	۰	٥	۰	۰	۰	٥	٥	30288
Flat-blade disc agitator, 6-blade, $\rm D_{\rm o}$ 60 mm, for mounting on a 12 mm shaft. Stainless steel 316L	-	٥	۰	۰	_	۰	٥	۰	30347
Propeller agitator, 4-blade, $D_0$ 48 mm, for mounting on a 12 mm shaft. Stainless steel 316L	۰	٥	۰	۰	۰	۰	0	۰	30712
Propeller agitator, 4-blade, $D_0$ 66 mm, for mounting on a 12 mm shaft. Stainless steel 316L	-	٥	۰	۰	_	۰	٥	۰	30713
Segment pitched blade agitator, 2-blade, $D_{\rm o}$ 48 mm, for mounting on a 12 mm shaft. Stainless steel 316L	۰	٥	۰	۰	۰	۰	٥	٥	112862
Segment pitched blade agitator, 2-blade, $\mathrm{D}_{\mathrm{0}}$ 66 mm, for mounting on a 12 mm shaft. Stainless steel 316L	-	۰	۰	۰	-	۰	٥	٥	112861

Temperature control	RALF Basic				RA	LF Ac			
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Chiller 50 L for connection of up to 6 RALF. Incl. circulation pump. 230 V, 50/60 Hz	۰	٥	٥	0	۰	۰	٥	0	52503.1
Chiller 50 L for connection of up to 6 RALF. Incl. circulation pump. 110 V, 50/60 Hz	۰	۰	٥	۰	۰	۰	٥	٥	52503.2
Connection set for connecting of water supply and drain of up to 4 RALF to 1 connection									
point	0	0	0	٥	0	0	0	0	57512

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Aeration		RALF Basic				RALF Advanced			
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Aeration tube, 275 mm, for submerged aeration. The inlet gas is led to agitator blades	٥	٥	٥	-	٥	٥	٥	-	34475.2
Aeration tube, 375 mm, for submerged aeration. The inlet gas is led to agitator blades	-	-	-	۰	-	-	-	٥	34475.1
Aeration tube with ring sparger, 300 mm, small ring diameter, for submerged aeration	٥	-	-	-	٥	-	-	-	34477
Aeration tube with ring sparger, 300 mm, large ring diameter, for submerged aeration	-	٥	٥	-	-	٥	٥	-	34489.1
Aeration tube with ring sparger, 400 mm, large ring diameter, for submerged aeration	-	-	-	۰	-	-	-	٥	34489.2
Aeration tube with sinter-metal microsparger for 2 L vessel	٥	-	-	-	٥	-	-	-	34474
Aeration tube with sinter-metal microsparger for 3.7 L vessel	-	٥	-	-	-	۰	-	-	34488
Aeration tube with sinter-metal microsparger for 5 L vessel	-	-	٥	-	-	-	٥	-	34494.1
Aeration tube with sinter-metal microsparger for 6.7 L vessel	-	-	-	۰	-	-	-	٥	34494.2
Surface aeration kit: Additional sterile filter, check valve, hoses and lid connection piece for independent surface aeration with a secondary gas module	b	0	۰	۰	b	٥	٥	۰	58195

Addition/Transfer	RALF Basic			C	RΔ	ΙFΔ	RALF Advanced			
Addition in manager	2 L		. 5 L		2 L	3.7 L			Order no.	
Autoclavable glass bottle 250 mL, incl. GL45 screw cap with sterile filter and dip tube	° °	J.7 L	. JL	0.7 L	- Z L	3.7 L	, ,	0.7 L	53267	
Stainless steel mounting bracket to fix GL45 bottle with cap to the fermentor vessel unit	0			0			0	0	46995	
Screw cap for GL45 bottles, incl. gas filter. Autoclavable	0	0	0			•	0		57503	
Connection tube DN04, length 10 mm, for DN12 lid port. Stainless steel									46960.1	
Connection piece with DN12 diaphragm interface to connect hoses by needle-diaphragm									+0300.1	
technique. Incl. cup. Stainless steel	٥	۰	٥	٥	۰	۰	٥	۰	41045	
Cup DN12 to support diaphragms for needle connection to lid ports DN12. Stainless steel	٥	0	٥	٥	٥	۰	٥	٥	40658	
Immersion tube D <sub>i</sub> 3.5 mm, length 245 mm, with connection piece for DN12 lid port. Stainless steel	۰	٥	٥	_	۰	۰	۰	_	46960.2	
Immersion tube D; 3.5 mm, length 345 mm, with connection piece for DN12 lid port.										
Stainless steel	-	-	-	۰	-	-	-	۰	46960.3	
Immersion tube $D_{\rm i}$ 6 mm height adjustable, for DN12 ports. Stainless steel, 355 mm	٥	٥	٥	۰	٥	٥	٥	٥	33602.2	
Immersion tube D <sub>i</sub> 6 mm height adjustable, for DN12 ports. Stainless steel, 455 mm	٥	۰	۰	۰	۰	۰	٥	۰	33602.1	
Immersion tube for rotor filter, Di 6 mm, height adjustable, for DN12 ports. Stainless steel	۰	۰	٥	۰	۰	۰	٥	۰	34869	
Hypodermic needle D <sub>i</sub> 2 mm with cup for DN12 ports. Stainless steel	٥	۰	٥	۰	۰	۰	٥	٥	41037	
Hypodermic needle D <sub>i</sub> 3.5 mm with cup for DN12 ports. Stainless steel	٥	0	٥	۰	٥	٥	0	0	41038	
Hypodermic needle D <sub>i</sub> 4 mm with cup for DN12 ports. Stainless steel	٥	٥	٥	۰	٥	٥	٥	٥	41039	
Rotor filter to be mounted on agitator shaft, height adjustable.										
Sieve length 127 mm, pore size 10 μm. Stainless steel	٥	٥	٥	-	٥	٥	٥	-	33711.1	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 222 mm, pore size 10 μm. Stainless steel	-	-	-	۰	-	-	-	0	33576.1	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 127 mm, pore size 20 µm. Stainless steel	۰	٥	٥	_	۰	٥	۰	_	33711.3	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 222 mm, pore size 20 µm. Stainless steel	_	-	-	۰	-	-	-	۰	33576.3	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 127 mm, pore size 30 µm. Stainless steel	۰	٥	٥	-	۰	٥	۰	-	33711.4	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 222 mm, pore size 30 µm. Stainless steel	_	_	_	۰	_	_	_	0	33576.4	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 127 mm, pore size 40 µm. Stainless steel	۰	٥	٥	_	۰	٥	۰	_	33711.5	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 222 mm, pore size 40 µm. Stainless steel	_	_	_	0	_	_	_	۰	33576.5	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 127 mm, pore size 75 µm. Stainless steel	0	٥	٥	_	۰	٥	۰	_	33711.6	
Rotor filter to be mounted on agitator shaft, height adjustable. Sieve length 222 mm, pore size 75 µm. Stainless steel	-	-	-	۰	_	-	-	۰	33576.6	
Sampling system with glass tube for hygienic sampling, incl. mounting bracket.  Autoclavable	۰	٥	۰	۰	٥	٥	٥	0	34979	



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Control unit	ı	RALF	Basi	С	RA				
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Gas analyzer type Exhalyzer to measure concentration of $\rm O_2$ (0–25%) and $\rm CO_2$ (0–10%) incl. connection kit. EU power supply plug	۰	٥	۰	٥	۰	۰	٥	٥	57520.1
Gas analyzer type Exhalyzer to measure concentration of $\rm O_2$ (0–25%) and $\rm CO_2$ (0–10%) incl. connection kit. US power supply plug	۰	۰	۰	٥	٥	۰	٥	٥	57520.2
Redox probe 256 mm with transmitter, incl. 4–20 mA cable. To be connected to existing universal controller	а	С	С	-	а	С	С	-	57508
Redox probe 311 mm with transmitter, incl. 4–20 mA cable. To be connected to existing universal controller	-	-	-	С	-	-	-	С	57509
Balance, range 10–35,000 g. Can be connected to the RS232 input of existing universal controller	0	۰	٥	۰	۰	۰	۰	٥	56104
Balance, range 1–16,100 g. Can be connected to the RS232 input of existing universal controller	٥	٥	٥	۰	۰	۰	۰	٥	56102
Balance, range 1–6,500 g. Can be connected to the RS232 input of existing universal controller	٥	٥	٥	٥	۰	۰	٥	٥	55870
Optical density probe 228 mm with controller box incl. 4–20 mA cable.  To be connected to existing universal controller or analog input	а	С	С	-	а	С	С	-	63613
Optical density probe 283 mm with controller box incl. 4–20 mA cable.  To be connected to existing universal controller or analog input	-	-	-	С	-	-	-	С	63614

### Upgrade kits

Possible

Side modules for gases and pumps that can be selected to upgrade or modify existing fermentor systems

Aeration	RALF Basic	RALF Advanced
	2 L 3.7 L 5 L 6.7 L	2 L 3.7 L 5 L 6.7 L Order code

Gas module to be added as a secondary gas module or to be exchanged with any existing primary or secondary gas module.

Containing 1 or 3 gas lines which can be individually configured with order code:

Gas type/flow control type/maximal flow/line number (e.g.: Nitrogen / Mass flow meter / 40 Ln/h / second gas line = N/M/40/2).

Each gas supply channel is equipped with pressure control valve, pressure gauge, rotameter for gas flow indication, needle valve for manual adjustment of maximal gas flow and gas flow control element.

First gas line									
Air	٥	۰	٥	۰	۰	٥	٥	٥	A/-/-/1
$\overline{N_2}$	۰	۰	٥	0	0	٥	٥	٥	N/-/-/1
CO <sub>2</sub>	۰	٥	٥	٥	۰	٥	٥	0	C/-/-/1
$\overline{O_2}$	۰	۰	٥	۰	٥	٥	۰	۰	0/-/-/1
Control by pulsed valve	٥	۰	٥	۰	٥	٥	٥	۰	-/P/-/1
Measurement and control by thermal mass flow controller	٥	٥	٥	٥	۰	٥	٥	0	-/M/-/1
Flow rate up to 2 Ln/h	۰	0	٥	٥	۰	٥	٥	0	-/-/2/1
Flow rate up to 5 Ln/h	۰	٥	٥	٥	۰	٥	٥	0	-/-/5/1
Flow rate up to 8 Ln/h	۰	۰	٥	0	0	0	0	٥	-/-/8/1
Flow rate up to 16 Ln/h	٥	٥	٥	٥	۰	٥	٥	0	-/-/16/1
Flow rate up to 40 Ln/h	٥	٥	٥	٥	۰	٥	٥	0	-/-/40/1
Flow rate up to 100 Ln/h	۰	٥	٥	٥	۰	٥	٥	0	-/-/100/1
Flow rate up to 250 Ln/h	۰	0	٥	٥	۰	٥	٥	0	-/-/250/1
Flow rate up to 500 Ln/h	•	0	٥	٥	0	٥	٥	0	-/-/500/1

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Second gas line									
Air	0	٥	۰	۰	۰	۰	۰	0	A/-/-/2
$N_2$	•	٥	٥	۰	۰	0	0	٥	N/-/-/2
CO <sub>2</sub>	۰	٥	٥	٥	۰	0	0	0	C/-/-/2
02	•	٥	٥	۰	۰	0	0	٥	0/-/-/2
Control by pulsed valve	٥	٥	۰	۰	0	۰	۰	0	-/P/-/2
Measurement and control by thermal mass flow controller	۰	٥	۰	۰	٥	۰	۰	0	-/M/-/2
Flow rate up to 2 Ln/h	٥	٥	٥	۰	۰	٥	٥	0	-/-/2/2
Flow rate up to 5 Ln/h	0	٥	٥	۰	۰	٥	۰	0	-/-/5/2
Flow rate up to 8 Ln/h	۰	٥	۰	۰	۰	۰	۰	0	-/-/8/2
Flow rate up to 16 Ln/h	٥	٥	٥	۰	۰	٥	۰	0	-/-/16/2
Flow rate up to 40 Ln/h	٥	٥	۰	۰	۰	۰	۰	٥	-/-/40/2
Flow rate up to 100 Ln/h	۰	٥	۰	۰	۰	٥	۰	٥	-/-/100/2
Flow rate up to 250 Ln/h	٥	٥	٥	۰	۰	٥	۰	0	-/-/250/2
Flow rate up to 500 Ln/h	٥	٥	٥	۰	۰	٥	۰	0	-/-/500/2
Third gas line									11.1.10
Air	۰	٥	۰	•	•	0	۰	٥	A/-/-/3
<u>N<sub>2</sub></u>	0	٥	۰	•	0	٥	۰	٥	N/-/-/3
CO <sub>2</sub>	•	٥	۰	•	•	٥	٥	0	C/-/-/3
	0	٥	٥	•	0	0	0	0	0/-/-/3
Control by pulsed valve	0	٥	۰	•	•	0	۰	0	-/P/-/3
Measurement and control by thermal mass flow controller	•	0	۰	•	٥	0	۰	0	-/M/-/3
Flow rate up to 2 Ln/h	•	٥	۰	•	0	0	0	0	-/-/2/3
Flow rate up to 5 Ln/h	•	0	0	•	•	٥	0	٥	-/-/5/3
Flow rate up to 8 Ln/h				•	•	0		0	-/-/8/3
Flow rate up to 16 Ln/h	•	٥	۰	•	0	٥	۰	٥	-/-/16/3
Flow rate up to 40 Ln/h	•	۰	۰	•	•	۰	۰	0	-/-/40/3
Flow rate up to 100 Ln/h	•	0	•	•	•	0	•	0	-/-/100/3
Flow rate up to 250 Ln/h	0	0	۰	•	•	0	۰	0	-/-/250/3
Flow rate up to 500 Ln/h	0	٥	۰	•	•	۰	۰	٥	-/-/500/3

Addition/Transfer		RALF Basic						RALF Advanced					
	2	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.			
Pump module with 2 fixed speed peristaltic pumps, 130 rpm.													
Incl. 2 sets of hoses (D <sub>i</sub> 3.5 mm) and 2 hose clamps		٥	۰	٥	۰	٥	٥	٥	٥	14775			
Pump module with 2 fixed speed peristaltic pumps, 130 rpm													
and 1 variable speed reversible peristaltic pump, 0–130 rpm.													
Incl. 3 sets of hoses (D <sub>i</sub> 3.5 mm) and 3 hose clamps		0	٥	٥	٥	۰	٥	٥	٥	14770			

0845-12e RALF (Type 2017)

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### Vessel kits

- Minimal selection
- Possible optional selection
- Not possible

Spare vessel kit configurator.

An additional autoclavable vessel unit – either single or double wall – for an existing RALF fermentor system can be chosen and configured with the table below. For the RALF Basic only a single wall vessel can be chosen.

Single wall vessel kit	RALF Basic					RALF Advanced				
	2 L	3.7 L	. 5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.	
Spare vessel kit single wall, autoclavable, minimal package. Incl. glass vessel with lid and blind plugs, bearing and shaft, sampling/harvest tube, temperature probe (Pt100), condenser with hoses and connection pieces, inlet and outlet gas filter with hoses, check valve, cooling device (RALF Basic: finger, RALF Advanced: perfused baffles)										
Single wall vessel kit	•	-	-	-	-	-	-	-	58207	
Single wall vessel kit	-	•	-	-	-	-	-	-	58208	
Single wall vessel kit	_	-	•	-	_	-	-	-	62090	
Single wall vessel kit	-	-	-	•	-	-	-	-	62091	
Single wall vessel kit	-	-	-	-	•	-	-	-	58211	
Single wall vessel kit	-	-	-	-	-	•	-	-	58212	
Single wall vessel kit	-	-	-	-	-	-	•	-	62092	
Single wall vessel kit	-	-	-	-	_	-	-	•	62093	

Double wall vessel kit	RALF Basic					RALF Advanced					
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.		
Spare vessel kit double wall, autoclavable, minimal package. Incl. glass vessel with lid and blind plugs, bearing and shaft, sampling/harvest tube, temperature probe (Pt100), condenser with hoses and connection pieces, inlet and outlet gas filter with hoses, check valve											
Double wall vessel kit	-	-	-	-	•	-	-	-	58215		
Double wall vessel kit	-	-	-	-	-	•	-	-	58216		
Double wall vessel kit	-	-	-	-	-	-	•	-	62094		
Double wall vessel kit	-	-	-	-	-	-	-	•	62095		

Additional options to vessel kits		RALF	Basi	С	RA				
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Baffles, 4 pcs. (RALF Advanced: only with double wall vessel)	۰	-	-	-	۰	-	-	-	33923
Baffles, 4 pcs. (RALF Advanced: only with double wall vessel)	-	۰	-	-	-	۰	-	-	33905
Baffles, 4 pcs. (RALF Advanced: only with double wall vessel)	-	-	۰	-	-	-	٥	-	23249
Baffles, 4 pcs. (RALF Advanced: only with double wall vessel)	-	-	-	۰	-	-	-	۰	22771
Flat-blade disc agitator, 6-blade, for radial mixing ( $D_0$ 40 mm) (2 pcs. recommended for microbial culture)	۰	_	_	-	٥	_	_	_	30209
Flat-blade disc agitator, 6-blade, for radial mixing ( $D_0$ 48 mm) (2 pcs. recommended for microbial culture)	-	۰	-	-	-	٥	_	-	30288
Flat-blade disc agitator, 6-blade, for radial mixing ( $D_0$ 60 mm) (2 pcs. recommended for microbial culture)	_	-	۰	٥	_	-	۰	۰	30347
Propeller agitator, for axial mixing (D <sub>o</sub> 48 mm)	٥	-	-	-	0	-	-	-	30712
Propeller agitator, for axial mixing (D <sub>o</sub> 66 mm)	-	٥	٥	۰	-	٥	٥	۰	30713
Segment pitched blade agitator, for axial mixing (D <sub>o</sub> 48 mm)	۰	-	-	-	۰	-	-	-	112862
Segment pitched blade agitator, for axial mixing (D <sub>o</sub> 66 mm)	-	٥	٥	0	-	٥	0	٥	112861



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Aeration	RALF Basic					RALF Advanced					
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.		
Aeration tube	٥	٥	٥	-	۰	٥	0	-	34475.2		
Aeration tube	-	-	-	۰	-	-	-	۰	34475.1		
Ring sparger	۰	-	-	-	۰	-	-	-	34477		
Ring sparger	-	٥	٥	-	-	٥	٥	-	34489.1		
Ring sparger	-	-	-	۰	-	-	-	٥	34489.2		
Sinter-metal microsparger	٥	-	-	-	۰	-	-	-	34474		
Sinter-metal microsparger	-	٥	-	-	-	٥	-	-	34488		
Sinter-metal microsparger	-	-	٥	-	-	-	٥	-	34494.1		
Sinter-metal microsparger	-	-	-	۰	-	-	-	٥	34494.2		

Addition/Transfer		RALF	Basi	С	RA				
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Immersion tube, height adjustable	٥	٥	0	۰	۰	٥	٥	۰	58219
Open rotor filter with stainless steel sieve 20 µm pore size, sieve length 127 mm, mounted on agitator shaft.  Immersion tube for cell free harvest.  (For 2 L vessels not possible in combination with heating circuit via perfused baffles.  Availability of lid ports has to be checked)	۰	۰	٥	_	۰	٥	٥	_	58220
Open rotor filter with stainless steel sieve 20 $\mu$ m pore size, sieve length 222 mm, mounted on agitator shaft. Immersion tube for cell free harvest.	_	_	_	۰	_	_	_	0	58221
Autoclavable glass bottle 250 mL, incl. GL45 screw cap with sterile filter and immersion tube, incl. mounting bracket to attach bottle to vessel. Incl. hoses	۰	۰	۰	۰	٥	٥	۰	٥	58222
Sampling system with glass tube for hygienic sampling, incl. mounting bracket.  Autoclavable	٥	۰	۰	۰	۰	۰	٥	0	34979

Control unit		RALF	Basi	С	RA				
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Autoclavable pH probe, short	٥	۰	٥	-	۰	۰	٥	-	64474
Autoclavable pH probe, long	_	-	-	۰	_	-	-	٥	64475
Autoclavable DO (pO <sub>2</sub> ) probe, nominal length 200 mm (without transmitter)	٥	0	٥	-	٥	٥	٥	-	64476
Autoclavable DO (pO <sub>2</sub> ) probe, nominal length 300 mm (without transmitter)	-	-	-	0	-	-	-	٥	64477
Head transmitter for pH and DO probes	٥	0	٥	0	٥	٥	٥	0	64086
Conductive foam/level probe, length 254 mm. (RALF Basic: only functional if existing control system already includes transmitter and controller). (Can be used to control foam or level, not both together. Also necessary for level control together with rotor filter)	۰	۰	٥	_	۰	٥	0		30275.2
Conductive foam/level probe, length 354 mm.  (RALF Basic: only functional if existing control system already includes transmitter and controller).  (Can be used to control foam or level, not both together. Also necessary for level control together with rotor filter)				0					30275.3



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# Spare parts

- Available
- Not available

Small set of spare parts	RALF Basic					RALF Advanced				
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.	
Contents: O-ring set, 2x blind plug DN12, 1x mechanical seal, set of silicone tubing										
Small set of spare parts	٥	-	-	-	٥	-	-	-	64478	
Small set of spare parts	-	۰	-	-	-	۰	-	-	64479	
Small set of spare parts	-	-	٥	۰	-	-	0	٥	64480	

Large set of spare parts	RALF Basic			RALF Advanced					
	2 L	3.7 L	5 L	6.7 L	2 L	3.7 L	5 L	6.7 L	Order no.
Contents: O-ring set, 2x blind plug DN12, 1x mechanical seal, set of silicone tubing, pH buffer 4, pH buffer 7, pH electrode, set of quick connections									
Large set of spare parts	۰	-	-	-	۰	-	-	-	64481
Large set of spare parts	-	٥	-	-	-	٥	-	-	64482
Large set of spare parts	-	-	٥	۰	-	-	٥	٥	64483

Set of filters, inlet and outlet gas	RALF Basic	RALF Advanced
	2 L 3.7 L 5 L 6.7 L	2 L 3.7 L 5 L 6.7 L Order no.
Contents: 4x autoclavable filter 0.2 µm pore size, D 50 mm		
Set of filters	· · · · ·	° ° ° 57525



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### Technical data

General	2 L	3.7 L	5 L	6.7 L	
Ambient temperature [°C]	5–40				
Relative humidity (non-condensing) [%]	85				
Operating temperature (cultivation) [°C]	Max. 80				
Operating temperature (sterilization in autoclave) [°C]	Max. 130				
Operating pressure (sterilization in autoclave) [barg   psig]		Max. 1	.5   21		
Net weight RALF Basic [kg   lbs]	73   161.0	74   163.1	75   165.4	76   167.6	
Gross weight RALF Basic wrapped [kg   lbs]	96   211.7	97   213.9	98 216.1	99   218.3	
Net weight RALF Advanced [kg   lbs]	82   180.8	83   183.0	84   185.2	85   187.4	
Gross weight RALF Advanced wrapped [kg   lbs]	105   231.5	106   233.7	107   235.9	108   238.1	
Weight autoclavable unit (empty) [kg   lbs]	17   37.5	19   41.9	21   46.3	23   50.7	
Utility requirements					
Power supply	CEE 7/7, 1x 230 V (110	0 V to 264 V), 50/60 Hz, 16 A	10 A fused   NEMA 5–1 fused	2, 1x 110 V, 50/60 Hz	
Max. power consumption (230V)   (110 V) [W]		1400   800 or 1400 (de	pending on heater type)		
Cooling water supply: connection   flow   pressure	Hose	nipples 6/1 mm   2–4 L/1	min   0.6–2 bar (8.7-29.0	O psig)	
Cooling water return: connection   flow   pressure		Hose nipples 6/1 mm   2	2–4 L/min   pressureless		
Peak water consumption during cooling at 2 bar, with exhaust cooler [L/h]		Max	. 250		
Average water consumption during cultivation mode [L/h]		Appro	ox. 60		
Gas (dry, particle- and oil-free): connection   flow   pressure	Pneumatic plug	connection 8/1 mm   2-	-500 L/h   2.5-10 barg (	36.3–145.0 psig)	
Gas consumption		Depending on pro	ocess parameters		
Vessel	2 L	3.7 L	5 L	6.7 L	
Recommended working volume [L], max.	1.3	2.5	3.3	4.5	
Recommended working volume [L], min.			1.2	1.0	
	0.65	0.9	1.2	1.2	
Lid process connections	0.65	0.9	1.2	1.2	
Lid process connections  DN04 connection tubes	0.65	0.9	5	5	
DN04 connection tubes	6	5	5	5	
DN04 connection tubes DN12 lid ports	6 8	5 12	5 12	5 12	
DN04 connection tubes DN12 lid ports DN19 lid ports	6 8 -	5 12 - 1	5 12 1	5 12 1	
DN04 connection tubes DN12 lid ports DN19 lid ports Agitator port	6 8 -	5 12 - 1	5 12 1 1	5 12 1	
DN04 connection tubes  DN12 lid ports  DN19 lid ports  Agitator port  Motor type	6 8 -	5 12 - 1 BL	5 12 1 1	5 12 1	
DN12 lid ports DN19 lid ports Agitator port  Motor type Motor torque [Nm]	6 8 -	5 12 - 1 BL	5 12 1 1 DC	5 12 1	
DN04 connection tubes  DN12 lid ports  DN19 lid ports  Agitator port  Motor type  Motor torque [Nm]  Motor power [W]	6 8 -	5 12 - 1 BL	5 12 1 1 DC	5 12 1	
DN04 connection tubes  DN12 lid ports  DN19 lid ports  Agitator port  Motor type  Motor torque [Nm]  Motor power [W]  Agitator diameter, standard [mm]	6 8 - 1	5 12 - 1 1 BL 1.	5 12 1 1 1 DC	5 12 1 1	
DN04 connection tubes  DN12 lid ports  DN19 lid ports  Agitator port  Motor type  Motor torque [Nm]  Motor power [W]  Agitator diameter, standard [mm]  Flat-blade disc agitator (2x)	6 8 - 1	5 12 - 1 1 BL 1. 23	5 12 1 1 1 DC .6 30	5 12 1 1	
DN04 connection tubes  DN12 lid ports  DN19 lid ports  Agitator port  Motor type  Motor torque [Nm]  Motor power [W]  Agitator diameter, standard [mm]  Flat-blade disc agitator (2x)  Propeller agitator (1x)  Segment pitched blade agitator (1x)	6 8 - 1	5 12 - 1 1 BL 1 23 48 66 66	5 12 1 1 1 DC .6 30	5 12 1 1 1	
DN04 connection tubes  DN12 lid ports  DN19 lid ports  Agitator port  Motor type  Motor torque [Nm]  Motor power [W]  Agitator diameter, standard [mm]  Flat-blade disc agitator (2x)  Propeller agitator (1x)	6 8 - 1	5 12 - 1 1 BL 1. 23 48 66 66	5 12 1 1 1 DC .6 30	5 12 1 1 1	
DN04 connection tubes  DN12 lid ports  DN19 lid ports  Agitator port  Motor type  Motor torque [Nm]  Motor power [W]  Agitator diameter, standard [mm]  Flat-blade disc agitator (2x)  Propeller agitator (1x)  Segment pitched blade agitator (1x)  Material vessel (in contact with medium)	6 8 - 1	5 12 - 1 1 BL 1. 23 48 66 66 66	5 12 1 1 1 DC .6 30	5 12 1 1 1	



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Temperature control	2 L	3.7 L	5 L	6.7 L	
Temperature control range with cooling water (chilled) [°C]		4-	80		
Double jacketed vessel: electrical heater [W]	800*				
Single wall vessel: heating blankets [W]	300*	400*	400*	500*	
Heating-up time	Approx. 1 min/°C				
Max. cooling-down time from 60 to 25 °C (at 15 °C cooling water temperature, double wall, 500 rpm agitator speed, no aeration) [min]	50	50	50	50	

<sup>\*</sup> only with 208V-230V power supply

### Requirements for external chiller

Cooling water supply: connection   pressure	Hose to nipples 6/1 mm   0.6-2 bar (8.7-29.0 psig)
Cooling water return: connection   pressure	Hose to nipples 6/1 mm   pressureless
Cooling capacity up to 3 RALF   up to 6 RALF	400 W, 30 L water tank capacity   600 W, 50 L water tank capacity

Aeration	2 L	3.7 L	5 L	6.7 L	
Rotameter Air for microbial cultivation [Ln/h] *	0-250	0-250	0-500	0-500	
Rotameter Air   O <sub>2</sub>   CO <sub>2</sub> for cell cultivation [Ln/h] *	0-8   8   5	0-16   16   8	0-16   16   8	0-40   40   8	
Rotameter N <sub>2</sub> [Ln/h] *	0-100	0-100	0-250	0-250	
Mass flow controller Air for microbial cultivation [Ln/h] *	0-250 [±1.0%, 1:50]		0-500 [±1.0%, 1:50]		
Mass flow controller Air $\mid$ 0 <sub>2</sub> $\mid$ C0 <sub>2</sub> for cell cultivation [Ln/h] *	0-8   8   5 [±1.0%, 1:50]	0-16   16   8 [±1.0%, 1:50]	0-16   16   8 [±1.0%, 1:50]	0-40   40   8 [±1.0%, 1:50]	
Mass flow controller N <sub>2</sub> [Ln/h] *	0-100 [±1.0%, 1:50]		1.0%, 1:50]		
Inlet filter and outlet filter	0.2 μm pore size				

 $<sup>^{\</sup>star}$  Other maximal flow rates available for each gas line: 2, 5 8, 16, 40, 100, 250 or 500 Ln/min

Addition/Transfer	2 L	3.7 L	5 L	6.7 L		
Peristaltic pumps						
Pump head	BioE/Oina					
Fixed rpm   flow rate hose D <sub>i</sub> 2.0 mm   flow rate hose D <sub>i</sub> 3.5 mm	130 rpm   35 mL/min   60 mL/min					
Variable rpm   flow rate hose D <sub>i</sub> 2.0 mm   flow rate hose D <sub>i</sub> 3.5 mm	0-130 rpm   0-35 mL/min   0-60 mL/min					
Storage bottles, volume [mL]		25	0			

Control unit	2 L	3.7 L	5 L	6.7 L		
Communication to PC						
Agitator speed [rpm]	20–1500					
Temperature [°C]	0-150 ± 0.1					
pH, gel electrode [pH]	2-12 ± 0.05					
DO, optical	4 ppb to saturation ± [1% + 4 ppb]					
Foam and level, conductive on / off	On/off, reaction time					
Free I/Os: RS232 in   USB in   4–20 mA in   4–20 mA out   24 V out	t 1   1   4   4   1					

## Minimum requirements for external PC

Processor   RAM   HD   ports   OS	PIII, 1.2 GHz   512 MB   20 GB   USB 2.0   Windows XP, 7, 8.1, 10
Screen	Min. 15"   color

Material tower

Stainless steel AISI 304 + steel 37, varnished



[inch]

3.78

4.92

5.90

5.91

[inch]

11.81

11.81

11.81

15.75

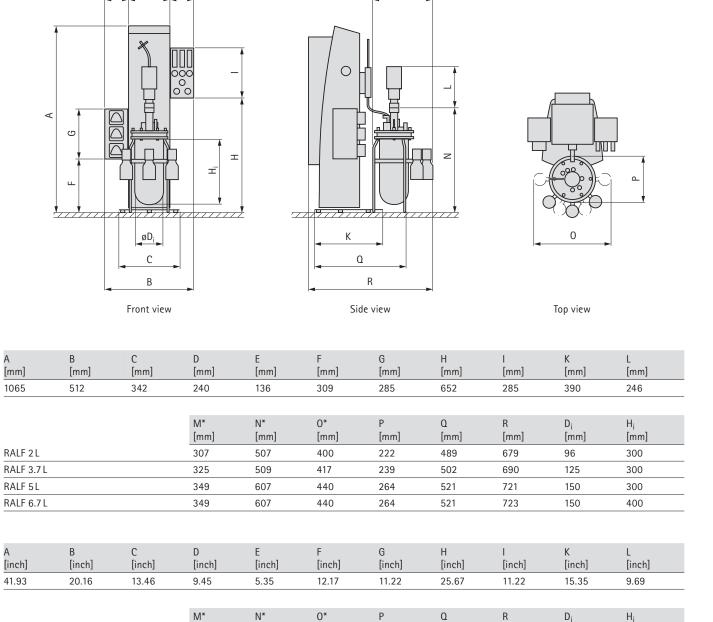
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### **Dimensions**

D



[inch]

19.96

20.04

23.89

23.89

[inch]

12.09

12.80

13.74

13.74

[inch]

15.75

16.42

17.32

17.32

[inch]

8.74

9.41

10.39

10.39

[inch]

19.25

19.76

20.51

20.51

[inch]

26.73

27.17

28.38

28.46

Μ

RALF 2L

RALF 5L

RALF 6.7 L

RALF 3.7 L

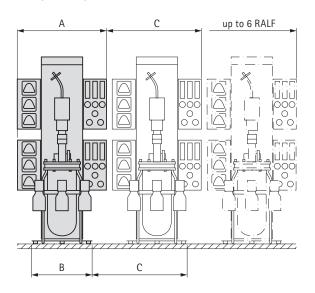
<sup>\*</sup> Maximum dimension for autoclaving

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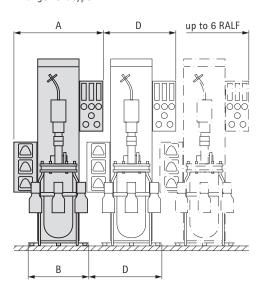
0845-12e RALF (Type 2017)

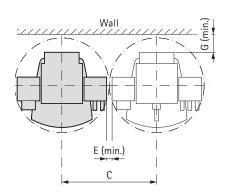
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#### Arrangement type 1



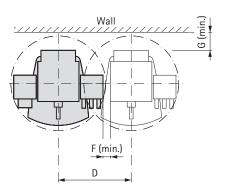
#### Arrangement type 2





Top view (Arrangement type 1)

21.653



Top view (installation type 2)

1.968

5.118

A [mm]	B [mm]	C [mm]	D [mm]	E* [mm]	F* [mm]	G* [mm]
512	342	550	426	35	50	130
Α	В	C	D	E*	F*	G*
[inch]	[inch]	[inch]	[inch]	[inch]	[inch]	[inch]

1.378

16.771

13.464

20.157

<sup>\*</sup> Minimum dimension for maintenance