

# MINIFOR Laboratory Fermentor - Bioreactor

## ONE INSTRUMENT for:

- High density microbial fermentation (Bacteria, Yeast, Fungi)
- Batch / Fed-batch / Perfusion / Continuous cultures
- Aerobic / Anaerobic fermentation
- Protein / Vaccine / Monoclonal antibody production
- Animal / Mammalian / Insect cell culture
- Controlled Stem cell culture
- Tissue Engineering
- Algal / Plant cell culture
- Universities / Life sciences & technical Schools



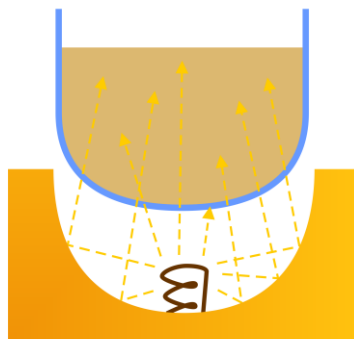
Based on long personal practical experience with fermentation and cell culture, we have designed an **easy to use** system with the capacity to **measure and control all the important parameters** of the biological culture.

The fermentor have to take up **minimum space** on the bench but with **good access to all parts**. Several fermentors should, when placed side by side, be suitable for the optimization of the parameters of growth of culture or optimization of bio-transformations etc.

Each fermentor should be able to **work independently or be connected to a PC for advanced regulation and extensive data treatment**.

**To keep the cost of the MINIFOR fermentor-bioreactor low, without compromising quality, several new ideas and innovations have been introduced:**

- Instead of a fermentor flask with a stainless steel cover, which is expensive, we use **whole glass vessels with threaded fittings**. They have been used for many years in cell culture and are proved to maintain perfect sterility. Thanks to this concept, the MINIFOR fermenter-bioreactor is **set up in shortest possible time**.
- The culture is heated by **heat radiation** produced in a parabolic radiator with a gold reflector placed under the fermentation vessel. The heat is absorbed gently in the culture similarly to the sun heating water. There is **no overheating** of the culture at any volume and expensive double-wall vessels with thermostatic baths are eliminated. At the same time tubing and cables disappear making the fermentor **less complex**.
- Instead of a traditional propeller agitator, which requires an expensive motor and magnetic coupling, we have introduced a new **up-and-down agitation**. A motor together with an inexpensive membrane **perfectly assure sterility** and produce an **efficient mixing** without formation of a vortex (**no baffles** needed). At the same time this type of **mixing is gentler on cells** and produces **less foam**. Novel **bio-mimicking “fish-tail” stirring discs** offer **maximum mixing efficiency without cutting edges**.
- As far as possible expensive pieces of equipment have been replaced by **new high performance plastics**.



## Dimension

Size of an A4 paper (22 x 40 cm)

## Parameter control

pH (automatic regulation with high quality, variable speed peristaltic pumps)

Temperature (precise control, no hot spots)

Agitation: 0 – 20 Hz (0 – 1200 rpm)

pO<sub>2</sub> (automatic control of DO with air flow rate)

Air flow rate (precise control with internal MASSFLOW 0 – 5 L/min)

Parameter “X”: Redox potential (ORP), Conductivity, pCO<sub>2</sub>, Chemostat, OD, etc.

Antifoam detector and controller (*no expensive probe needed*)

## Automatic gas-mix

Customizable Massflow controlled supply of gasses (N<sub>2</sub>, air, O<sub>2</sub>, CO<sub>2</sub>, others)

## Exit gas measurement

O<sub>2</sub> (OUR), CO<sub>2</sub> (CPR) and CH<sub>4</sub>

## Parallel cultivation

# MINIFOR Advanced kit (Standard)

## 2 PRECIFLOW pumps

For the automatic addition of acid or base to maintain the set pH. Can also be used as a stand-alone pump

## Storage bottles

Storage bottles for liquids with magnetic holders can get conveniently placed at the rear of the control unit

## Parameter control

Each base control unit displays the measurement and regulation, low and high alarms of all the necessary six parameters:

Temperature

Agitation (0 – 1200 rpm)

Airflow rate (0 – 5 L/min in 0.01 L/min steps)

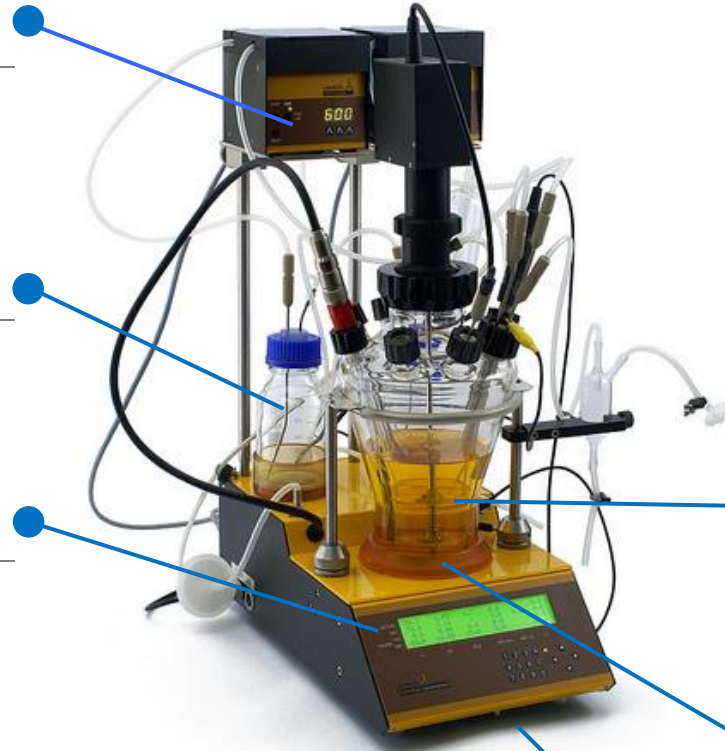
Internal MASSFLOW with proportional needle valve for precise control of the flow rate

pO<sub>2</sub>

pH

Parameter 'X'

(For example: optional weighing module for continuous cultures, optical density (OD), Redox potential - ORP, conductivity, pCO<sub>2</sub>)



## Accessories:

Quadruple sampling port with septum

For example: inoculation / seeding, feed, harvest, antifoam, addition of nutrients

Self-cleaning micro-sparger & "Fish-tail" stirrers

Glass out gas condenser

Cooling loop (not included in 0.3L vessel kits)

Overpressure valve

pH & temperature probe

pO<sub>2</sub> probe

Sterile sampling device

## Fermentation vessel

Autoclavable vessel: 0.3 L, 0.4 L, 1 L, 3 L & 7 L with the working volumes from 35 ml to 6 L.

Interchangeable glass vessels, according to the working volume requirement

## Infra-red heating

No hot spots at any medium volume. Precise temperature control with the natural sun like way of heating

## Small footprint

Footprint same as that of A4 paper for all working volumes, 35 ml to 6 L

## Optional

Redox probe, OD measurement, Conductivity probe, pCO<sub>2</sub>, MINI-4-GAS automatic gas-mix, Weighing module (Chemostat), Exit gas measurement, Antifoam system, Fermentation software, Automation software, Parallel runs

## Vessel volume and ports

The LAMBDA MINIFOR bench-top laboratory fermenter and bioreactor was developed as a result of the need to construct a small laboratory fermentor for volumes from **35ml up to 6 liters**.



<b>Vessel type:</b>	<b>0.3L</b>	<b>0.4L</b>	<b>1L</b>	<b>3L</b>	<b>7L</b>
<b>Working volume:</b>					
Minimum (L)	0.035	0.15	0.3	0.5	1.0
Maximum (L)	0.40	0.45	1.7	3.0	6.0
<b>Vessel dimension for autoclaving:</b>					
Height (cm)	34	22	34	37	50
Diameter (cm)	22	23	25	34	30
<b>Ports:</b>					
No. of side necks	6	8	8	8	10
≈ Traditional no. of ports	16	22	22	22	28

## Red-Ox Potential (ORP) measurement

The measurement of the Red-OX potential for the anaerobic culturing in MINIFOR can be done with the REDOX probe and the control unit. LAMBDA REDOX control unit connected to the MINIFOR allows the measurement of the Red-Ox potential and the digital transfer of the data to the PC with the help of the fermentation software SIAM.

The redox control unit displays the measured Red-Ox potential in terms of mV.

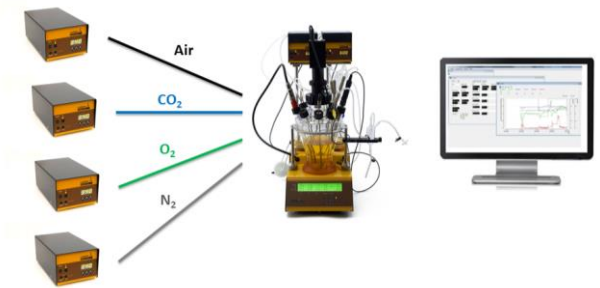


## MINI-4-GAS, automatic gas mixing module

MINI-4-GAS allows a flexible high precision MASSFLOW controlled supply of Air, O<sub>2</sub>, CO<sub>2</sub> and N<sub>2</sub> or the user-specified gases with individual gas flow paths.

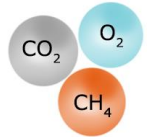
- 4-gas mix: mammalian / stem cell culture, constant gas flow
- 3-gas mix: Anaerobic fermentation, pH control by CO<sub>2</sub>
- 2-gas mix: O<sub>2</sub> enrichment & pO<sub>2</sub> control

Real time monitoring and automatically controlled gas mixing module provides an advanced gas diffusion by sparging and / or surface aeration with an excellent hydrodynamic shear stress free agitation.



## Exit gas measurement

CARBOMETER, OXYMETER and METHAMETER offers the possibility to measure the concentration of Carbon dioxide, Oxygen and Methane from the exit gas / out gas. With the SIAM industrial fermentation software, OUR (oxygen uptake rate), CPR (carbon dioxide production rate) and RQ value (respiratory quotient or respiratory coefficient) can be calculated.



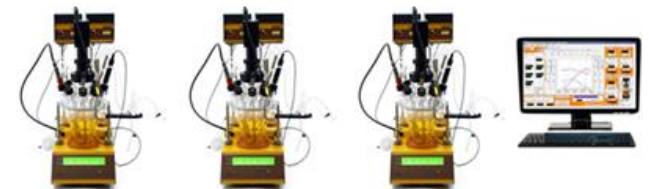
## LUMO: Light control for phototropic cells

LUMO includes the light control unit and the LEDs which are specially designed to use with the MINIFOR laboratory fermenter-bioreactor for precise control of light intensity, photoperiod and spectral distribution. Continuous gentle mixing prevents light inhibition and mutual shading inside the reaction vessel.



## Parallel cultivation

MINIFOR is a perfect tool for parallel running experiments. In contrast to traditional systems, the MINIFOR-units do not need to stand next to each other in parallel processes, but can be distributed in your labs, depending on your lab space availability. Several MINIFOR-units can be connected and controlled by fermentation control software on a PC. The connection of several MINIFOR-units to the control software does not require additional licenses.



# Customize your fermentor – bioreactor system

Select the preconfigured basic start-up kit, standard advanced kit or build up your own kit by choosing the desired accessories, according to your project requirements.

	Basic start-up kit	Standard advanced kit	Build your own kit
<b>Master control unit</b> with microprocessor, MASSFLOW, internal software, display of parameters (°C, pH, pO <sub>2</sub> , air flow rate, stirring and 'X') and keypad	✓	✓	✓
<b>Agitation:</b> 0 – 20 Hz (0 – 1200 rpm), 'fish-tail' agitation discs	✓	✓	✓
<b>Temperature:</b> measurement 0 to 99.9°C in 0.1°C steps, automatic control, IR heating, cooling loop	✓	✓	✓
<b>pH:</b> measurement 0 – 13, automatic controller	✓	✓	✓
Acid and Base PRECIFLOW peristaltic pump for automatic pH regulation, storage bottles, magnetic bottle holders and lines	*optional	✓	*optional
<b>Aeration:</b> measurement with internal MASSFLOW, automatic controller	✓	✓	✓
<b>DO (pO<sub>2</sub>):</b> automatic controller	✓	✓	✓
Measurement with DO probe	*optional	✓	*optional
<b>Free parameter X:</b> automatic controller, socket	✓	✓	✓
<b>Alerts:</b> high and low values of each parameter	✓	✓	✓
<b>Sampling device</b>	*optional	✓	*optional
<b>Overpressure valve</b>	✓	✓	✓
<b>Microsparger</b>	✓	✓	✓
<b>Glass outgas condenser</b>	✓	✓	✓
<b>Fermentation control software</b> (Fnet, SIAM), Laptop	*optional	*optional	*optional
<b>Automatic antifoam control</b> (no expensive probes needed)	*optional	*optional	*optional
<b>Feed &amp; Harvest pumps, Chemostat</b> (Weighing module)	*optional	*optional	*optional
<b>REDOX probe</b> (ORP), controller, pump / massflow	*optional	*optional	*optional
<b>pCO<sub>2</sub> probe</b> , controller, pump / massflow	*optional	*optional	*optional
<b>Conductivity probe</b> , controller, pump / massflow	*optional	*optional	*optional
<b>Turbidity / OD probe</b> , controller, pump / massflow	*optional	*optional	*optional
<b>Gas-mix / O<sub>2</sub> enrichment:</b> MASSFLOWS 500 / 5000, software control	*optional	*optional	*optional
<b>Exit gas measurement:</b> Oxygen (OXYMETER), Carbon dioxide (CARBOMETER), Methane (METHAMETER), software for OUR, CPR & RQ calculation	*optional	*optional	*optional
<b>LUMO</b> , light and controller for PBR	*optional	*optional	*optional
<b>Peltier cooling</b> for medium and outgas / exit gas	*optional	*optional	*optional
<b>Air compressor</b> AEROSILENTO	*optional	*optional	*optional

# Technical specification

<b>Power</b>	Universal power supply for mains 100-245 V AC/50-60Hz, 560W, CE conform
<b>Display</b>	LCD 4 x 40 digits with backlight illumination
<b>Dimensions</b>	22 x 40 x 38 cm (W x D x H)
<b>Fermentor vessel</b>	Pyrex borosilicate glass with 6 to 8 threaded necks; 0.3, 0.4, 1, 3, 7 liter vessels
<b>Temperature control</b>	High efficiency 150 W infrared (IR) radiation heat source with gilded parabolic reflector
Regulation	From 5°C over RT to 70°C
Measurement	From 0 to 99.9°C in 0.1°C steps
Precision	+/- 0.2°C (0 to 60°C)
Sensor	Pt 100 incorporated in the glass electrode of the pH probe
<b>pH control</b>	Sterilizable pH electrode pH 0-14 with automatic temperature correction, two-point semi-automatic calibration and Variopin connector
Resolution	0.01 pH unit
Precision	+/- 0.02 pH unit
<b>pO<sub>2</sub> control</b>	Sterilizable Clark type oxygen sensor with fast response, automatic temperature correction, two-point semiautomatic calibration, dissolved oxygen (DO) control through regulation of the airflow rate
Range	0 to 25 mg oxygen/ l, in 0.1 mg/l steps
<b>Air flow</b>	0 to 5 l/min in 0.01 l/min steps, measured by precise mass flow meter, linearity +/- 3%, reproducibility +/- 0.5%
Control	Proportional valve controlled by microprocessor
Supplied air pressure	0.05 – 0.2 MPa (0.5 - 2 atm)
<b>Agitation</b>	50 W Vibromixer 0 to 20 Hz (0 to 1200 rpm) in 0.1 Hz steps (6 rpm) with 1 or more stirring discs; Sterility similar to magnetic coupling
<b>Selectable parameter</b>	An additional parameter can be controlled by the instrument (foaming control, weight (for continuous cultures), pCO <sub>2</sub> , redox potential, conductivity, optical density, etc.); with standard 0-10V or 0-20mA output
<b>Ports</b>	One large quadruple sampling or additions port with four needles with LAMBDA PEEK double-seal connections, used for sampling, inoculation, antifoam, feeds, harvest, addition of correction solutions etc., additional double ports are available
<b>Pumps</b>	Up to 4 independent pumps (PRECIFLOW, MULTIFLOW, HIFLOW or MAXIFLOW) with speed variation from 0 to 100 % can be used with MINIFOR laboratory fermenter-bioreactor
<b>Gas flow control</b>	In addition to pumps, several electronic flow controllers with flow rate ranges of 0-5 l/min (MASSFLOW 5000) or 0-500 ml/min (MASSFLOW 500) can be used for the controlled addition of gases (e.g. N <sub>2</sub> , O <sub>2</sub> , air, CO <sub>2</sub> ) in cell cultures; freely configurable gas station module
<b>Working temperature</b>	0 - 40 °C
<b>Working humidity</b>	0 - 90 % RH, not condensing
<b>Security</b>	IEC 1010/1
<b>Weight</b>	7.5 kg
<b>PC control</b>	Complete PC control and data processing using the fermentation software FNet (for up to 6 MINIFOR fermenters) or SIAM (for an even higher number of instruments)

For further assistance, please contact [support@lambda-instruments.com](mailto:support@lambda-instruments.com).