

Labfors 5

Bench-Top Bioreactor - Version for Microorganisms



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Engineering and production in Switzerland

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1 General Information

1.1 About this Manual

This manual enables the safe and efficient handling of the equipment.

All the information and instructions in this operating manual comply with the current standards, legal regulations, the latest technological and scientific developments and the knowledge gained from the manufacturer's many years of experience in this field.



This operating manual is a component part of the equipment. It must be kept near to the equipment and must be accessible to the operators at all times.

The users must read the operating manual thoroughly and fully understand its contents before beginning any work.

Adhering to all the safety and operating instructions in this manual is essential to ensure that work is carried out safely.

The scope of delivery may differ from the explanations, descriptions and figures in this operating manual due to special designs, additional options specified on ordering and the latest technical/mechanical modifications.

This manual contains illustrations to aid general understanding. These may differ from the actual equipment as supplied.

1.2 Explanation of Special Notices

1.2.1 Warning Notices

Warning notices in this manual are indicated by a coloured bar and begin with a signal word that signifies the degree of the hazard.



DANGER

The signal word "DANGER" indicates a dangerous situation that will lead to severe or even fatal injuries if not avoided.

General Information

WARNING

The signal word “WARNING” indicates a potentially dangerous situation that may result in severe or even fatal injuries if not avoided.

CAUTION

The signal word “CAUTION” indicates a potentially dangerous situation that may result in minor injuries if not avoided.

1.2.2 Other Notices

ATTENTION

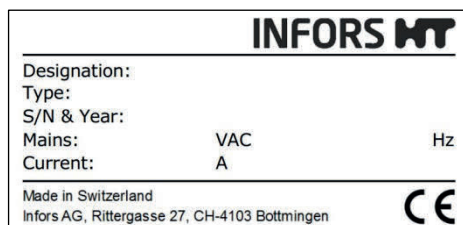
The word “ATTENTION” on a blue bar indicates a situation that may result in significant damage to property if not avoided.

INFORMATION

Texts located below a grey bar bearing the notice “INFORMATION” provide useful tips and recommendations for ensuring efficient, fault-free operation of the equipment.

1.3 Equipment Identification (Standard Identification Plate)

The identification plate is designed to allow clear identification of the equipment. It contains the following information:



- Manufacturer name
- Designation = Category of equipment
- Type = Equipment type (name)
- S/N = Serial number
- Year = Year of manufacture
- Mains = Nominal voltage and frequency
- Current = Current consumption
- Manufacturer address
- CE marking

1.4 Declaration of Conformity

The equipment is in compliance with the essential requirements of the following Directives:

- Machinery Directive 2006/42/EC
- EMC Directive 2014/30/EU

The Declaration of Conformity according to EC Machinery Directive 2006/42/EC, annex II 1 A is included in the general documentation supplied with the equipment.

1.5 Customer Service and Services

Our Customer Service is at your disposal for technical advice and specialist enquiries. For contact information, see page 2.

Due to their familiarity with the potential applications of the equipment, the Customer Service team is able to provide information on whether the equipment can be used for a specific application or modified to handle the planned process.

Experience of working with the equipment will be published semi-regularly on the manufacturer's website in the form of "application notes".

Furthermore, our colleagues are always interested in new information and experiences resulting from user's applications for the equipment that may be valuable for the continued development of our products.

Safety and Responsibility

2 Safety and Responsibility

This section describes general considerations relating to user safety that must be taken into account when working with the equipment.

In the remaining sections, warning notices are used only to highlight particular hazards directly arising from the actions being described in the section in question.



It is essential to read the operating manual carefully – especially this section and the warning notices in the text – and to follow the instructions therein.

This section also refers to areas that are the responsibility of the provider due to certain risks arising from particular applications for which the equipment is used deliberately and with full awareness of the associated risks.

2.1 Intended Use, Incorrect Use and Misuse

The bench-top bioreactor Labfors 5 from INFORS HT is designed especially for running bio processes with microorganisms or animal cells for research and development in a biotechnology laboratory.

The equipment is designed and constructed exclusively for the intended use described above.

Intended use also includes following all the instructions in this operating manual, especially those relating to:

- The installation site
- User qualifications
- Correct operation and maintenance
- The use of undamaged tubing and glass vessels

Any failure to observe the requirements specified in this manual shall be deemed incorrect use.

Any use of the equipment outside the scope of the intended use as described above shall be deemed misuse.

This also applies to applications for which the equipment is not designed, such as the use or production of explosive gases, which is not permitted because the equipment is not explosion-proof.

Safety and Responsibility

For use for special applications not covered by conventional, intended use, the equipment must be modified and certified accordingly by the manufacturer.

Any use of the equipment outside of a biotechnology laboratory, i.e. in any environment in which the conditions required for the safety of the users cannot be fulfilled or cannot be fulfilled to their full extent, shall also be deemed misuse.

2.2 Qualified Personnel

Due to the complexity of the equipment and the potential risks arising from its operation, the equipment may only be used by qualified, specialist personnel.

2.2.1 Provider

The term “provider” applies to all persons who are responsible for making the equipment and the necessary infrastructure available. These persons may also be included in the group of people known as “users”, though this is not always the case.

Irrespective of whether a provider is a member of the company’s board of management or a supervisor, they bear a special level of responsibility with regard to the processes and the qualification and safety of the users.

2.2.2 User

General

The term “user” applies to all persons who come into contact with the equipment in any way and perform work on or with it. This primarily applies to the following activities, which can be performed by the manufacturer’s own specialists or a variety of other persons (it is not always possible to distinguish clearly between the different types of person):

- Assembly, installation and commissioning
- Definition and preparation of the process
- Operation
- Troubleshooting and remedying of faults
- Maintenance and cleaning (autoclaving, if necessary)
- Service work and repairs
- Disassembly, disposal and recycling

Safety and Responsibility

Qualified personnel

On account of their specific education, training and – in many cases – experience, the qualified personnel required for this work are able to recognise risks and respond accordingly to potential hazards.

The qualified personnel (either internal or external) who cannot be categorised under the separate “operators” group are made up of the following groups of persons:

- Electricians (electrical engineers)
- Decontamination specialists
- Repair specialists
- Specialists in disassembly and (environmentally friendly) disposal
- Recycling specialists

2.2.3 Operator

The “operators” are a specific sub-group of users distinguished by the fact that they work with the equipment. They are the true target audience for this operating manual.

Qualified technicians

Only technicians who have been trained for working in a biotechnology laboratory can be considered for the role of operator. These include:

- Process technicians in the fields of biotechnology and chemistry
- Biotechnologists (biotechnicians)
- Chemists with a specialisation in biochemistry; chemists in the field of organic chemistry or biochemistry
- Life scientists (biologists) with special education in cytology, bacteriology, molecular biology, genetics, etc.
- Lab assistants (lab technicians) from various fields

In order to be classed as a “sufficiently qualified technician” for the operation of the equipment, the persons in question must have received thorough training and have read and understood the operating manual.

The operator must be informed in a training session provided by the provider of the tasks delegated to the operator and the potential risks of improper conduct. Tasks that go beyond the scope of operation under normal conditions may only be performed by the operator if this is specified in the manual and the provider has explicitly entrusted said tasks to the operator.

Safety and Responsibility

Technicians in training

Persons in this group who are undergoing training or apprenticeships are only permitted to use the equipment under supervision and in accordance with the instructions of a trained and qualified technician.

2.3 Unauthorised Persons

The term “unauthorised persons” applies to all persons who can access the work area but are not qualified to use the equipment in accordance with the aforementioned requirements.

Unauthorised persons are not permitted to operate the equipment or use it in any other way.

2.4 Responsibility of the Provider

The equipment is used for industrial and scientific purposes. As such, the provider of the equipment is individually liable with regard to the legal requirements relating to occupational health and safety in a biotechnology laboratory. In particular:

- The provider is responsible for ensuring that the work and environmental regulations applicable in a biotechnology laboratory are observed.
- The provider must ensure that the equipment remains in safe and proper working condition throughout its entire term of use.
- The provider must ensure that all safety equipment is fully functional and is not disabled.
- The provider must ensure that the equipment is only worked on by qualified users, and that said users receive sufficient training.
- The provider must ensure that the protective equipment required for working with the equipment is provided and worn.
- The provider must ensure that this operating manual remains in the immediate vicinity of the equipment throughout its entire term of use.

2.5 General Hazards

This section covers general hazards and residual risks that are always present when using the equipment in accordance with normal, intended use.

Safety and Responsibility

The following notices are general in nature. As such, with a few exceptions they are not repeated in the remaining sections.

2.5.1 Electrical Current



The equipment runs on electrical power. There is an immediate risk of fatal injury if contact is made with live parts.

The following points must be observed in order to avoid the risk of fatal injury:

- In case of damage to insulation, disconnect the equipment from the mains immediately and arrange for it to be repaired.
- Disconnect the equipment from the mains before commencing any work on the electrical system.
- Always use qualified electricians for any work on the electrical system.
- Keep moisture away from live parts. It may lead to a short circuit.

2.5.2 Unauthorised Spare Parts and Accessories



Incorrect or imitated spare parts and accessories as well as spare parts or accessories that have not been authorised by the manufacturer represent a significant safety risk. As such, we recommend procuring all spare parts and accessories from an authorised dealer or directly from the manufacturer. For the contact details of the manufacturer's representatives, see page 2.

2.6 Particular Hazards

This section covers particular hazards and residual risks that may arise when using the equipment for special applications in accordance with normal, intended use.

Since the use of the equipment for such applications is deliberate, it is the responsibility of the operators and the provider to ensure that all personnel are protected from potential damage to health. The provider is responsible for ensuring that the appropriate protective equipment for such applications is provided, and that the necessary infrastructure is in place.

2.6.1 Hot Surfaces



For processes that are carried out with temperatures over 55 °C, there is a danger of burns on hot surfaces.

Since the equipment is intended for applications at high temperatures, it is the responsibility of the users to ensure that they have sufficient protection.

The motor gets hot during operation. There is a risk of burns if it is touched.

2.6.2 Dangerous Gases



The use or production of dangerous gases i.e. toxic or asphyxiant gases entails a significant health risk, especially in enclosed spaces.

In order to prevent high emissions of dangerous gases, the following measures must be taken:

- The gas connections on the equipment must be checked before any cultivation processes using dangerous gases are initiated.
- The gaskets on the equipment must be checked at regular intervals and replaced if necessary.
- Siphon off exit gas safely.

2.6.3 Flammable or Explosive Substances



The use or production of flammable or explosive substances is not covered under “intended use” of the equipment, as the equipment is not explosion-proof.

If the provider intends to use the equipment for such purposes, he must check its suitability for the planned application with the responsible local authorities.

2.6.4 Corrosive or Toxic Substances



The use or production of corrosive or toxic substances entails a significant health risk. As such, special measures must be taken to protect the users for such applications.

Since the equipment is used deliberately for such applications, it is the responsibility of the users to ensure that they have sufficient protection.

Safety and Responsibility

2.6.5 Bioactive Substances or Pathogenic Organisms



The use or production of bioactive substances, pathogenic organisms or genetically modified cultures entails a significant health risk. As such, special measures must be taken to protect the users for such applications.

Since the equipment is used deliberately for such applications, it is the responsibility of the users to ensure that they have sufficient protection.

2.6.6 Overpressure or Vacuum



Glass vessels may break or shatter when subjected to overpressure or vacuums.

2.7 Warning Symbols on the Equipment

The following warning symbols (stickers) are attached to the equipment:

Position

- Motor



WARNING

Illegible or missing warning symbols on the equipment will lead to the user being exposed to risks that the warning symbols in question were designed to make him or her aware of.

It is the provider's responsibility to ensure that all the stickers with warning symbols on the equipment are always intact.

2.8 Declaration of Decontamination

When returning the equipment for repair, disassembly or disposal, it is required for the safety of all parties involved and because of legal provisions that a lawful declaration of decontamination is present.

Safety and Responsibility

The following must be observed if this is the case:

- The equipment, the component part or accessory must be entirely decontaminated before sending to the manufacturer
- The provider is therefore required to completely and truthfully fill out a declaration of decontamination, and have it signed by the person responsible.
- **The declaration of decontamination must be affixed on the outer packaging in which the equipment is sent back.**
- These forms can be obtained from the licensed dealer or the manufacturer. See address on page 2.

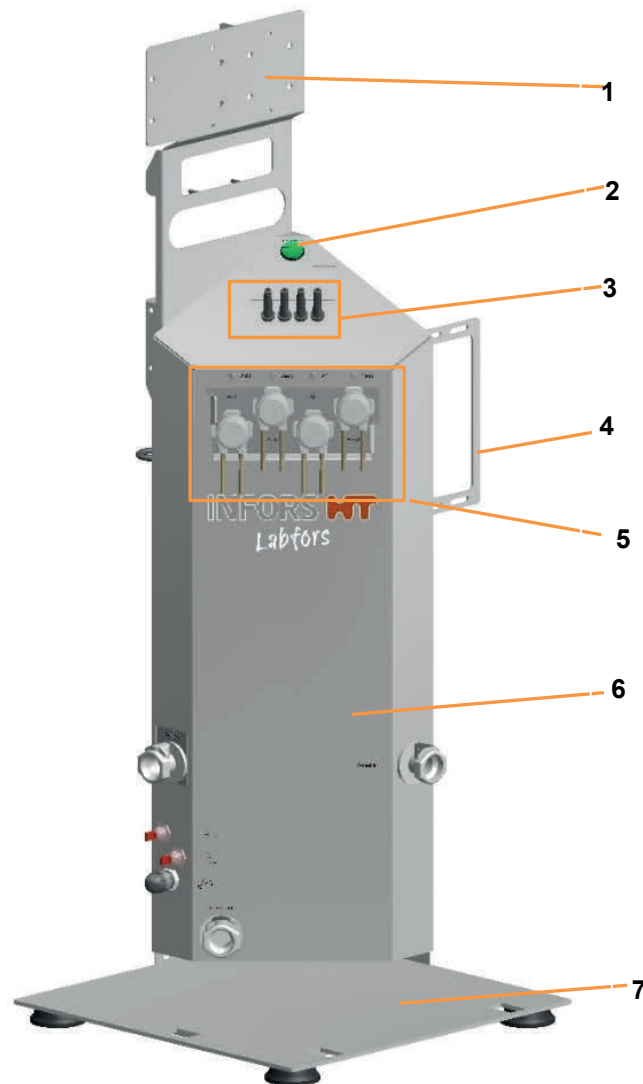
Important notice

If the return shipment is not accompanied by a signed and complete declaration of decontamination or it is not affixed to the outer packaging, the shipment will be returned unopened to the sender at their expense (see also T&C).

Setup and Function

3 Setup and Function

3.1 Basic Unit



- | | | | |
|---|---|---|------------|
| 1 | Holder for operating unit, manometers and pressure reduction valves | 5 | Pumps |
| 2 | Main switch | 6 | Console |
| 3 | Sensor cables | 7 | Base plate |
| 4 | Holder for gassing unit(s) ¹ and optional pressure control | | |

¹⁾ depending on the chosen gassing strategy this can be rotameter(s), mass flow controller(s), solenoid valve(s)

Setup and Function

The whole measuring and control technology of the bioreactor is integrated in the console of the basic unit. One operating unit with touchscreen software can be used to control up to six bioreactors (culture vessels) see also chapter „Operating Unit“. This means, one basic unit serves as the master unit and can control up to five more basic units, referred to as satellite units.

3.1.1 Main Switch



The main switch, a green rocker switch, is situated on top of the console. It is labelled with **POWER** and it is illuminated as soon as it is switched on.

3.1.2 Pumps

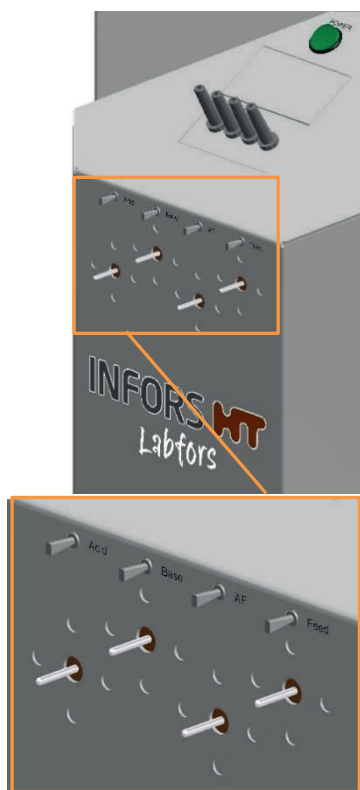
Corrective reagent and feed solutions are added via four peristaltic pumps. The pumps are driven by stepper motors.

The drive shafts of the pumps are situated on the upper front side of the console on the basic unit. Direction of rotation is clockwise by default. Rocker switches for manual operation of the pumps are provided above the drive shafts. They are labelled as follows (from left to right):

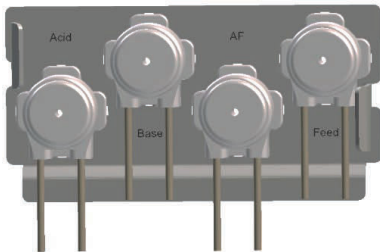
- **Acid**
- **Base**
- **AF (Antifoam)**
- **Feed**

When the basic unit is switched on, pumps can be manually operated via the rocker switches:

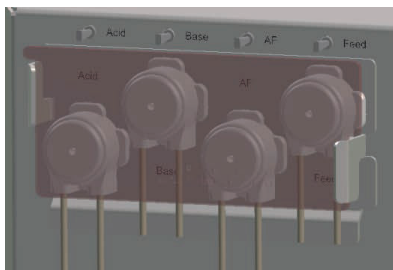
- Push and hold the rocker switch to the left:
The pump drive shaft turns counter clockwise
- Push and hold the rocker switch to the right:
The pump drive shaft turns clockwise.



Setup and Function



The autoclavable pump heads are latched onto a mounting plate. The mounting plate is identically as the drive shafts labelled with the pump names.



The pump heads together with the mounting plate can easily be plugged onto or pulled off the drive shafts.

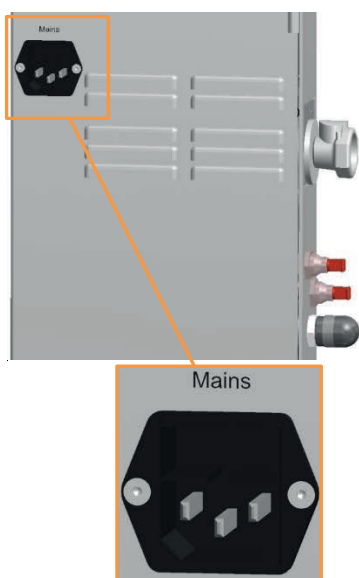
A transparent, not autoclavable (!) cover plate made of plexiglass (highlighted in red in the picture on the left) can be inserted into the holder of the mounting plate for protection during operation.

3.1.3 Identification Plate

The identification plate is located on the rear of the basic equipment.

The data provided on the identification plate is specified in the main chapter “General Information”, chapter “Equipment Identification”.

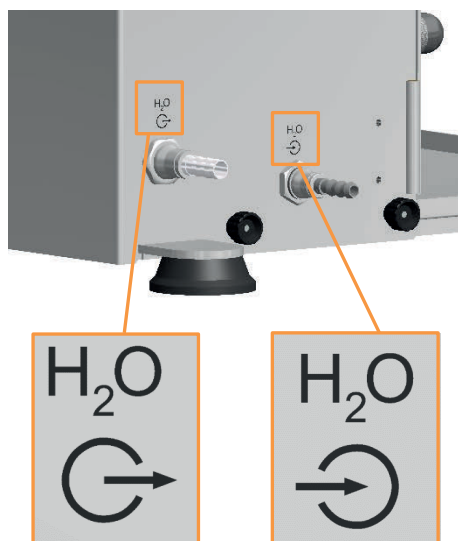
3.1.4 Mains Connection



The connection socket for the power cable of the equipment is situated on the rear side of the console. It is labelled with **Mains**.

Setup and Function

3.1.5 Water Connections



The two hose nozzles for connection of water inlet and outlet of the basic unit are situated on the rear side at the bottom of the console. They are labelled with corresponding symbols:

- Left: Water outlet
- Right: Water inlet

3.1.6 Gas Connections

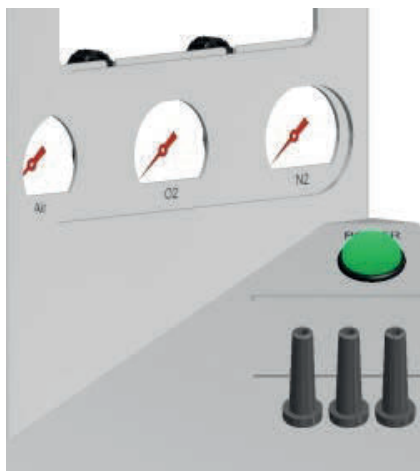


The connection(s) for gas is/are located at the top on the back of the basic unit. Each connection is labelled accordingly, e.g. **Air IN** etc.

A pressure reduction valve is installed after each connection.

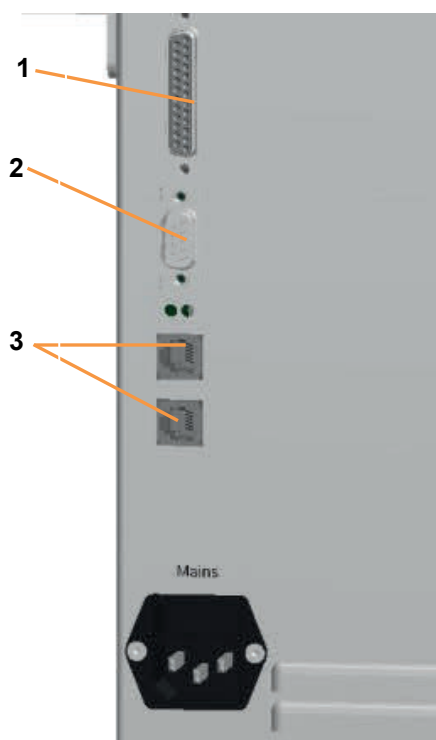
The factory settings of the pressure reduction valves must not be changed!

Setup and Function



Manometers are installed after each pressure reduction valve for pressure indication. They are labelled accordingly, e.g. **Air** etc.

3.1.7 Signal Connections



The following signal connectors are situated above the mains socket (from top to bottom):

- 1 25 pin Dsub Multi I/O: for connecting analogue and digital input and output signals (0/4..20 mA)
- 2 9 pin RS232: for connecting a balance or a switchbox with up to 7 balances
- 3 2 x iDDC bus: for connecting the touch screen operating unit and one or two satellites

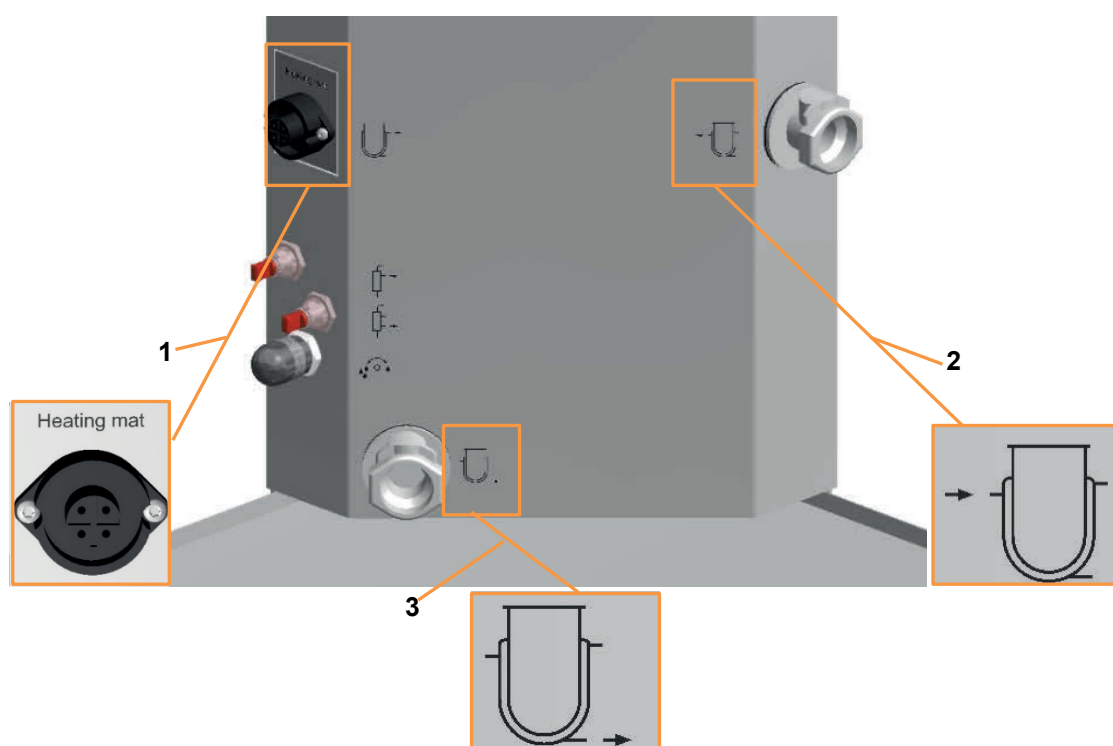
3.1.8 Connections for Single or Double Walled Vessels

Depending on the present temperature control system, different connectors for either the single or double walled vessels are located on the basic unit.

Setup and Function

3.1.8.1 Connections for Single Walled Vessels

The socket for cable connection of the electrical heater pad is labelled and the water connectors for the cold finger are labelled with symbols.

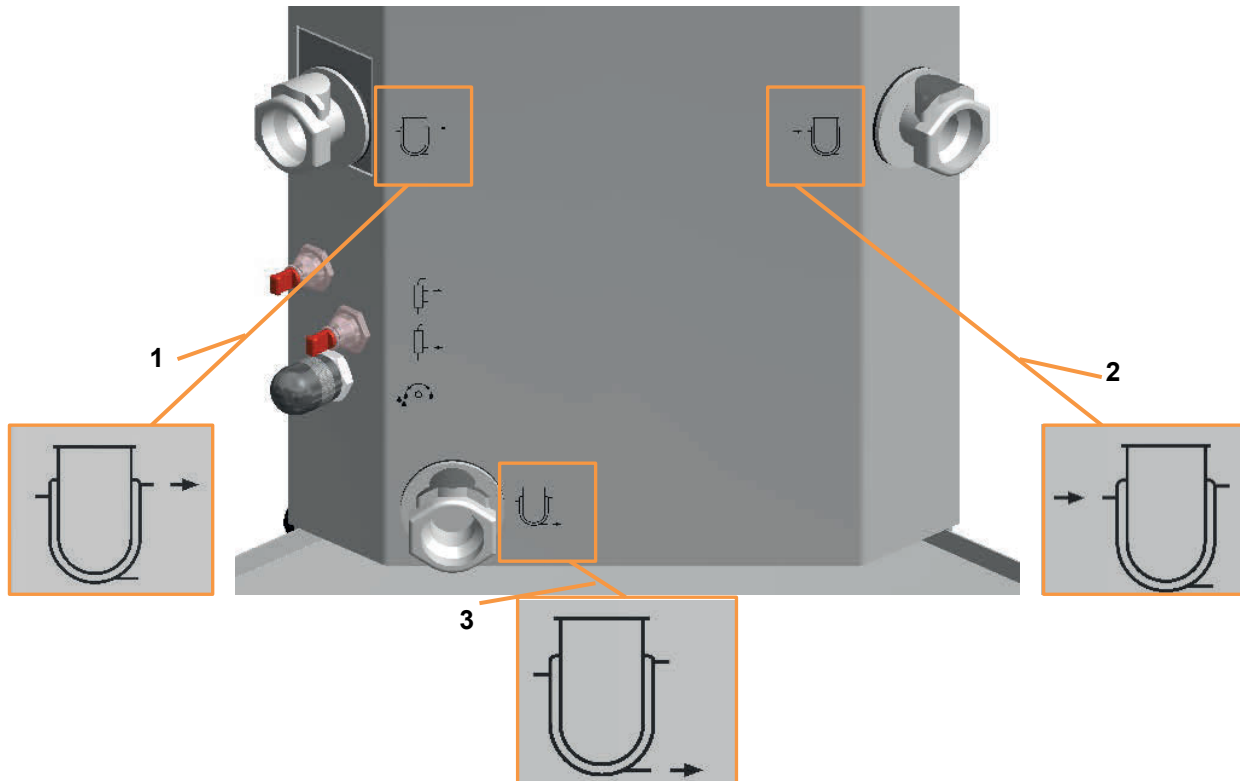


- | | | | |
|---|--|---|--------------------------|
| 1 | Mains connection heater pad <i>Heating mat</i> | 3 | Water outlet cold finger |
| 2 | Water inlet cold finger | | |

Setup and Function

3.1.8.2 Connections for Double Walled Vessels

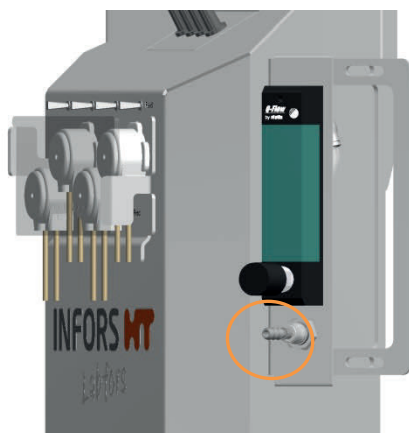
The water connectors for the vessel jacket are labelled with corresponding symbols.



- 1 Water overflow vessel jacket
- 2 Water inlet vessel jacket

- 3 Water outlet vessel jacket

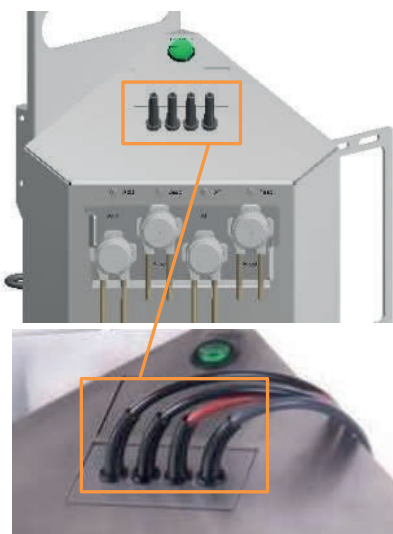
3.1.9 Gassing Connection (Sparger)



The hose nozzle for connection of the gassing hose (sparger) is located below the holder for gassing unit(s)¹ on the right side of the basic unit.

¹) depending on the chosen gassing strategy, this can be rotameter(s), mass flow controller(s), solenoid valve(s)

3.1.10 Sensor Connections (Sensor Cables)



The basic unit is equipped and configured by default for measurement of temperature, pH, pO₂ and antifoam. This means, the temperature sensor (Pt100) and the cables for connecting these sensors are always present.

The appropriate sensors for pH, pO₂ and antifoam are separately available, they are not included in the standard package.

From left to right: pH / Antifoam / Temperature (Pt100) / pO₂.



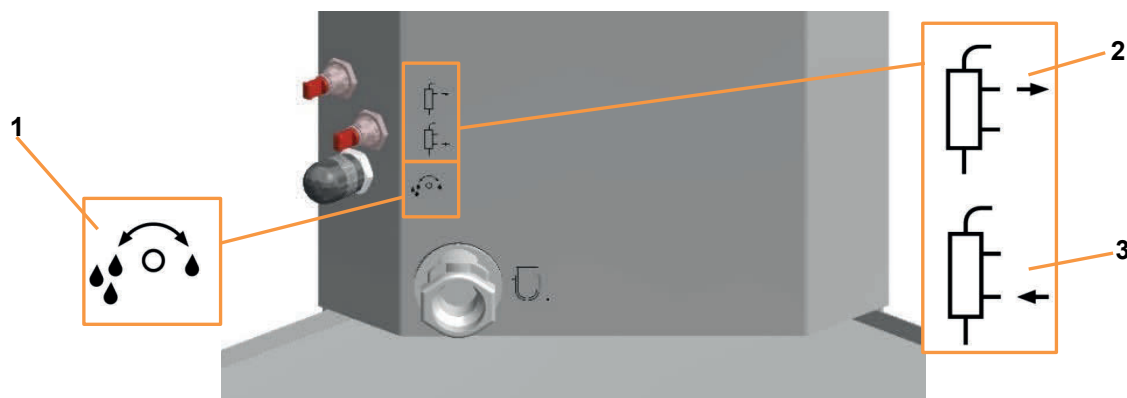
INFORMATION

Depending on the chosen variant, the measuring system for pH and pO₂ is equipped and configured either for analogue sensors from the manufacturer METTLER or digital sensors from the manufacturer HAMILTON.

Setup and Function

3.1.11 Connections and Valve for Water Flow Regulation of the Exit Gas Cooler

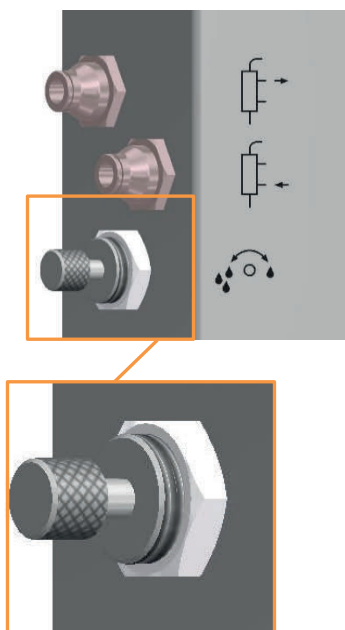
The water connections for the (optional!) exit gas cooler and the valve for the water flow regulation are located on the left front side of the basic unit. The connectors are closed with plugs and the valve is covered with a cap on delivery. Connections and valve are labelled with symbols.



1 Water flow regulation

2 Water outlet exit gas cooler

3 Water inlet exit gas cooler



The valve is factory adjusted, If needed, water flow can be manually adjusted here.

- Open: turn it counter clockwise
- Close: turn it clockwise

A counter nut is provided to lock the valve in its desired position.

3.2 Operating Panel



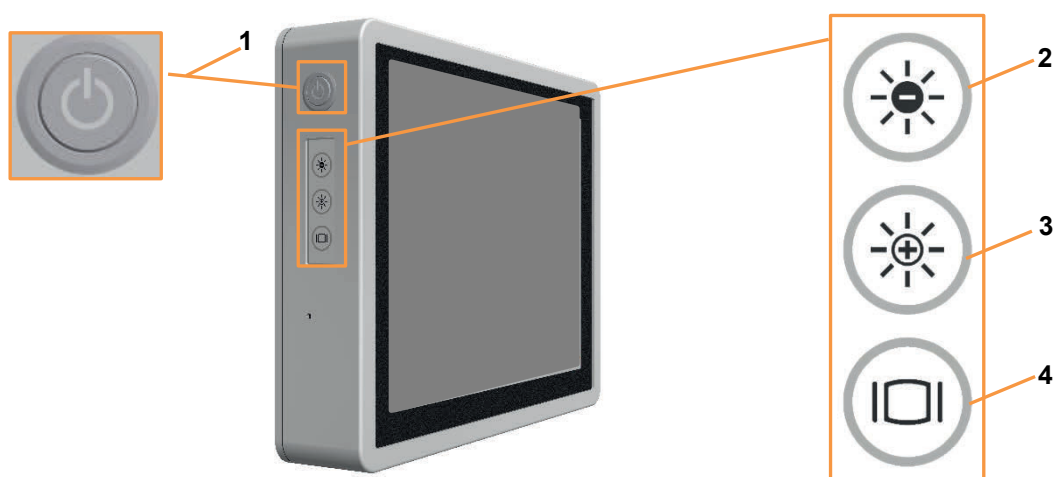
The operating panel has a 12" colour-touch screen with protection IP66.

Up to six bioreactors (= culture vessels) can be individually or in parallel controlled by one operating panel.

A detailed description of the touch screen software can be found in the separate manual.

3.2.1 Monitor Keys

Four monitor keys are situated on the upper left side of the touch screen operating panel.



- | | | | |
|---|--|---|--|
| 1 | ON/OFF key | 3 | INCREASE brightness key: to set the display illumination brighter |
| 2 | DECREASE brightness key: to set the display illumination darker | 4 | DISPLAY key: to switch the display on/off |

Special details about the ON/OFF key

The touch screen operating panel is switched on and off at the main switch on the basic unit. Therefore separate switching on at the ON/OFF key is not necessary. The symbol on the key is illuminated when the operating panel is switched on.

Setup and Function

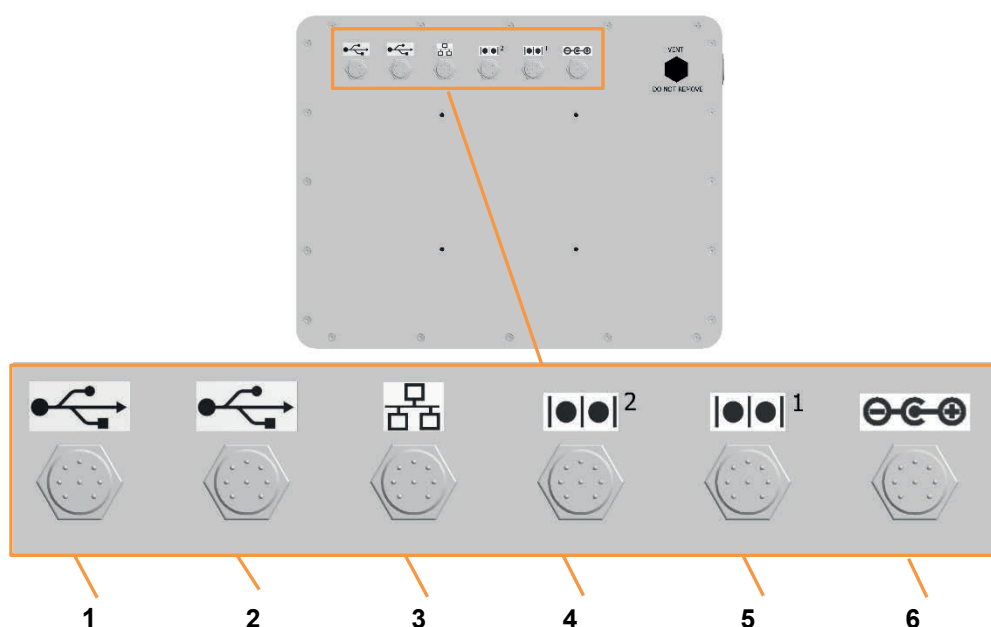


INFORMATION

The **ON/OFF** key is locked when a bioreactor (fermentation) is running. A dialogue box with the appropriate message appears when pressing the **ON/OFF** key by mistake during fermentation. When pressing the **ON/OFF** key when the bioreactor (fermentation) is stopped, a dialogue box for shutting down the system appears

3.2.2 Operating Panel Connections

Six connectors labelled with different symbols are situated on the rear side of the operating panel.



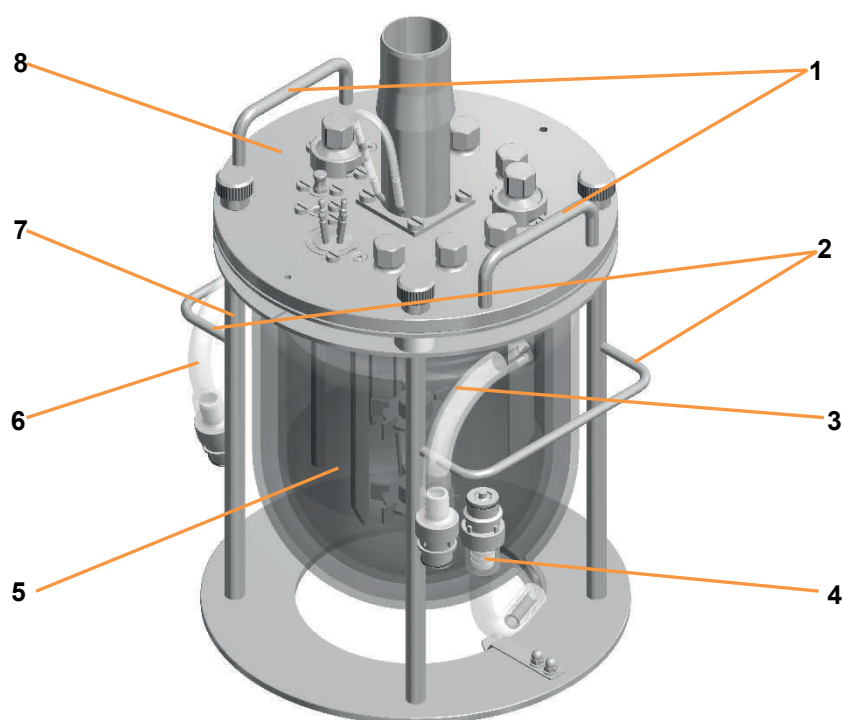
- | | | | |
|---|---|---|---|
| 1 | USB2.0 x 2: for backups and service purposes ¹ | 4 | COM2 (Reserve) |
| 2 | USB2.0 x 2: (Reserve) | 5 | COM1: for iDDC bus cable ¹ (display cable) |
| 3 | Ethernet: for Ethernet cable ¹ to connect with a network | 6 | DC: for power supply cable ¹ |

¹⁾ Cable supplied with equipment

3.3 Culture Vessels

Culture vessels consist of the glass vessel, the top plate with standard mounting parts and handholds and the vessel holder with handholds. The vessels are either made of double or single walled borosilicate glass, depending on the temperature control system used. For details see the chapter “Temperature Control System”.

3.3.1 Double walled Culture Vessels



- 1 Handhold top plate
- 2 Handhold vessel holder
- 3 Water overflow vessel jacket
- 4 Water outlet vessel jacket

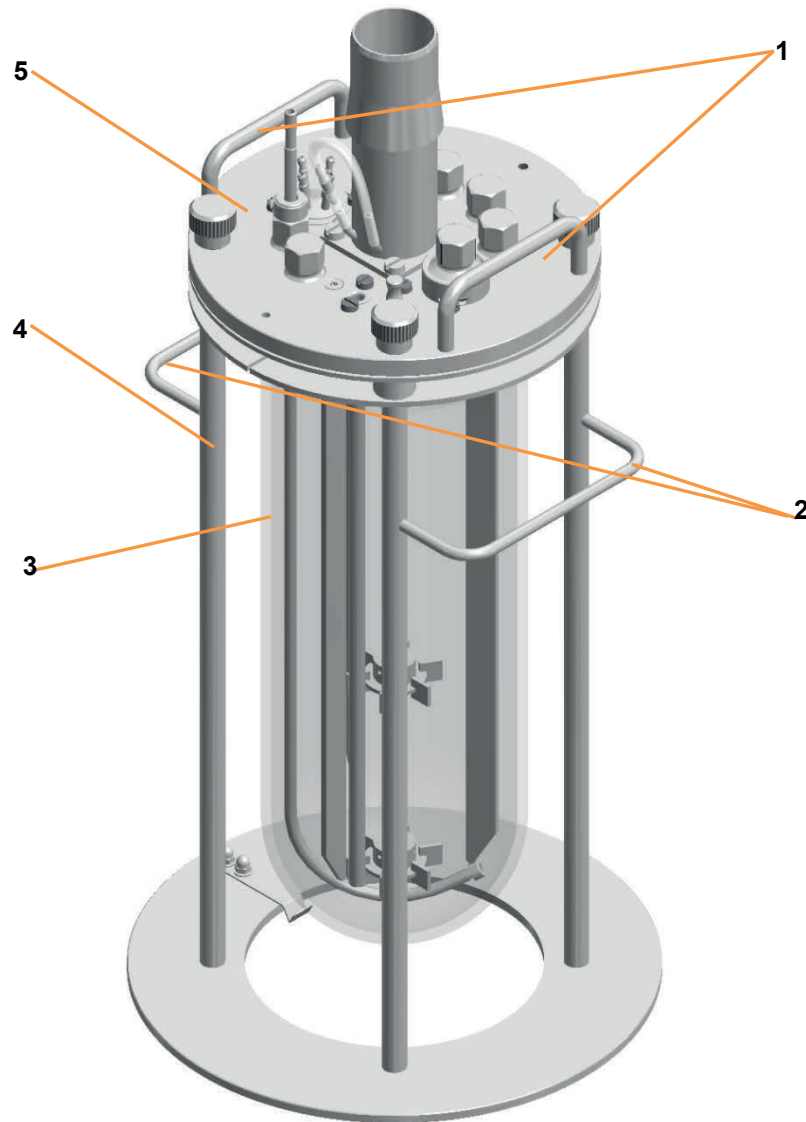
- 5 Glass vessel
- 6 Water inlet vessel jacket
- 7 Vessel holder
- 8 Top plate

The picture above shows a double walled culture vessel with a total volume of 3.6 L and DN (diameter nominal = inner diameter) of 150 mm.

Double walled vessels are readily equipped with silicone hoses with rapid couplings for connection to the basic unit ex-factory.

Setup and Function

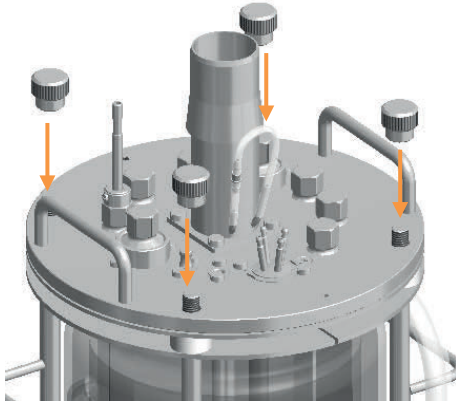
3.3.2 Single walled Culture Vessels



- | | | | |
|---|------------------------|---|---------------|
| 1 | Handhold top plate | 4 | Vessel holder |
| 2 | Handhold vessel holder | 5 | Top plate |
| 3 | Glass vessel | | |

The picture above shows a single walled culture vessel with a total volume of 3.6 L and DN (diameter nominal = inner diameter) of 115 mm.

Single walled culture vessels need an electrical heater pad and a cold finger for temperature control. For details see the chapter "Temperature Control System".

Setup and Function**3.3.3 Top Plate**

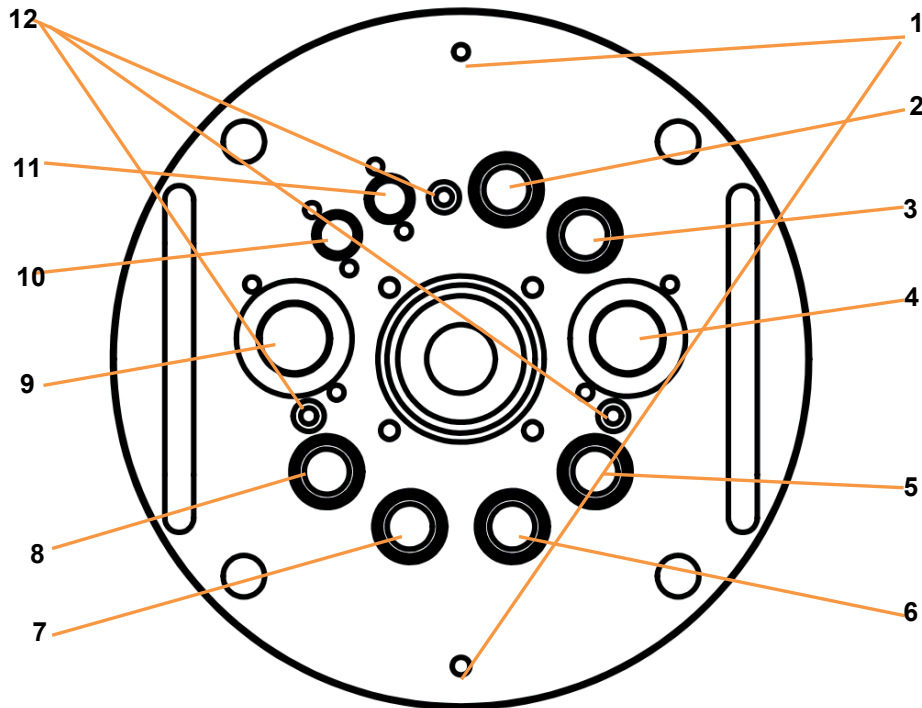
Four knurled screws are used to fixate the top plate to the glass vessel and the vessel holder. Drive hub and motor coupling are located in the middle of the vessel top plate.

3.3.4 Ports in the Vessel Top Plate and their Configuration

The vessel top plate has different ports of different sizes to mount the different components such as sparger, blanking plugs, sensors etc. The number of ports in the top plate and its configuration depends on the diameter nominal (= inner diameter) of the culture vessel.

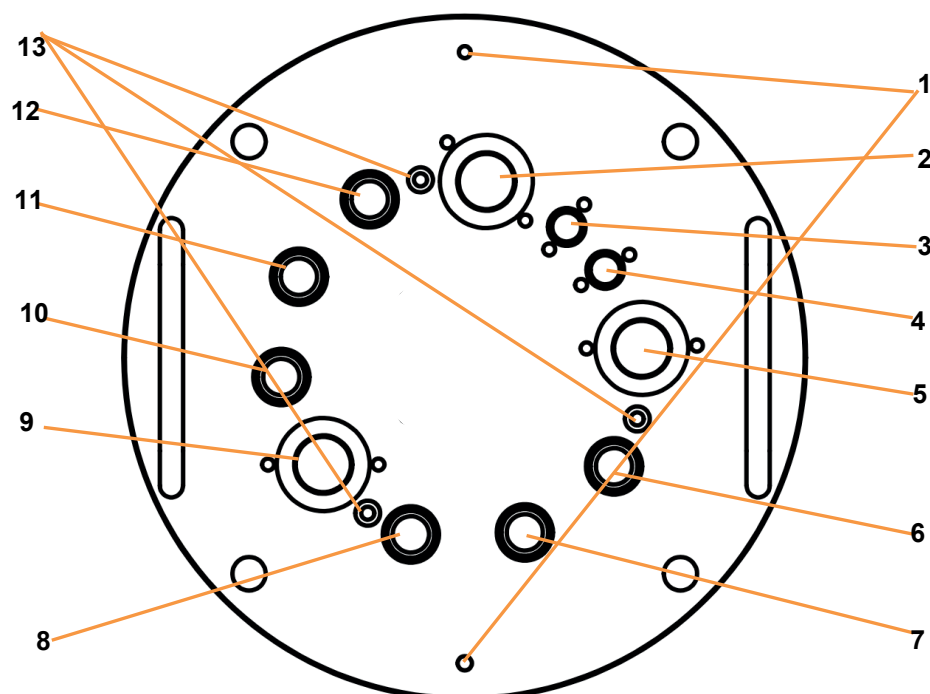
Setup and Function

3.3.5 Top Plate DN 115



- | | | | |
|---|---|----|---|
| 1 | Ground connector antifoam sensor | 8 | Ø 12 mm / Pg13.5: Dip tube for sampling |
| 2 | Ø 12 mm Pg13.5: Exit gas cooler | 9 | Ø 19 mm: Spare |
| 3 | Ø 12 mm / Pg13.5: Sparger | 10 | Ø 10 mm: Antifoam sensor |
| 4 | Ø 19 mm: Addition port adapter, quadruple (for reagents & feed) | 11 | Ø 10 mm: Temperature sensor (Pt100) |
| 5 | Ø 12 mm / Pg13.5: pO ₂ sensor | 12 | Fixation of baffle |
| 6 | Ø 12 mm / Pg13.5: pH sensor | | |
| 7 | Ø 12 mm / Pg13.5: Inoculation needle | | |

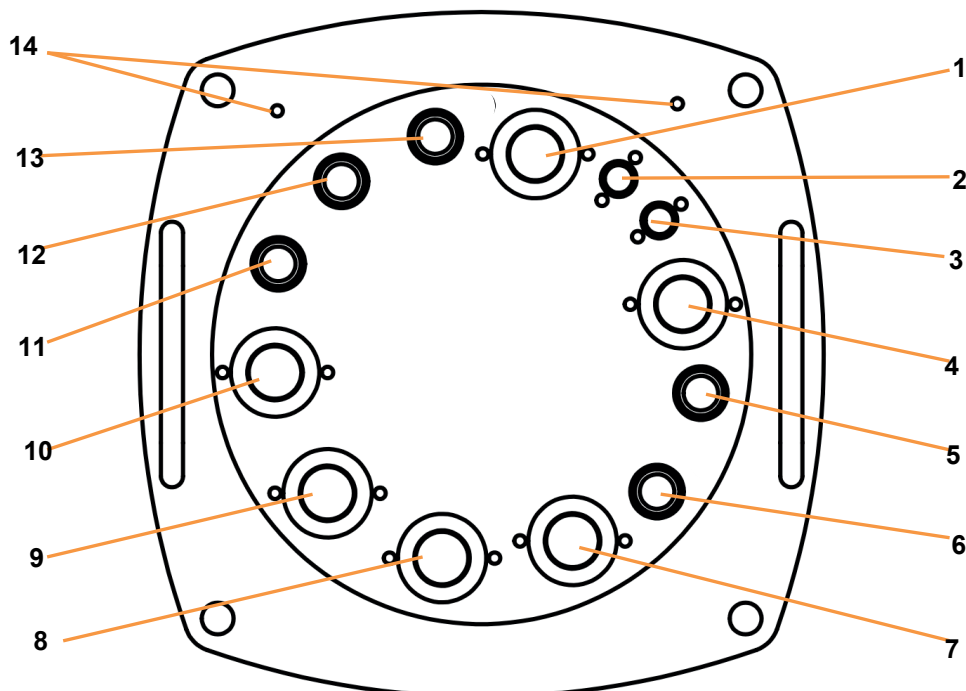
3.3.6 Top Plate DN 150



- | | | | |
|---|---|----|---|
| 1 | Ground connector antifoam sensor | 8 | Ø 12 mm / Pg13.5: Dip tube for sampling |
| 2 | Ø 19 mm: Spare | 9 | Ø 19 mm: Inoculation needle |
| 3 | Ø 10 mm: Temperature sensor (Pt100) | 10 | Ø 12 mm / Pg13.5: pH sensor |
| 4 | Ø 10 mm: Antifoam sensor | 11 | Ø 12 mm / Pg13.5: pO2 sensor |
| 5 | Ø 19 mm: addition port adapter, quadruple (reagents & feed) | 12 | Ø 12 mm / Pg13.5: Exit gas cooler |
| 6 | Ø 12 mm / Pg13.5: Sparger | 13 | Fixation of baffle (bact. cult.) |
| 7 | Ø 12 mm / Pg13.5: Spare | | |

Setup and Function

3.3.7 Top Plate DN 200



- | | |
|--|--|
| 1 Ø 19 mm: Spare | 8 Ø 19 mm: Spare or cold finger |
| 2 Ø 10 mm: Temperature sensor (Pt100) | 9 Ø 19 mm: Spare |
| 3 Ø 10 mm: Antifoam sensor | 10 Ø 19 mm: addition port adapter, quadruple
(corrective reagent & feed) |
| 4 Ø 19 mm: Spare | 11 Ø 12 mm / Pg13.5: pH sensor |
| 5 Ø 12 mm / Pg13.5: Sparger | 12 Ø 12 mm / Pg13.5: pO ₂ sensor |
| 6 Ø 12 mm / Pg13.5: Dip tube for sampling | 13 Ø 12 mm / Pg13.5: Exit gas cooler |
| 7 Ø 19 mm: Inoculation | 14 Ground connector antifoam sensor |

3.4 Temperature Control System

The following two temperature control systems are available:

- Water temperature control for double walled vessels
- Temperature control with electrical heater pad and cold finger for single walled vessels.

Measurement of the temperature in the culture vessel takes place by a platinum resistance sensor (Pt100) for both systems. Water

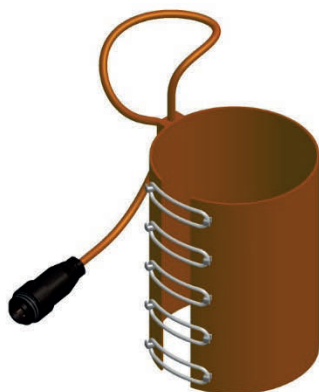
Setup and Function

flow for either the circuit in the double walled vessel or in the cold finger is regulated via solenoid valve.

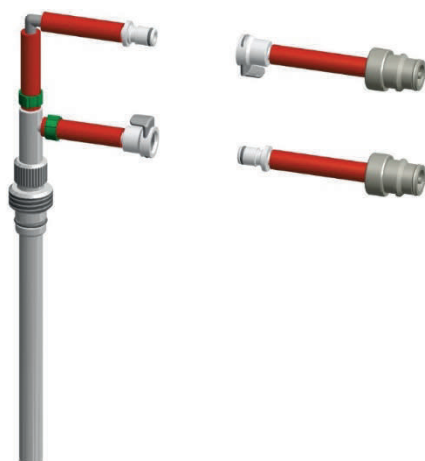
3.4.1 Water Temperature Control

The water temperature control takes place in the vessel jacket, which is connected to the basic unit. The water is heated by the means of an electrical heating element in the basic unit. Cold water is fed into the circuit for cooling. The overflow in this open system prevents a dangerous overpressure in the circuit and allows pressure equalisation of the vessel jacket during sterilisation in the autoclave.

3.4.2 Temperature Control with Heater Pad and Cold Finger



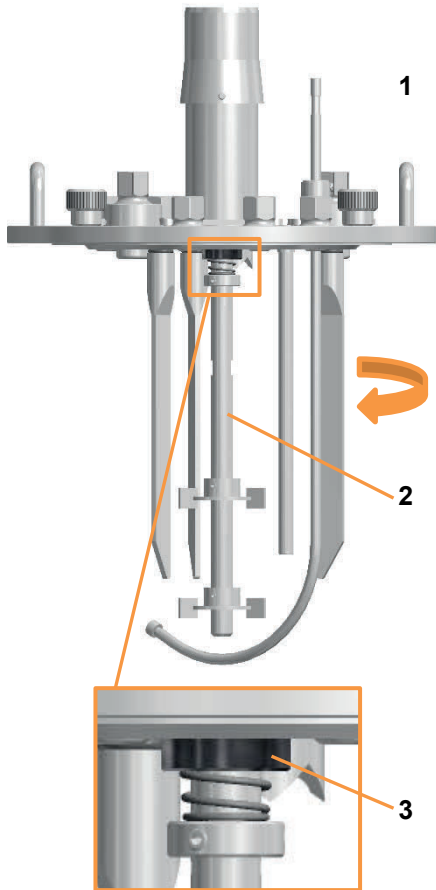
An electrical heater pad is put around the vessel and connected to the basic unit for heating.



The water cooling is effected via a cold finger, which is connected to the basic unit and mounted into a port in the vessel top plate. Appropriate hoses with rapid couplings for connection to the basic unit are included. For further details see the main chapter "Accessories", chapter "Cold Finger".

Setup and Function

3.5 Stirrer



The stirrer shaft is rotated counter clockwise (top view) by a top drive.

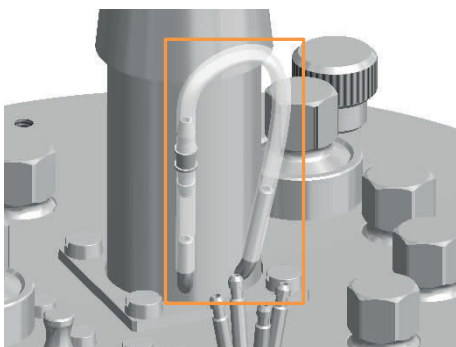
- 1 Drive hub
- 2 Stirrer shaft
- 3 Mechanical seal

The stirrer shaft is screwed on the drive hub in the vessel top plate and is sealed by a single mechanical seal.



ATTENTION

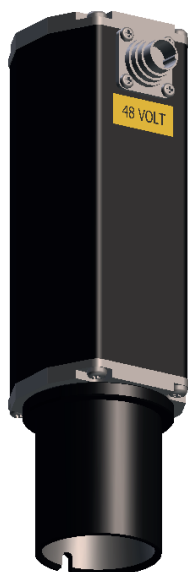
Manipulation on the mechanical seal may lead to its damage!



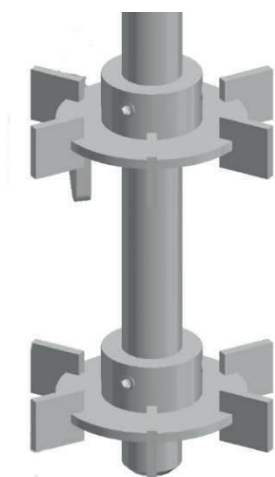
The mechanical seal must be lubricated at any time. For this, two nozzles fitted with a piece of silicone hose are located on the drive hub.

For details see chapter “Lubricating the Mechanical Seal” in the main chapter “Cleaning & Maintenance”.

Setup and Function



A brushless DC motor with mechanical coupling is used as a standard. To couple the motor, it is simply plugged onto the drive hub on the vessel top plate.



Two Rushton impellers with six blades are provided as a standard for bacterial cultures. They are fixed by the means of grub screws to the shaft.

3.6 Gassing System

The basic unit is equipped with the appropriate gassing units (rotameter, solenoid valves, mass flow controllers and configured according to the chosen gassing strategy.

The following gases can be used:

- Air
- Oxygen (O₂)
- Nitrogen (N₂)

Setup and Function

3.6.1 Gassing Strategy

The following variants are available:

Basic

- Manual flow control via rotameter
- Gasmix via solenoid valves

Standard

- Gas flow control via one electronic mass flow controller
- Gasmix via solenoid valves

High End

Gas flow control and Gasmix via electronic mass flow controllers, 1 piece per gas.

3.6.2 Gasmix System

The gas mixture takes place before entry into the culture vessel. The composition of the gas mixture is set and controlled in the touch screen software.

A detailed description of the touch screen software can be found in the separate manual.

3.6.3 Gas Entry

The gas or the gas mixture is led via a silicone hose from the gassing connection on the basic unit via sparger directly into the medium in the culture vessel. For details about the sparger see the main chapter „Accessories“, chapter „Sparger“.

3.7 Exit Gas

Pressure in the culture vessel may be increased due to temperature increase or gas production also without actively gassing the culture. For this reason, installing an exit gas line to the vessel is mandatory for every cultivation process.

Deviating the exit gas without exit gas cooler

If no exit gas cooler is used, the exit gas can be deviated via addition port adapter or inoculation needle fitted with an exit gas filter.

Setup and Function

However, using this method may lead to blocking the exit gas filter due to humidity in the exit gas. For this reason, the use of an exit gas cooler is strongly recommended.

The exit gas cooler is separately available, it is NOT included in the standard package.

Deviating the exit gas via exit gas cooler

The exit gas cooler dries the exit gas by condensation so that humidity cannot block the exit filter. This prevents from liquid loss in the culture medium at the same time.



INFORMATION

If strong build-up of foam is expected, a foam trap i.e. a bottle containing antifoam agent can be installed before the exit gas filter as an additional safety precaution.

For details see main chapter “Accessories”, chapter “Exit Gas Cooler”.

3.8 pH Control

pH in the medium is measured by the pH sensor and controlled by addition of reagents (acid, base). Addition of acid and base takes place via the two peristaltic pumps *Acid* and *Base*.

Reagent bottles are filled with acid and base which are connected to an/the addition port adapter(s) in the vessel top plate and the two pumps by silicone hoses.

3.8.1 Measurement System

The measurement system for pH is either equipped and configured for analogue sensors from the manufacturer METTLER or digital sensors from the manufacturer HAMILTON.

The pH sensors are separately available, they are NOT included in the standard packages.

Variant METTLER

- Traditional pH sensor (potential measurement against reference)
- Type: 405-DPAS-SC-K8S
- Manufacturer: METTLER TOLEDO

Setup and Function

Variant HAMILTON

- Traditional pH sensor (potential measurement against reference) with integrated electronics
- Type: Easyferm Plus ARC
- Manufacturer: HAMILTON

HAMILTON pH sensors are preconfigured before dispatch by the equipment manufacturer INFORS HT. Replacement sensors of this type must be reconfigured before use!

Details on technical data, use and maintenance of the pH sensors can be found in the separate documentation of the sensor manufacturer. Read and follow instructions stated in there.

3.8.2 Calibration

As a general rule: Calibration of a pH sensor always must be carried out **BEFORE** sterilisation. This is executed on the touch screen operating unit. For details refer to the separate operating manual of the touch screen software.

3.8.3 Mounting of the Sensor

pH sensors are mounted into a 12 mm / Pg13.5 port by the means of an electrode holder. For details see main chapter “Accessories”, chapter “Electrode Holder”.

3.9 pO₂ Control

The oxygen saturation of the (culture) medium is measured by the pO₂ sensor, and can be adjusted as follows:

Increasing the pO₂

The content of the oxygen dissolved in the medium (pO₂) can be increased using the following methods:

- Increasing the stirrer speed
- Increasing the gas volume flow rate (air and/or oxygen)
- Increasing the oxygen content in the Gasmix.

These approaches can also be combined.

Setup and Function

pO₂ reduction

In anaerobic processes, the vessel can be gassed using nitrogen. This displaces the oxygen dissolved in the medium.

For details about pO₂ control refer to the separate operating manual of the touch screen software.

3.9.1 Measuring System

The measuring system for pO₂ is either equipped and configured for analogue sensors from the manufacturer METTLER or digital sensors from the manufacturer HAMILTON.

The pO₂ sensors are separately available, they are NOT included in the standard packages.

Variant METTLER

- Traditional amperometric/polarographic pO₂ sensor
- Type: InPro 6820/25/080
- Manufacturer: METTLER TOLEDO.

Polarographic pO₂ sensors must be polarised at initial operation or after disconnection from the voltage source. This means that the pO₂ sensor must be polarised after sterilisation in the autoclave. For details refer to the separate documentation from the manufacturer.

Variant HAMILTON

- pO₂ sensor with integrated optical electronics
- Type: Visiferm DO ARC
- Manufacturer: HAMILTON

HAMILTON pO₂ sensors are preconfigured before dispatch by the equipment manufacturer INFORS HT. Replacement sensors of this type must be reconfigured before use!

Details on technical data, use and maintenance of the pO₂ sensors can be found in the separate documentation of the sensor manufacturer. Read and follow instructions stated in there.

3.9.2 Measurement and Calibration

Generally speaking, the following applies: Unlike measurements such as pH, which are calibrated to absolute measurement values,

Setup and Function

the oxygen measurement is always calibrated to a relative reference point. For this purpose, the calibration is set to 100 % relative oxygen saturation, usually with air at max. stirring speed and maximum gas flow rate. The actual concentration of dissolved oxygen in mmol/L may therefore vary at 100 % saturation, depending on the process.



INFORMATION

Calibration is always carried out **AFTER** autoclaving. This is carried out on the touch screen operating unit. Depending on the specifications defined by the user, the pO₂ sensor will be calibrated either before the vessel is filled with medium or afterwards, in the prepared medium.

For details about calibration refer to the separate operating manual of the touch screen software.

3.9.3 Mounting of the Sensor

pO₂ sensors are mounted into a 12 mm / Pg13.5 port by the means of an electrode holder. For details see main chapter “Accessories”, chapter “Electrode Holder”.

3.10 Antifoam Control

Foam hinders the exchange of gas between the medium and the gas phase in the head space. The exit gas filter can become clogged with foam, which causes a pressure build-up in the vessel. This can be prevented by adding antifoam agent.

The antifoam agent is kept in a reagent bottle that is connected to the antifoam sensor and the antifoam pump via a hose. The sensor also acts as a dosing needle. When the sensor comes in contact with foam, the antifoam pump is activated and antifoam agent is fed into the vessel via the dosing needle.



INFORMATION

The antifoam sensor is separately available, it is NOT included in the standard packages. For details refer to main chapter “Accessories”, chapter “Antifoam Sensor”.

4 Options

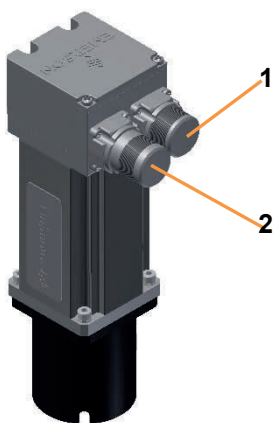
The following options are available in addition to the equipment included in the scope of supply for the basic unit.

4.1 Pump(s)



Additionally to the four peristaltic pumps, which are integrated on the basic unit by default, two analogue pumps are available. These are mounted to the side of the basic unit. Control is the same as for the standard analogue pump, it is adjustable within a range of 0 and 100 %.

4.2 Servomotor (High Torque)



For high speed requirements, a powerful servomotor is available and can be used instead of the standard brushless DC motor.

- 1 Signal connector for (orange) signal cable
- 2 Power connector for (green) power cable

The motor has a mechanic coupling and is coupled to the drive hub on the vessel top plate like the standard motor.

Options



The servomotor is operated by a separate AC servo amplifier. This is connected to the basic unit via two cables (not visible in the picture to the left).

The green power cable and the orange signal cable are connected on the rear side of the amplifier box. Control of the servomotor takes place via touch screen operating panel like the standard motor.

Specification Stirrer with High-Torque Motor

Description	Value
Drive	Shaft with mechanical seal
Motor	Servomotor Nominal power: 330 W Nominal torque: 1.05 Nm
Range of rotation speed with 2 impellers (Standard)	13 L / DN 200 vessel: 10 up to 1250 min ⁻¹ All other vessels: 10 up to 1500 min ⁻¹
Range of rotation speed with 3 impellers (Option)	13 L / DN 200 vessel: 10 up to 1000 min ⁻¹ All other vessels: 10 up to 1500 min ⁻¹
Accuracy	Measurement: ± 5 min ⁻¹ at 100 - 1000 min ⁻¹ 1 % setpoint at > 1000 min ⁻¹ Control: ≤ ± 5 min ⁻¹ at 100 – 1000 min ⁻¹ ≤ 1 % setpoint at > 1000 min ⁻¹
Direction of rotation	Counter clockwise (top view vessel)
Bearing	Outside of vessel, in drive hub
Impellers	Rushton with 6 blades



INFORMATION

Rotation speed is valid for viscosity similar to water, without aeration. Vessels are equipped with two impellers by default. The max. adjustable rotation speed on the operating panel is set for 2 impellers.

4.3 Level Measurement

Detects liquid in the culture vessel, i.e. measures the level by means of the level sensor. When the level sensor comes in contact with liquid, a signal is generated which is displayed as 100 % in the touch screen software.

If required, this signal can be used for level control in order to keep the working volume constant in the culture vessel. For this, e.g. a simple cascade can be setup to control the feed pump or one of the optional pumps, to either feed liquid into the vessel or to extract liquid from the vessel. Customized configurations are available on request.

Level Sensor

The type of level sensor with clamping adapter without O-ring for mounting in a Ø 12 mm / Pg13.5 port in the vessel top plate is supplied as standard.

An additional appropriate adapter is supplied for mounting in a 19 mm port in a vessel top plate with DN200 (mm).



- 1 Connection for banana connector of sensor cable
- 2 Clamping adapter with slotted screw (A)
- 3 Sensor shaft with transparent insulation

The level sensor is equipped with two NON-autoclavable protective caps.

Level sensor types with clamping adapters for Ø 10 mm or 19 mm ports are available, too. For details about clamping adapters and adapters, refer to chapter "Accessories".

Options

4.4 Exit Gas Analysis

In order to allow the user to draw conclusions regarding the status of the culture while the bioprocess is still underway, the CO₂ and O₂ measurements are often taken and analysed in the exit gas flow of the bioreactor.

4.4.1 Measuring Systems (Gas Sensors)

The following measuring systems are available for exit gas analysis:

- INFORS HT Gas Analyser: gas analysis equipment (combined CO₂ and O₂ sensor) from the equipment manufacturer.
- Gas sensors from the manufacturer BlueSens: combined CO₂ and O₂ sensors of the type BlueInOne Ferm, BlueInOne Cell or BlueVary

Measurement ranges gas sensors

Type gas sensor	Vol. % O ₂	Vol. % CO ₂
Gas Analyser	0.1 – 25 ¹⁾	0 – 10
BlueInOneFerm BlueVary	1.0 – 50 ¹⁾	0 – 10 or 0 – 25
BlueInOneCell BlueVary	0.1 – 100 ²⁾	0 – 10 or 0 – 25

¹⁾ only suitable for use in aerobic bioprocesses

²⁾ suitable for use in aerobic and anaerobic bioprocesses

For details on the safety, technical data, usage and maintenance requirements for the gas sensors, see the separate documentation provided by the sensor manufacturer. Read this documentation before using the gas sensor and follow the instructions contained therein.

4.4.2 Connecting the Gas Sensors

In order to view measurements on the operating panel, the measuring system for exit gas analysis must be connected to the bioreactor.

INFORS HT Gas Analyser

Connection of the gas analysis equipment from the equipment manufacturer is described in details in its separate documentation.

Gas sensors from manufacturer BlueSens

The gas sensor must be connected to the sensor cable and the bioreactor's exit gas must be led into the sensor via hose line. Generally, the cable connection is established only once during installation and remains then. The connection to the exit gas line must be re-established before each cultivation process

The ideal connection conditions are detailed in the separate documentation provided by the manufacturer.

Connecting the sensor cable

The fixed sensor cable is pre-installed in the factory (rear of equipment). The cable has an 8-pin round plug connector. In order to connect the sensor, the plug connector is plugged into the socket marked Port **A** on the gas sensor.

Due to the length of the sensor cable, the gas sensor can be positioned in a large number of possible locations.

Establishing the hose connection

3 m of pressure hose, D = 8 x 14.5, and a hose clamp are provided with the equipment in order to establish the hose connection between gas sensor and culture vessel (exit gas filter).

The hose connection between the culture vessel (exit gas filter) and the gas sensor must be designed in line with the direction in which the gas flows through the gas sensor.

Proceed as follows:

Procedure

1. Cut as short a piece as possible off the supplied pressure hose.
2. Push one end of the hose onto the hose nozzle (observe direction of flow) on the gas sensor's flow adapter and fasten in place with the clamp.
3. Push the open end of the hose onto the exit gas filter on the exit gas cooler.

**INFORMATION**

Do NOT use a clamp here, as the hose must be easy to disconnect at this point, e.g. for autoclaving the culture vessel.

Options

4.4.3 Calibration

INFORS HT Gas Analyser

The display of measured values on the bioreactor should be calibrated after the annual maintenance of the gas analyser has been carried out

For details about maintenance of the gas analyser refer to its separate documentation.

Gas Sensors from manufacturer BlueSens

1-point calibration must be carried out once per month and after installation in order to guarantee exact measurement results.

This is done directly on the gas sensor itself. The procedure is described in the separate documentation provided by BlueSens.

4.4.4 Replacing the BlueVary Gas Sensor Cartridge

The max. operating time of a BlueVary gas sensor cartridge amounts to 9000 operating hours. Once this limit is reached, measurement is no longer possible. I.e. there is no measured value output anymore and the display turns red. The gas sensor cartridge must be replaced by the sensor manufacturer.

For detailed information refer to the separate documentation from the sensor manufacturer.

4.5 Multiplexer (Gas Switching Module)

To be able to measure exit gas values - usually O₂ and CO₂ - while bio processes are running in parallel, every single bioreactor usually has to be equipped with the corresponding measuring system (see chapter "Exit Gas Analysis"). Using one or more of the equipment's manufacturer's Multiplexers makes it possible to use only a single measuring system for this. The exit gases from the individual bioreactors are directed sequentially to the measuring system used by means of the gas switching module(s). The determined values are assigned to the corresponding bioreactor.

When using Multiplexers, the measurement information for the individual culture vessels is not available continually since one measurement sensor sequentially measures the exit gas of all culture vessels. The measurement interval achievable for each culture vessel depends, among other things, on the gas volume stream and the hose type used as well as its length.

4.6 Turbidity Measurement

The Optek ASD12-N measurement sensor can be used to determine the turbidity of the culture. Turbidity measurement can be used to draw conclusions regarding the biomass concentration in the culture.

The system comprises a sensor with a transmitter that is integrated into the bioreactor basic unit:

- Type ASD12-N with three optical path lengths:
 - OPL01: for very high cell densities
 - OPL05: for higher cell densities
 - OPL10: for lower cell densities
- Manufacturer: Optek
- Measures the absorption in the 0 – 4 CU range

The ASD12-N sensors supply a non-linearised turbidity measurement for the culture. This can be linearised manually using the soft sensor in eve®, for example, in order to determine correlation with factors such as the biomass concentration or optical density.



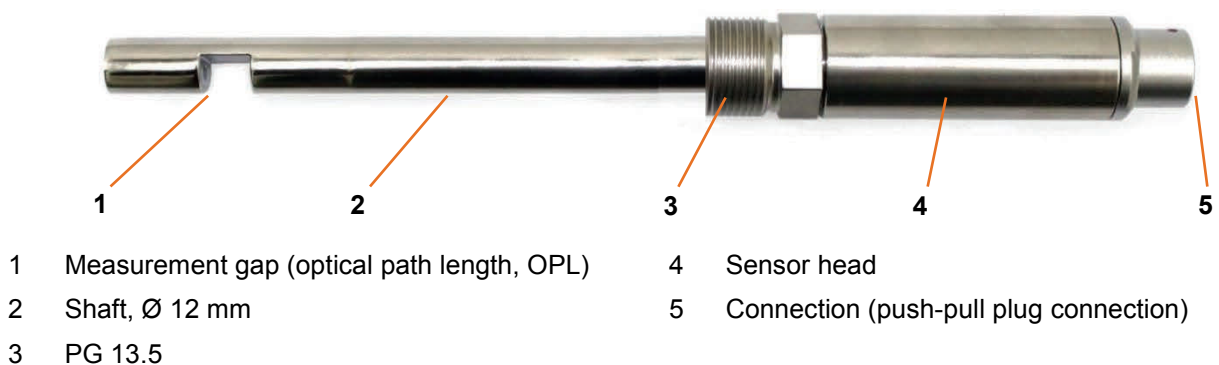
INFORMATION

The Optek ASD sensors are designed exclusively for use as turbidity sensors for liquids and gases in accordance with the technical data ("Specifications").

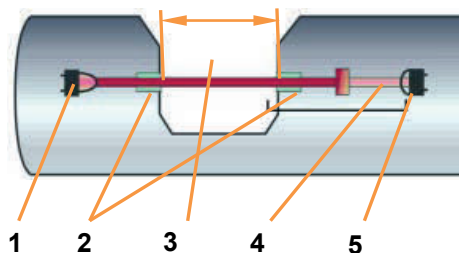
The use of these sensors is forbidden in potentially explosive areas.

4.6.1 Sensors

Optek ASD sensors are high-precision turbidity sensors. They can be used to draw conclusions regarding the growth of microbial cultures or cell cultures as a function of NIR absorption.



Options



The sensors possess a measurement segment that is optimised in terms of flow and sterility. The seal-free design of the sapphire window means that there are no gaps or joints. This guarantees complete sterility. All components that come into contact with the media are made of electrolytically polished steel.

Main components

- 1 LED light source
- 2 Sapphire window
- 3 Optical path length (OPL)
- 4 Daylight filter
- 5 Silicon photodiode detector

A defined LED light beam is shone through the process medium. The weakening of the light intensity, which is caused by absorption and/or diffusion by the dissolved and undissolved particles in the carrier medium, is detected by a hermetically encapsulated silicon photodiode.

The ASD-N sensors use the light in the near-infrared range (NIR) of 840 nm to 910 nm.

4.6.2 Calibrating the Zero Point

Optek sensors are pre-calibrated in the factory. Inserts are available for reference measurement.

Due to the different light absorption of different media, zero point calibration should be performed before each cultivation process. This can be done on the operating panel, either **before or after** autoclaving, depending on the application in question. For more details refer to the separate operating manual of the touch screen software.

4.6.3 Mounting the Sensor

Optek-ASD sensors can be mounted directly into 12 mm / Pg13.5 ports. An additional adapter is necessary for mounting the sensor into a 19 mm port. In order to adjust the mounting depth of the sensor, an electrode holder is needed. For details see chapter "Accessories", "Electrode Holder".

Please note the following points when mounting the components:

- Ensure that the sensor is fitted with an O-ring; fit an O-ring if necessary.
- Mount the sensor by hand – do not use any tools!

Options

- If the mounting depth of the sensor is adjustable (mounting with electrode holder), make sure the mounting depth is set correctly prior to autoclaving, as later adjustment represents a contamination risk.
- Mount the sensor in such a way that it cannot come in contact with other components or the glass vessel.
- Mount the sensor in such a way that it has good access to the flow and there is no risk of bubbles collecting in the measurement gap.

4.6.4 Cleaning and Storing the Sensor

A build-up of deposits on the sapphire window will cause shifts in the zero point and restrict the dynamic range of the sensor. As such, the sapphire window on the sensor must be checked for deposits before each use and cleaned if necessary.

If necessary, store the Optek sensor in a clean, dry place at a temperature of between -20°C and 70°C.

4.6.5 Interferences Turbidity Measurement

Interference		
Displayed measured value is not plausible / unusual		
Possible Cause	Remedy	By
Sensor cable is twisted or kinked or not properly connected.	Check and ensure that the sensor cable is not kinked or twisted. Connect the sensor cable properly as necessary.	Operator
Sensor is not calibrated	Calibrate the zero point	Operator
Window fouling on the sapphire windows .	Carefully clean the sensor	Operator
Faulty sensor cable	Replace sensor cable	Qualified electrician
Faulty sensor	Replace the whole sensor	Operator



INFORMATION

The measuring system automatically switches off, if the temperature of the sensor in the medium exceeds 50 °C during operation (thermal shutdown). Once the medium has cooled down, measurement automatically continues.

Options

4.6.6 Specifications

Description	Value
Sensor type and manufacturer	ASD12-N
Available path lengths	OPL01: for very high cell densities OPL05: for higher cell densities OPL10: for lower cell densities
Material sensor	316L, electropolished and sapphire glass
Measuring principle	1-channel absorption of light
Measurement wavelength	840 nm – 910 nm
Detector	Silicone photodiode (hermetically sealed)
Measuring range	0 – 4 CU (concentration units)
Protection	IP 68
Light source	Hybride LED
Temperature	Shutdown at 50 °C ¹

¹⁾ The measuring system automatically switches off, if the temperature of the sensor in the medium exceeds 50 °C during operation (thermal shutdown). Once the medium has cooled down, measurement automatically continues.

4.7 Permissive Measurement

The sensor with the corresponding transmitters must be purchased directly from the manufacturer ABER. INFORS HT offers a connection to the transmitter on the basic unit.

Calibration is performed according to the manufacturer's guidelines directly on the transmitter.

- Manufacturer: ABER
- System: Futura
- Measured parameters:
 - Permittivity in the 0 to 400 pF cm⁻¹ range
 - and:
 - Conductivity in the 0 to 40 mS cm⁻¹ range

Sensors of the ABER Futura systems measure the permittivity (also: *capacitance*) and conductivity of the culture. This measured data can be used to determine a correlation with the live biomass concentration, for example, using the soft sensor in eve® or data evaluation.

All information about the ABER Futura system is available in the separate documentation provided by the manufacturer.

4.8 Redox Measurement

Measures the reduction/oxidation potential (redox) in the medium.

4.8.1 Measuring Systems (Sensors)

Two systems are available for redox measurement:

METTLER version (analogue)

- Classic combined sensor (oxidation reduction potential measurement against a reference)
- Type: 405-DPAS-SC-K8S
- Manufacturer: METTLER TOLEDO
- Measures the reduced potential in the medium in the range from -2,000 mV to +2,000 mV.

To use the sensor, the basic unit must be equipped with a corresponding connection.

HAMILTON version (digital)

- Classic combined sensor (oxidation reduction potential measurement against a reference) with integrated electronics
- Type: Easyferm Plus ORP ARC
- Manufacturer: HAMILTON
- Measures the reduced potential in the medium in the range from -1,500 mV to +1,500 mV.

If the basic unit is configured for Hamilton sensors, the redox sensor can be connected instead of the pO₂ sensor. If the sensor is configured in addition to the Hamilton pO₂ sensor or if the basic unit is configured for Mettler sensors, an additional connecting cable is required.

4.8.2 Calibration

The redox sensor is usually not calibrated/adjusted. However, the calibration of the sensor can be checked using the appropriate redox buffer solution.

Options

- METTLER system: 1-point calibration in the calibration menu of the redox parameter in the touch screen software from the administrator user level.
- HAMILTON system: Calibration using a Hamilton Arc Handheld or a Hamilton Arc USB cable, both of which are available separately from the sensor manufacturer.

In case of a deviation of ± 10 mV from the buffer solutions, clean the redox sensor according to the description provided by the respective sensor manufacturer or contact the sensor manufacturer.

For details on the technical data, usage and maintenance requirements for the redox sensors, see the separate documentation provided by the respective sensor manufacturer, i.e. METTLER TOLEDO or HAMILTON.

4.8.3 Mounting the Sensor

Redox sensors (both variants) are mounted into a 12 mm / Pg13.5 port in the vessel top plate by the means of an electrode holder. An additional adapter is necessary for mounting the sensor into a 19 mm port. For details about the electrode holder see chapter "Accessories", "Electrode Holder".

4.9 pCO₂ Measurement

Measures saturation of dissolved carbon dioxide (CO₂) in the culture in hPa. Measurement is done by a digital CO₂ sensor with integrated temperature sensor. Measured values are displayed on the associated transmitter and in the touch screen software.

- Type of sensor (digital): InPro5000i ISM
- Measuring principle: potentiometric
- Type of transmitter: M400
- Manufacturer (sensor & transmitter): METTLER TOLEDO

The displayed value of parameter pCO₂ in the touch screen software is set to a range of 0 hPa to 1000 hPa analogous to the displayed value of the transmitter.

If a CO₂ gassing line is present and configured with a mass flow controller (parameter *CO₂ Flow*), then this can be used e.g. via cascades for pCO₂ control.

Calibration of the sensor is carried out directly on the transmitter according the sensor manufacturer's specifications.

For details about technical data, use and maintenance of the pCO₂ sensor and transmitter, refer to the separate documentation from the manufacturer METTLER TOLEDO.

Mounting of the sensor

pCO₂ sensors are mounted into a 12 mm / Pg13.5 port in the vessel top plate by the means of an electrode holder. An additional adapter is necessary for mounting the sensor into a 19 mm port. For details about the electrode holder see chapter “Accessories”, “Electrode Holder”.

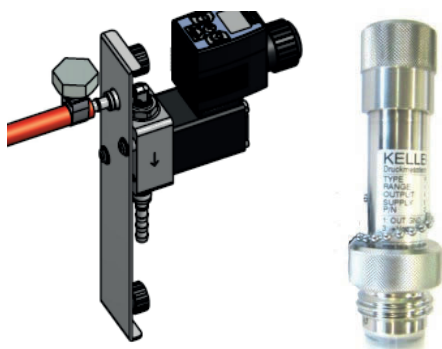
4.10 Pressure Control

The standard equipment is built for pressure-free operation. It is mandatory to have a pressure control installed, if a cultivation process under pressure is foreseen.



WARNING

Overpressure in the glass vessel may cause the vessel to burst or break. Any build-up of pressure must be avoided without the pressure control option!



Pressure control consists of a solenoid valve (proportional valve) and a piezo-resistive pressure sensor with fixed O-ring (the O-ring is not visible in the picture to the left).

Depending on the equipment configuration, the solenoid valve is situated next to or below the gassing unit on the right side of the equipment.



CAUTION

Risk of slight burns when touching the hot solenoid valve!

The solenoid valve heats up when under electric voltage, which is the case as soon as the equipment is switched on.

The pressure hose for connection to the exit gas filter during operation i.e. cultivation is installed when the equipment is stalled.

Pressure control is set and activated in the touch screen software in parameter *Pressure*. Control is possible up to 400 mbar.

Options

If pressure control is switched off (parameter *Pressure OFF*), the valve automatically opens to prevent build-up of pressure in the vessel.

For details about the touch screen software refer to the separate operating manual.



The pressure sensor is mounted into a 19 mm port in the vessel top plate. A threaded adapter is used for this (refer to chapter “Accessories” for details).

A plastic cap protects the steel membrane from damage. A screwed on steel cap protects the female cable plug during autoclaving.

- 1 Threaded steel cap
- 2 Hollow screw
- 3 Protective cap (plastic)

Before autoclaving

The pressure sensor is mounted into a 19 mm port in the vessel top plate and autoclaved with the culture vessel.

Proceed as follows for the mounting:

Procedure

1. Fit a threaded adapter into the 19 mm port in the vessel top plate.
2. Carefully remove the protective cap from the steel membrane of the sensor.



ATTENTION

The steel membrane is very sensitive and can be damaged when knocking it on solid objects or when rubbed.

Carefully mount the pressure sensor by hand. Do not use any tool!

3. Ensure the sensor is equipped with an intact O-ring, fit one if necessary.
4. Carefully screw the pressure sensor into the threaded adapter.
5. Screw the steel cap onto the female sensor connector.

After autoclaving

The exit gas filter (on the exit gas cooler) must be connected to the pre-installed pressure hose of the solenoid valve. This ensures that the exit gas is led via solenoid valve into the atmosphere i.e. into the exit gas line, which has to be installed on-site by the provider. The sensor cable must be connected to the pressure sensor, too.

Proceed as follows:

Procedure

1. Fit the pressure hose from the solenoid valve to the exit gas filter.
2. Unscrew the steel cap from the cable plug on the sensor.
3. Plug the male plug of the sensor cable into the female plug on the sensor.
To do so, the red mark on each plug must be aligned.



Maintenance

Basically, the pressure sensor is maintenance-free. The recalibration interval depends on the operating conditions. However, annual recalibration is recommended by the sensor manufacturer.

4.11 LabCIP, CIP/SIP Unit

The equipment is used for cleaning (CIP) and sterilisation (SIP) of the bioreactor, provided there is a certain equipment configuration.

Options

All information regarding safety, setup and function, operation, maintenance and technical data of the LabCIP is available in the separate operating manual from the equipment manufacturer.

5 Accessories

The kind and number of accessories included by default in every standard package are listed the following table. It is divided in columns according the diameter nominal (= inside diameter in mm) of the vessels and their different sizes (TV = total volume in L).

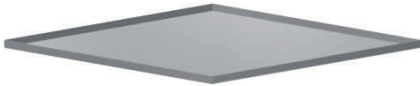
Accessory	DN115		DN150		DN200
	2.0 L TV	3.6 l TV	3.6 l TV	7.5 L TV	13 l TV
Base tray	1	1	1	1	1
Sparger, L-shaped	1	1	1	1	1
Impeller, Rushton	2	2	2	2	2
Pocket for temperature sensor in Ø 10 mm port.	1	1	1	1	1
Baffle	3	3	3	3	3
Blanking plug for Ø 10 mm port	1	1	1	1	1
Blanking plug for Ø 12 mm / Pg13.5 port	5	5	5	5	4
Blanking plug for Ø 19 mm port (with fixed O-ring)	1	1	2	2	5
Addition port adapter, quadruple, for Ø 19 mm port.	1	1	1	1	1
Inoculation needle and septum collar for Ø 12 mm / Pg13.5 port	1	1	---	---	---
Inoculation needle and septum collar for Ø 19 mm port.	---	---	1	1	1
Clamping adapter for Ø 12 mm / Pg13.5 port with inside-Ø 6 mm (for sparger)	1	1	1	1	1
Dip tube, straight, Ø 6 mm for Ø 12 mm / Pg13.5 port	1	1	1	1	1
Threaded adapter for Ø 19 mm port	1	1	2	2	5
Sampling system Super Safe Sampler for Ø 12 mm / Pg13.5 port	1	1	1	1	1
Starter Set	1	1	1	1	1
Cold finger ¹ for Ø 19 mm port.	1	1	1	1	1
Heater pad ¹	1	1	1	1	1
Reagent bottle and pump holder for 250 mL reagent bottles	1	1	1	1	---
Reagent bottle and pump holder for 500 mL reagent bottles	---	---	---	---	1

¹⁾ For single walled vessels with temperature control system with electrical heater pad and cold finger.

Accessories

5.1 Base Tray

Culture vessels are delivered with a base tray made of stainless steel.



Dimensions:

- 373 mm × 373 mm for vessels with DN 115 / 150
- 423 mm × 423 mm for vessels with DN NW 200
- 437 mm x 612 mm for vessels combined with a scale underneath the vessel.

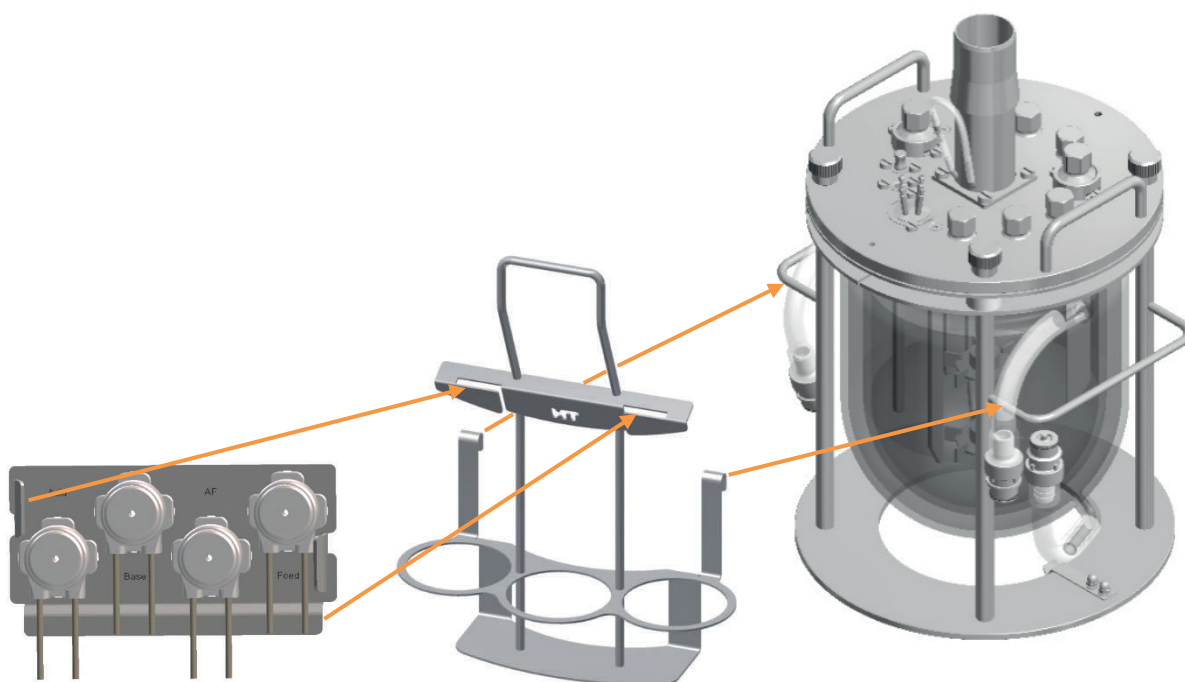
5.2 Reagent Bottle and Pump Holder

The culture vessel is autoclaved along with reagent bottles, hoses and pump heads.

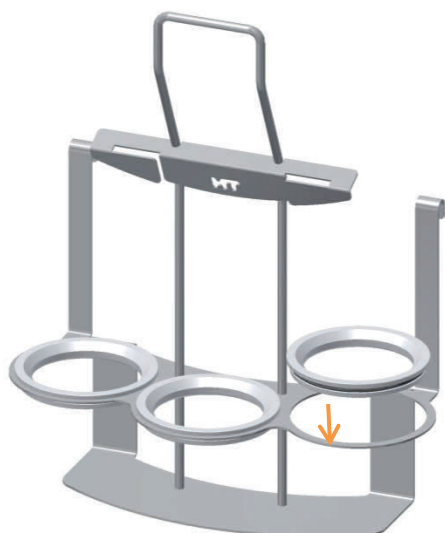
For easy handling, a holder for reagent bottles and pump heads is available. There are two types available:

- for 250 mL reagent bottles, purchased with vessels with DN 115 and 150
- for 500 mL reagent bottles, purchased with vessels with DN 200





The reagent bottle and pump holder can be fitted to the vessel holder. The mounting plate with the pump heads can be fitted to the reagent bottle and pump holder.



The holder for 500 mL reagent bottles can be modified using the centering rings, which can be obtained as an optional modification set. The holder can be used then with 250 mL reagent bottles, too.

Accessories

5.3 Sampling System Super Safe Sampler

Basically different systems and also individual components are available for sampling. This operating manual describes the operation and handling of the aseptic sampling system Super Safe Sampler combined with a dip tube.

The use of the Super Safe Sampler prevents the culture vessel from contamination when sampling.

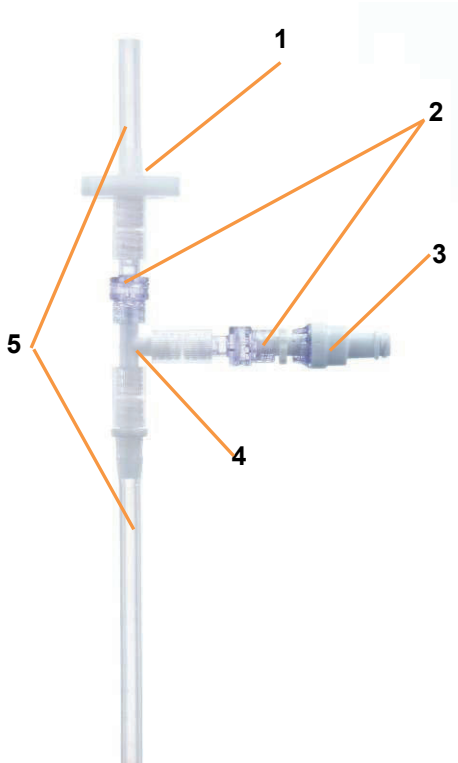
Content of the set

The set consists of a completely pre-assembled group of valves with hoses and two syringes. It is connected via silicone hose with a dip tube.

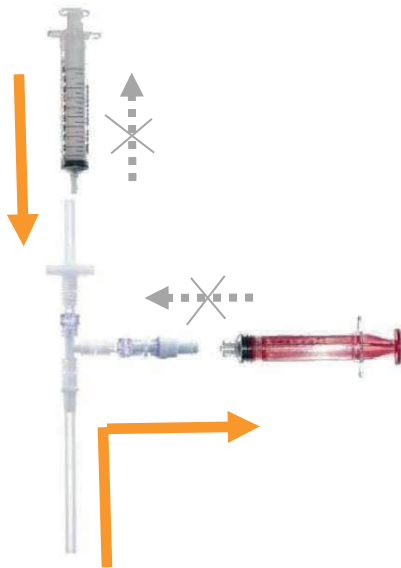


Valve assembly

- 1 Sterile filter
- 2 Check valve
- 3 Luer activated sample valve
- 4 T-piece
- 5 Hose



The valve assembly consists of a T-piece, two check valves, a Luer-activated automatic sample valve, a sterile filter, a length of hose as an adapter for the syringe and another hose for connection to the sample dip tube in the culture vessel.



Principle of function

The sample valve on the side arm of the T-piece opens by putting the Luer connector of the syringe into the valve and closes by removing the syringe. No further handling is necessary.

Unintentional re-introduction of the sample material once it has been withdrawn is prevented by a check valve. Thus, contamination of the bulk culture is impossible.

Following sampling, a second syringe can be fitted and air pushed in via the sterile filter, in order to displace culture solution from the sample hose and the dip tube of the vessel. With a conventional sampling system, the next sample cannot be taken immediately, as rinsing of the sampling hose and the immersion tube is necessary. By previously removing most of the culture in the sampling line, this sampling system can save culture volume, which is particularly important with small vessels and/or frequent sampling.

The dead volume of the culture remaining in the group of valves after flushing with sterile air amounts to a few μl and is negligibly small. If the withdrawal of a very small sample volume is required, with minimum possibility of falsification, a small quantity of culture solution (e.g. 1 ml) can be introduced and rejected before the actual sample is taken.

Designated use

The Super Safe Sampler is designed for aseptic sampling of completely liquid samples.

Solid parts in the sample may lead to clogging of the valves. Therefore, employing the Super Safe Sampler for solid media is not recommended.

The Super Safe Sampler is autoclavable (not the syringes!) and for this reason reusable.

Practical tips for the use of the Super Safe Sampler

Sterility of the culture vessel is ensured at all times without the possible measures mentioned below.

The use of a sterile syringe and sterile caps is only necessary if the

Accessories

sample has to be processed under sterile conditions. For sampling, the same non-sterile syringe can be used repeatedly, without fear of contamination of the culture vessel.

Aseptic Sampling

For each sample, use a new, sterile syringe with Luer Lock fitting, in order to ensure the sterility of the sample.

Sterile syringes are consumables and therefore not included in the set.



INFORMATION

The use of another syringe is also possible. But a syringe with Luer lock prevents unwanted movement of the syringe.

- Before fitting the syringe, disinfect the sample valve. For this, spray a commercially available disinfectant onto the valve.
- After spraying and after each sampling, close the the sample valve with a sterile Luer-Lock cap (Dead End Cap) to keep the valve and sample sterile.

The caps are not included in the kit. Very convenient to use are so-called combi-caps that fit on male and female connectors alike.

Caps that are vented and made of steam sterilisable material can also be fitted during autoclaving.

5.4 Sparger

The gas is fed directly into the medium via a sparger by default. The sparger is mounted in a 12 mm / Pg13.5 port in the vessel top plate using a clamping adapter, and connected to the gassing system on the basic unit via a silicone hose with a sterile filter.

Accessories

Sparger, L-shaped

Inside-Ø	4.0 mm
Outside-Ø hose connection	6.0 mm



Ring sparger

Inside Ø	4.0 mm
Outside-Ø hose connection	6.0 mm



Accessories

5.5 Impellers

For details about impellers, refer to chapter “Setup and Function”, “Stirrer”.

5.6 Pocket for Temperature Sensor (Pt100)

The pocket is a pipe with a sealed bottom end, and is used to insert the temperature sensor.

Pocket Ø 10 mm

Fitted with fixed O-ring.

Two slotted screws are used for fixing in the 10 mm.

The picture on the left does not show the full length of the pocket.



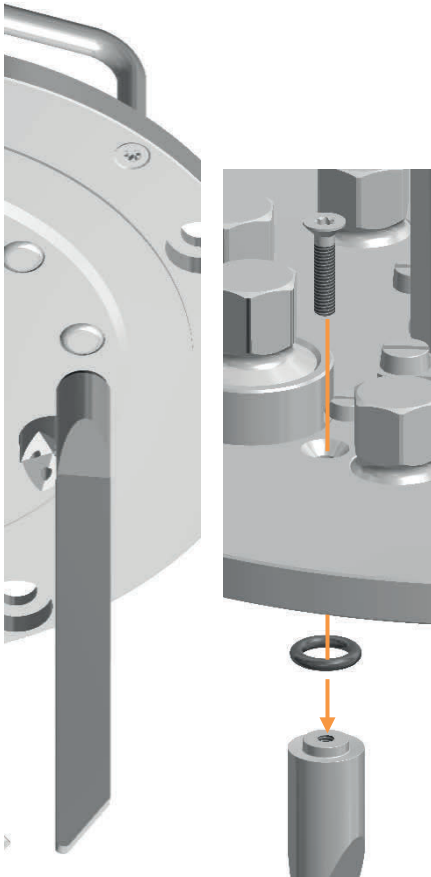
5.7 Baffles

Culture vessels are equipped with three baffles by default.

Baffle, 3 pieces

Must be fitted with O-ring before mounting.

A hexalobular screw is used for mounting in the vessel top plate.



Accessories

5.8 Lock Nut

If no baffles are used, lock nuts must be fitted into the vessel top plate instead. They are disposable in a set of 3 pieces.

Must be fitted with an O-ring before mounting.

A hexalobular screw is used for mounting in the vessel top plate.



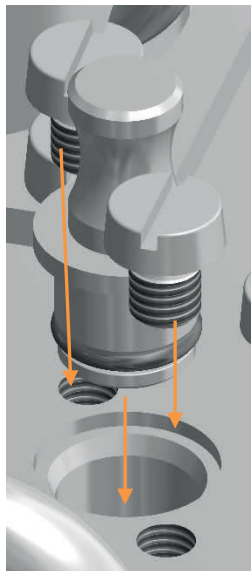
5.9 Blanking Plugs

Blanking plugs are used to seal open ports. There are different blanking plugs for the different types of port.

Blanking plug, Ø 10 mm

Fitted with fixed O-ring.

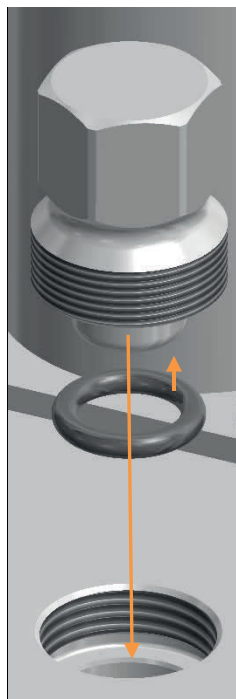
Two slotted screws are used for fixing in 10 mm port



Blanking plug, Ø 12 mm

Must be fitted with an O-ring before being mounted in the 12 mm/Pg13.5 port.

Mounted using a thread.

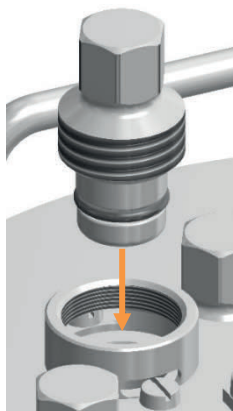


Accessories

Blanking plug Ø 19 mm

Fitted with fixed O-ring.

A threaded adapter is used for mounting in 19 mm port.



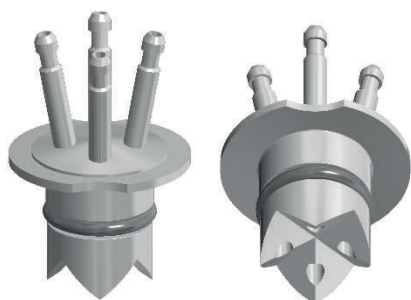
5.10 Addition Port Adapters

Addition port adapters are used for liquid addition into the culture vessel. They are mounted in a port in the vessel top plate and end in the headspace of the vessel. They have one or several hose connections and various models are available.

The following can be connected to addition port adapters:

- Reagent bottles with feed solution, antifoam agent or corrective reagent (base/acid).
- If appropriate, exit gas line

Addition port adapter, quadruple, Ø 19 mm



Inside-Ø	3.0mm
Outside-Ø hose connection	4.0 mm

Fitted with fixed O-ring.

Two slotted screws are used for mounting in 19 mm port.

Accessories



Addition port adapter Ø 12 mm

Inside-Ø	3.0 mm
Outside-Ø hose connection	5.0 mm

Must be fitted with O-ring.
Thread is used for mounting in 12 mm / Pg13.5 port.



Addition port adapter Ø 12 mm

Inside-Ø	6.0 mm
Outside-Ø hose connection	8.5 mm

Must be fitted with O-ring before mounting.
Thread is used for mounting in 12 mm / Pg13.5 port.



Addition port adapter Ø 19 mm

Inside-Ø	3.0 mm
Outside-Ø hose connection	5.0 mm

Fitted with fixed O-ring.
Threaded adapter is used for mounting in 19 mm port.

5.11 Inoculation Needles

Inoculation needles are used for feeding liquids into the culture vessel, which cannot be autoclaved with the culture vessel. These liquids may be e.g. the inoculum or heat-sensitive reagents.

If using an inoculation needle, then a septum (inoculation membrane) must be fitted along with a septum collar in the appropriate port. The inoculation needle is connected with the reagent bottle and autoclaved. The liquid, e.g. the inoculum, which shall to be added into the culture vessel, is shortly before addition filled into the reagent bottle under sterile condition. The septum is then

Accessories

pierced with the inoculation needle, which is screwed into the septum collar. The septum may be wetted e.g. with an alcohol solution that is lit up before the piercing.

Inoculation needles are purchased including septum collar. They have an oblique tip to facilitate the piercing. The hose connection and the very sharp needle tip are covered with non-autoclavable(!) protective caps.



INFORMATION

For addition of autoclavable liquids, addition port adapters or inoculation needles without septum and without septum collar are suitable, too. These must be mounted in the ports and connected to the reagent bottles before autoclaving.

Inoculation needle Ø 12 mm

Inside-Ø	2.5 mm
Outside-Ø hose connection	4.5 mm

Must be fitted with O-ring.

Thread is used for mounting in septum collar for a12 mm / Pg13.5 port.



Accessories

Inoculation needle, Ø 19 mm

Inside-Ø	2.5 mm
Outside-Ø hose connection	4.5 mm

Fitted with fixed O-ring.
Thread is used for mounting in septum collar in 19 mm port.



Inoculation needle, 19 mm

Inside-Ø	4.0 mm
Outside-Ø hose connection	6.0 mm

Fitted with fixed O-ring.
Thread is used for mounting into septum collar in 19 mm port.



Accessories



Inoculation needle, double, Ø 19 mm

Inside-Ø	2.0 mm
Outside-Ø hose connection	4.0 mm

Fitted with fixed O-ring.

Thread is used for mounting in septum collar in 19 mm port.

5.12 Septum Collars

Septum collars are either used in combination with the corresponding inoculation needle with septum (piercing membrane) or with a syringe with injection needle and a septum. Inoculation needles are always supplied including a septum collar, but septum collars are separately available, too.

Septum collar, Ø 12 mm

With internal thread.

A septum must be inserted in the 12 mm / Pg13.5 port before mounting.

A thread is used for mounting.

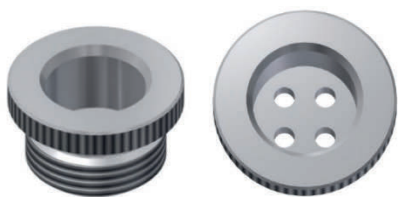


**Septum collar, Ø 19 mm**

With inside thread.

Septum must be inserted in port before mounting in 19 mm port.

Threaded adapter is used for mounting.

**Multi-inlet septum collar, system Roussel, Ø 19 mm**

With inside thread, for inoculation with syringe.

Septum must be fitted in 19 mm port before mounting.

Threaded adapter is used for mounting.

5.13 Dip Tubes

Dip tubes are open at both ends and are mounted in a vessel top plate port with a clamping adapter.

Dip tubes are used for a variety of purposes:

- For filling the culture vessel after autoclaving. Using a dip tube prevents foaming.
- For adding inoculum.
- For sampling. The aseptic Super Safe Sampler system can be used for sampling.
- For harvesting
- For siphoning off medium during continuous cultivation
- For draining the culture vessel

Depending on the purpose, silicone hoses are connected to the dip tube via other vessels, sampling systems or, if necessary, hose trees.

Multiple dip tubes can be used at any one time, providing that enough vessel top plate ports are available.

Different types of dip tubes are available.

Accessories



Dip tube, straight, Ø 6 mm

Inside-Ø	3.0 mm
Hose connection outside-Ø	4.2 mm / 5.0 mm

The dip tube does not reach as far as the bottom of the vessel.
The illustration on the left shows only the upper section of the dip tubes.



Dip tube, straight Ø 12 mm

Inside-Ø	10 mm
Hose connection outside-Ø	12 mm

The dip tube does not reach as far as the bottom of the vessel.
The illustration on the left shows only the upper section of the dip tube.



Dip tube, curved with horizontal tip, Ø 6 mm

Inside-Ø	4,0 mm
Hose connection outside-Ø	6.0 mm

The dip tube does reach to the vessel bottom.

Dip tube, curved with frit, Ø 6 mm

Inside-Ø	2.0 mm
Hose connection outside-Ø	4.0 mm
Pore size of frit	40 µm

The dip tube does reach to the vessel bottom.



5.14 Clamping Adapters

Clamping adapters are used for mounting the sparger, the various dip tubes and the antifoam/level sensors. The clamping adapter fixes the component part in place and can be used to adjust its mounting depth.

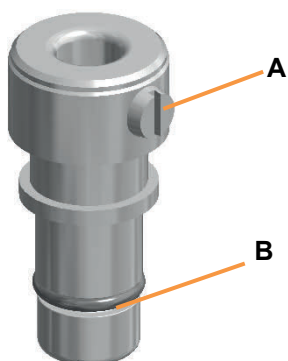
The clamping adapter must match the outside diameter of the part to be mounted and the size of the port.

Clamping adapter Ø 6 mm / 10 mm

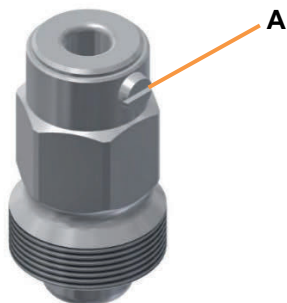
Fitted with fixed O-ring (B).

Two slotted screws are used for mounting in 10 mm port.

After loosening the slotted screw (A) the component part with Ø 6 mm can be inserted into/pulled out from the clamping adapter. The component part is fixed in the clamping adapter by fastening the slotted screw.



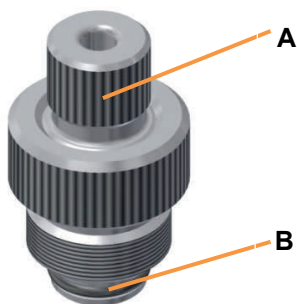
Accessories



Clamping adapter Ø 6 mm / 12 mm

Must be fitted with O-ring before mounting.
Thread is used for mounting in 12 mm / Pg13.5 Port.

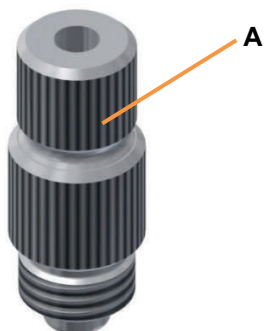
After loosening the slotted screw (A) the component part with Ø 6 mm can be inserted into/pulled out from the clamping adapter. The component part is fixed in the clamping adapter by fastening the slotted screw.



Clamping adapter, Ø 6 mm / 19 mm

Fitted with fixed O-ring (B).
Threaded adapter is used for mounting in 19 mm port (see chapter "Threaded Adapter")

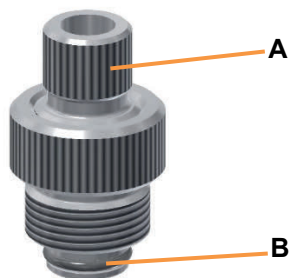
After loosening the hollow screw (A) the component part with Ø 6 mm can be inserted into/pulled out from the clamping adapter. The component part is fixed in the clamping adapter by fastening the hollow screw.



Clamping adapter Ø 8 mm / 12 mm

Must be fitted with O-ring before mounting.
Thread is used for mounting in 12 mm / Pg13.5 port.

After loosening the hollow screw (A) the component part with Ø 8 mm can be inserted into/pulled out from the clamping adapter. The component part is fixed in the clamping adapter by fastening the hollow screw



Clamping adapter, Ø 12 mm / 19 mm

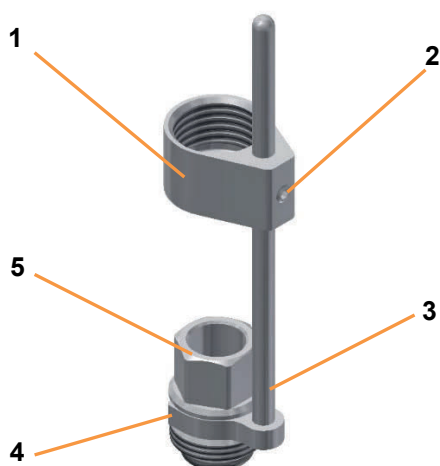
Fitted with fixed O-ring (B)
Threaded adapter is used for mounting in 19 mm port (see chapter "Threaded Adapter").

After loosening the hollow screw (A) the component part with Ø 12 mm can be inserted into/pulled out from the clamping adapter. The component part is fixed in the clamping adapter by fastening the hollow screw.

5.15 Electrode Holder

Electrode holders are used for mounting sensors (pH, pO₂, etc.) in 12 mm/Pg 13.5 ports. They can also be used to adjust the mounting depth of the sensor.

The electrode holder comprises a sheath with a grub screw, a guide bar with a fork, and a hollow screw. The wrench for the grub screw is also included in the scope of supply.



- 1 Sheath
- 2 Grub screw
- 3 Guide bar
- 4 Fork
- 5 Hollow screw

5.16 Threaded Adapter



The threaded adapter has an inside thread and is used for mounting blanking plugs or clamping adapters with Ø 19 mm in (threadless) 19 mm ports in the vessel top plate.

Two slotted screws are used for mounting.

5.17 Adapter



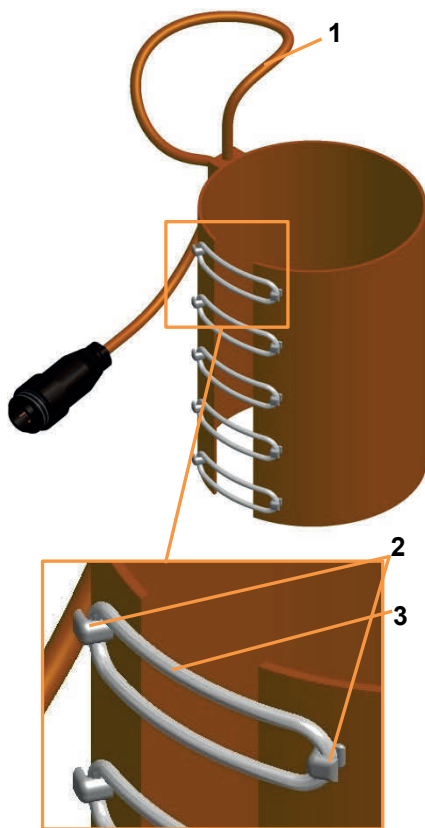
The adapter is used for component parts with Ø 12 mm into a (threadless) 19 mm port in the vessel top plate.

Fitted with a fixed O-ring.

Accessories

5.18 Heater Pad

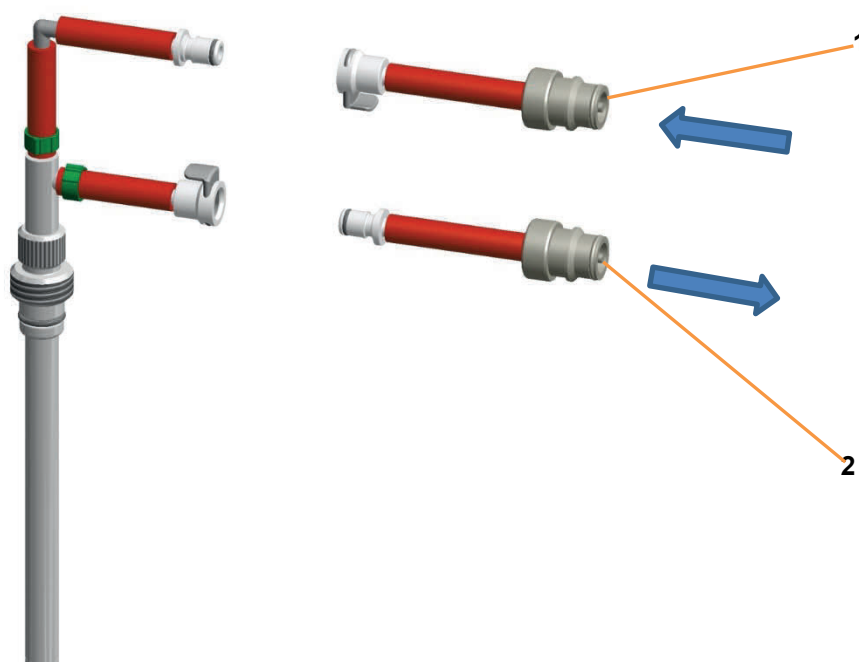
The electrical heater pad is needed for heating up single walled vessels. It is fitted around the vessel and held together with the tensioning springs.



- 1 Power cable
- 2 Hook
- 3 Tensioning spring

5.19 Cold Finger

A cold finger is provided for single walled vessels for cooling purposes.



1 Connection water inlet basic unit

2 Connection water outlet basic unit

The cold finger is already equipped with pressure hoses for water inlet (upper connector) and water outlet (lower connector). Appropriate hoses with rapid couplings and plug-in nozzles for connection to the basic unit are included.

Accessories

Cold finger, Ø 19 mm

Fitted with fixed O-ring.

Threaded adapter is used for mounting in 19 mm port.



Cold finger, Ø 12 mm

Adjustable mounting depth,

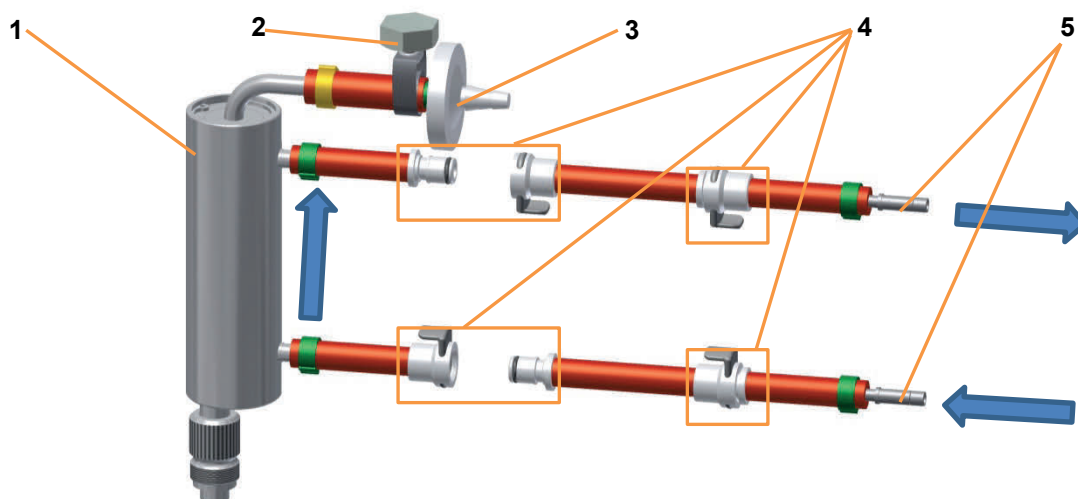
Must be fitted with O-ring before mounting.

Thread is used for mounting in 12 mm / Pg13.5 port.



5.20 Exit Gas Cooler

The exit gas cooler is fully equipped ex-factory.



- 1 Exit gas cooler
- 2 Adjustable hose clamp
- 3 Exit gas filter

- 4 Rapid coupling
- 5 Plug-in nozzle

The exit gas cooler is supplied with cooling liquid from the basic unit. The flow of the cooling liquid can be adjusted by the manual control valve on the basic unit.

The exit gas cooler is already equipped with pressure hoses for water inlet (lower connector) and water outlet (upper connector). Appropriate hoses with rapid couplings and plug-in nozzles for connection to the basic unit are included.

Another piece of pressure hose is fitted onto the exit gas pipe and equipped with a disposable exit gas filter. Hose connections and the filter are secured with hose clamps. The hose clamp securing the exit gas filter is equipped with a screw to loosen or tight it manually.



INFORMATION

The exit gas filter must be replaced after each cultivation. The exit gas cooler works with temperature control switched on only!

Accessories

Exit gas cooler Ø 12 mm

Must be equipped with O-ring

Its thread is used for mounting in 12 mm / Pg13.5 Port

Exit gas cooler Ø 19 mm

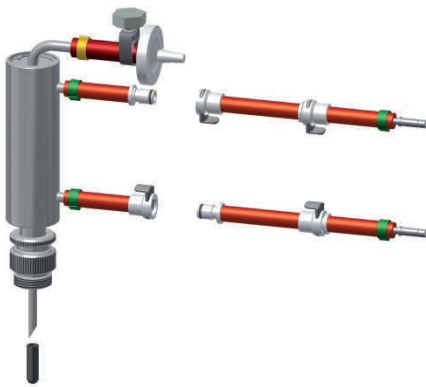
With fixed O-ring.

A threaded adapter is needed for mounting in 19 mm port.

Exit gas cooler with needle, Ø 19 mm

Separately autoclavable

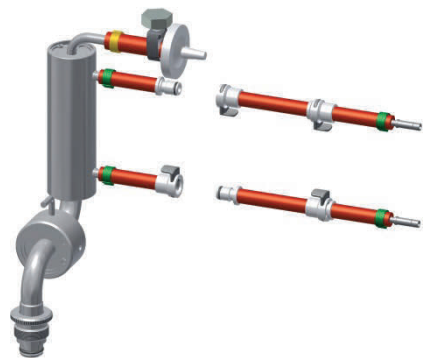
Only available for vessel top plates with DN 50 and DN200



Exit gas cooler, swivelling sideways, Ø 19 mm

With fixed O-ring.

A threaded adapter is needed for mounting into 19 mm port.

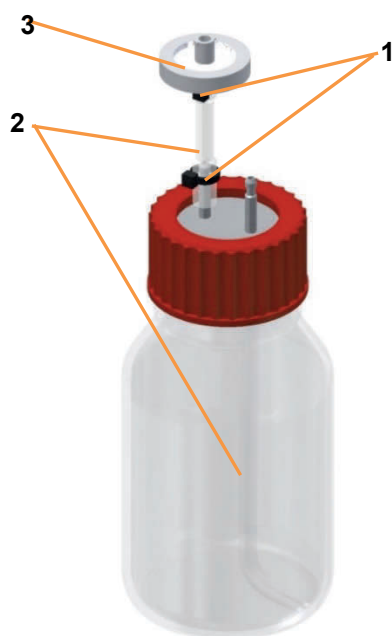


5.21 Reagent Bottles

For addition of corrective reagent and feed solution (substrate) into the culture vessel, different sizes and models of reagent bottles made of borosilicate glass are available.

Size	Ø Hose	Number of hose connectors
250 mL ¹	2 x 6 mm	2
250 mL	2 x 6 mm	3 + 1
500 mL ¹	2 x 6 mm	2
500 mL	2 x 6 mm	3 + 1
1000 mL	3 x 5 mm	2
2000 mL	3 x 5 mm	2
5000 mL	3 x 5 mm	2
10'000 mL	3 x 5 mm	2

¹⁾ These two bottle sizes fit into the reagent bottle and pump holder.



The reagent bottles are already equipped on delivery.

- 1 Cable tie
- 2 Silicone hose
- 3 Filter

Reagent bottles with two hose connectors are provided as standard.

Two hose connectors are situated on the lid. One is equipped with a short piece of silicone hose with filter for pressure equalisation. The second connector is equipped with a piece of silicone hose on the inside of the lid.

A piece of silicone hose is included to establish the hose line from the reagent bottle to the addition port adapter in the vessel top plate and to the pump head.

Accessories

The individual parts of the reagent bottle are:

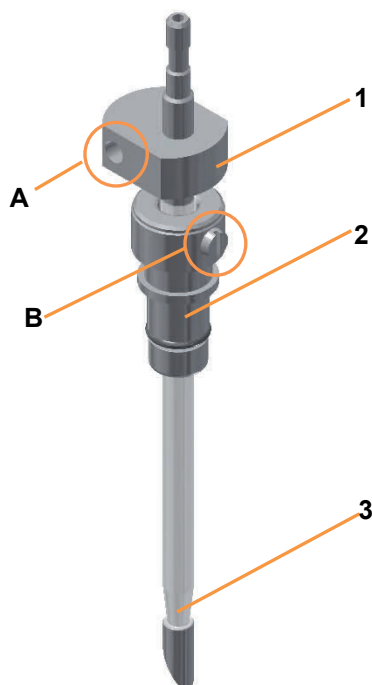


- 1 Threaded cap, PBT
- 2 Plate with two hose nozzles, PVDF
- 3 Flat gasket, silicone
- 4 Laboratory bottle, Borosilicate



The picture to the left shows the reagent bottle type with 3 + 1 hose connectors.

5.22 Antifoam Sensor



If ordered, the antifoam model fitting into Ø 10 mm ports is supplied by default. A clamping adaptor with fixed O-ring is used for mounting.

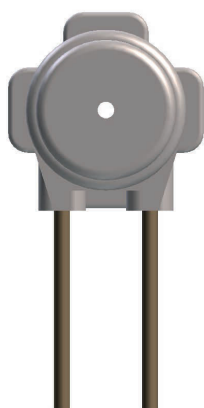
- 1 Sensor head with port for banana connector (A)
- 2 Clamping adaptor with slotted screw (B)
- 3 Needle with transparent insulation

The antifoam sensor is equipped with two NON-autoclavable protective caps.

Models for Ø 12 mm / Pg13.5 or 19 mm ports with appropriate clamping adaptors are available, too.

Port	Inside-Ø	Outside-Ø hose connection
Ø 10 mm	2 mm	4 mm
Ø 12 mm / Pg13.5	3 mm	4 mm
Ø 19 mm	3 mm	4 mm

5.23 Pump Heads



The autoclavable pump heads are fitted with PharMed pump hoses prior to delivery. Three different hose diameters are available for different delivery rates:

- 1.0 mm (standard)
- 0.5 mm
- 2.5 mm

For more detailed information about pumps and hoses refer to main chapter “Technical Data”, chapter “Specification”, “Pumps

Accessories

5.24 Sterile Filters

Sterile filters are used to protect against contamination in both the gassing line and the exit gas line. In addition to this, all reagent bottles used for pressure equalisation must be fitted with an open, short section of hose with a filter.

All the sterile filters in the scope of supply are autoclavable, disposable filters with PTFE diaphragms.



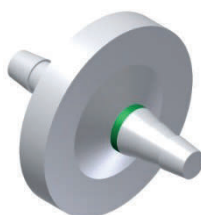
INFORMATION

Sterile filters must be clean and dry at all times, and should thus ideally be replaced after each use.



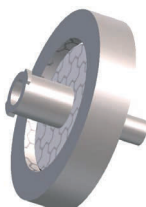
Ø 37 mm, marked red

Application	Supply air
Retention rate	0.2 µm



Ø 37 mm, marked green

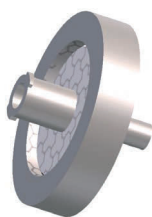
Application	Exit gas
Retention rate	0.3 µm dry 1.0 µm wet



Ø 25 mm, not marked

Application	Super Safe Sampler
Retention rate	0.2 µm
Diaphragm	PTFE

Accessories



Ø 25 mm, not marked

Application	Reagent bottles (pressure equalisation)
Retention rate	0.45 µm
Diaphragm	PTFE

Ø 50 mm, Type ACro50 TF, no label

Usage	Inlet air ¹ / Exit gas ²
Retention rate	0.2 µm

¹⁾ For high gas flows rates

²⁾ For absolute sterility

5.25 O-Rings and Gaskets

Description	Ø mm	Utilisation
O-ring, EPDM	1.5 x 7.5	Gasket, port size 10 mm
O-ring, EPDM	2.62 x 10.77	Gasket, port size 12 mm / Pg13.5
O-ring, EPDM	2.5 x 15.0	Gasket, port size 19 mm
O-ring, EPDM	1.78 x 6.07	Drive shaft
O-ring, EPDM	2.5 x 9.0	Baffles
O-ring, EPDM	3.53 x 123.42	Top plate gasket, culture vessel DN115
O-ring, EPDM	3.53 x 158.34	Top plate gasket, culture vessel DN 150
O-ring, EPDM60	5.0 x 208	Top plate gasket, culture vessel DN200
Flat gasket, Silicone	32 x 42 x 2	Gasket for reagent bottle lid (for all sizes with two hose connections)

Accessories

5.26 Hoses and Accessories

Hose type	Ø mm	Application
Pressure hose, fibre-glass-woven	10 x 17	Water outlet
Pressure hose, fibre-glass-woven	8 x 14,5	<ul style="list-style-type: none"> Water inlet Exit gas filter attachment (on exit gas cooler)
Pressure hose, fibre-glass-woven	6 x 11,9	<ul style="list-style-type: none"> Gas connection(s) Water supply and return, exit gas cooler
Silicone hose	5 x 8	Gassing (sparger)
Silicone hose, transparent	2 x 6	Reagent bottles: 250 ml und 500 ml (hose lines for reagents)
Silicone hose, transparent	3 x 5	Reagent bottles: 1000 ml, 2000 ml, 5000 ml, 10'000 ml (hose lines for reagents)
Silicone hose, 60° Shore,	10 x 16	Water connections vessel jacket (double walled culture vessels)

Attachment	Ø mm	Application
Hose clamp, 1 screw, INOX	14	Attachment hose(s) gas inlet(s).
Hose clamp, INOX	17	Attachment hose water inlet
Hose clamp, INOX	19	Attachment hose water outlet
Hoffmann pinchcock, nickel-plated brass	12	For clamping off hose lines, e.g. unused addition port adapters, sparger hose etc.
Cable tie, polyamide	2,4 x 85	Hoses for reagent bottles and pumps, inlet air filter, sparger, dip tube of sampling system.
Double hose nipple, 3/32" x 1/16", PVDF	---	Pump heads with hoses to reagent bottles with internal-Ø 1 mm
Double hose nipple, 1/8" x 1/8", PVDF	---	Pump heads with hoses to reagent bottles with internal-Ø 2.5 mm

Accessories

Rapid coupling plug nipple, DN12.7 hose nozzle 1/2" A	---	water inlet and outlet hoses of vessel jacket (double walled culture vessels)
Rapid coupling plug nipple DN12.7 hose nozzle 1/2"	---	water overflow hose of vessel jacket (double walled culture vessels)

5.27 Inoculation Accessories and Tools

Description	Application
Hexagon socket spanner, WAF 17	For blanking plugs in 12 mm/Pg13.5 ports
Allen key, WAF 2, DIN911,	For grub screws on impellers
Septum (inoculation diaphragm), Ø = 16 mm MVQ Silicone, transparent	For 12 mm/Pg13.5 ports
Septum (inoculation diaphragm), Ø = 19 mm MVQ Silicone, transparent	For 19 mm ports

Transport and Storage

6 Transport and Storage

The following specifications are based on transport and storage of an unpacked equipment at the provider's site.

6.1 Transport



WARNING

Improper transport, the use of incorrect auxiliary equipment and careless handling of the equipment may lead to injuries and severe property damage.

The following points must be observed when transporting the equipment internally (relocation):

- Always work in pairs and use suitable auxiliary equipment when transporting the equipment.
- The entire equipment (basic unit and culture vessel) contains delicate glass parts.
- Especially when using auxiliary tools, it is important to observe that the equipment's centre of gravity is not in the middle.



WARNING

The entire equipment (basic unit and culture vessel) is too heavy to be carried by one person alone.

Even the basic unit on its own exceeds the weight that should be carried by one person alone.

6.2 Storage

- Before each time they are put into storage, decontaminate, thoroughly clean and dry the culture vessel and all accessories¹.
- Store the equipment and its components clean, dry and protected against dust, dirt and liquids.
- Store the equipment and its components in a cool place with low air humidity but protected against frost.
 - Storage temperature: 5°C – 55°C
 - Relative air humidity, non-condensing: 10% - 95%.
- Protect the equipment from aggressive media, direct sunlight and mechanical vibrations.

1) *Maintain and store sensors produced by other manufacturers in accordance with the separate documentation.*

Installation and Initial Operation

7 Installation and Initial Operation

Installation and initial operation of the equipment may only be carried out by qualified personnel from the manufacturer or personnel authorised by the manufacturer.



WARNING

Installation and initial operation requires qualified and experienced personnel. Faulty installation may lead to dangerous situations or severe loss of property.

Only let carry out installation and initial operation by the manufacturer's qualified personnel or authorised personnel by the manufacturer only.

Therefore, the following sections only list the energies that must be provided and the connection requirements that are to be respected on site by the provider.

Exception

The basic functions of the bioreactor are tested and demonstrated at the same time to the operator in form of a short test run on site during installation by the qualified personnel.

In order to become familiar with the basic functions of the bioreactor before the first cultivation or after a longer period of non-use of the equipment, the operator may afterwards carry out this short test run any time, too.

For details refer to chapter "Test Run".

7.1 General Location Requirements for Installation

The following requirements must be met for the installation of the equipment:

- The figures and ranges specified in the chapters "Technical Data, Connection Values" and "Technical Data, Operating Conditions" must be observed.
- The equipment must only be installed inside a laboratory or a laboratory-like environment.
- The installation site must be level, sufficiently stable and able to bear loads.
- There must not be any sources of electrical interference near the equipment.

Installation and Initial Operation

7.2 Minimum Distances

To operate and maintain the unit it must be installed with a minimum spacing of 150 mm from walls, ceilings or other equipment.

7.3 Power Supply

The in-house electric power supply of the equipment must meet the following conditions:

- Single-phase, constant power supply
- Type 230 V / 50/60 Hz
- Type 115 V / 60 Hz

The power supply of the equipment must be made safe by the use of an FI-switch (or RCD – Residual Current Device) of the kind RCCB, Type B on the customer's side.

7.4 Water Supply and Return

The in-house water supply to the equipment, as well as the drainage of the water, must meet the following requirements

- “Very soft” or “soft” water quality (CaCO_3 concentration 0 mmol L^{-1} to 1.5 mmol L^{-1})



ATTENTION

Not observing the water quality requirements may lead to damage or failure of the equipment.

The heating system has protection against dry running which is based on measurement of conductivity. Therefore the heating does not work or does not work properly when using demineralised or distilled water as cooling liquid!

- Constant water supply at a pressure of 2 ± 1 bar
- Inlet temperature 10 °C up to 20 °C
- Manometer to check the primary pressure available
- The drain is heat-resistant and without back pressure

Installation and Initial Operation

Hoses

- Only use pressure-resistant and intact hoses.
- Only use appropriate hoses, use adaptors as necessary.
- Secure hoses with the appropriate clamps.

7.5 Gas Supply

The in-house gas supply to the equipment must meet the following requirements:

- Constant gas supply at a pressure of 2 ± 0.5 bar
- Gas(es) is/are dry, clean and free of oil and dust
- Recommended compressed-air quality as per DIN ISO 8573-1: Class 1,2,3,4



ATTENTION

The use of impure gases can lead to blockage of the sterile filter and damage the mass flow controller.

Only use dry, clean and oil-free gases.

Hoses

- Only use pressure-resistant and intact hoses.
- Only use appropriate hoses, use adaptors as necessary.
- Secure hoses with the appropriate clamps.



WARNING

The use of inappropriate or damaged hoses and/or inappropriate fixing may lead to leakage of gases. Depending on the gas in question, there may be a danger of gas explosion and/or danger of suffocation as well as a hazard for the health of the operator.

Always close the gas supply before a hose is removed and when the equipment is not in use.

Installation and Initial Operation

7.6 Exit Gas

On site, it must be ensured that:

- the exit gas is safely led away by means of a suitable, gas-tight hose.
- the working environment and/or the laboratory/laboratory-like facility is equipped with a sufficient ventilation system, depending on the application.

7.7 Test Run

In order to become familiar with the basic functions of the bioreactor before the first cultivation or after a longer period of non-use of the equipment, a short test run can be executed.

The test run comprises:

- Temperature control (cooling / heating)
- Stirring
- Gassing

Normal compressed air is used for gassing. To avoid calcium deposits, demineralised water is recommended for filling the vessel.

The following description of the test run does not detail handling of individual components, e.g. stirrer, sparger etc. Detailed descriptions of their handling are given in the corresponding chapters of the main chapter "Before Fermentation/Cultivation".

For details on operation, refer to the separate operating manual of the touch screen software.

7.7.1 Preparation Test Run

Before starting the test run, check and ensure the following:

- All required services are available and activated
- All services have the correct connection pressure

The following work is to be executed before the test run:

Procedure

1. Remove the vessel top plate and put it aside carefully.

Installation and Initial Operation



ATTENTION

If the vessel top plate presses against long built-in components they may be distorted due to the weight of the top plate.

Always position the vessel top plate so that it does not lie on top of components.

2. Fill the culture vessel with water – preferably demineralised – to the working level.
3. Ensure that the stirrer and sparger are mounted; if necessary, mount them.
4. Fit the top plate and secure it by fastening the knurled screws cross-wise.
5. Check the lubrication of the mechanical seal. For details about lubrication of the mechanical seal, refer to chapter “Cleaning and Maintenance”, “Lubricating the Mechanical Seal”.



INFORMATION

Lubrication of a new equipment is not necessary. When carrying out a test run on equipment which has not been in use for a longer period of time, controlling the lubrication of the mechanical seal, and if applicable, its lubrication, is imperative.

If an exit gas cooler is used:

6. Screw the exit gas cooler into the port on the vessel top plate port.

The exit gas cooler is equipped with a new exit gas filter in the factory.
7. Connect the exit gas cooler to the basic unit; follow the symbols on the basic unit:

water inlet on bottom of exit gas cooler / water outlet at top of exit gas cooler.
8. Close all remaining open ports with blanking plugs.

If no exit gas cooler is present or it is not used:

 - Close the control valve for water flow of the exit gas cooler on the basic unit.
 - One port in the vessel top plate must be open!
9. Connect the culture vessel to the basic unit:

Single walled vessel:

Installation and Initial Operation

- a) Connect the water inlet and water outlet of the cold finger to the basic unit; follow the symbols on the basic unit:
 - Connect the lower pressure hose of the cold finger to the connector with the symbol of the vessel jacket outlet.
 - Connect the upper pressure hose of the cold finger to the connector with the symbol of the vessel jacket inlet.
- b) Ensure the heater pad is dry and has no visible damages (cracks, kinks etc.)



DANGER

Danger of fatal electric shock!

The use of a damaged or wet/damp heater pad can be perilous!

- c) Fit the heater pad around the vessel and connect it to the basic unit.

Double walled (jacketed) vessel:

- a) Connect the water inlet, water outlet and overflow of the vessel jacket to the basic unit; follow the symbols on the basic unit.



INFORMATION

In order that the hose connections can be disconnected easily again, slightly moisten the rapid couplings on the silicon hoses prior to connecting them.

10. Equip the sparger with a piece of silicone hose (D= 5 x 8 mm) for gassing and a dry, clean inlet air filter (accessories, filter with red label).
11. Fit another piece of silicone hose for gassing (compressed air) to the hose nozzle on the basic unit.
12. Connect both hoses via the inlet air filter (connect the hose end to the hose nozzle of the inlet air filter).
13. Insert the temperature sensor as far as it will go into the pocket in the top plate.

Installation and Initial Operation

CAUTION

Risk of burns and loss of property due to elevated temperature!

The temperature control circuit will overheat without an inserted temperature sensor and/or without liquid in the vessel. This can lead to burns and loss of property.

14. Couple the motor.

INFORMATION

The motor is controlled via the basic unit. Its cable is plugged in during installation and will not be unplugged anymore during routing operation of the equipment.

15. Switch the equipment on at the main switch and wait until the system is booted.

7.7.2 Filling the Water Circuit

To fill the water circuit, proceed as follows:

Procedure

1. Set a low setpoint for parameter temperature (e.g. 10 °C), in order to activate the water supply into the vessel jacket or cold finger.
2. Start the bioreactor.
All parameters except for *Temperature* remain switched off; switch them off if necessary.

a) **Temperature control system with electrical heater pad and cold finger:**

You should hear water flowing into the cold finger now.

b) **Water temperature control system:**

You should hear and see water flowing into the vessel jacket.

If using an exit gas cooler:

The water supply of the exit gas cooler is activated now.

Installation and Initial Operation



INFORMATION

The exit gas cooler only works with activated temperature control (Parameter *Temperature* ON).

3. Use your hands to check whether the exit gas cooler is beginning to cool down. Open the control valve for water flow on the basic unit, if necessary.

When the circuit is full, water escapes from the overflow on the vessel jacket or cold finger and flows into the water outlet.

4. Wait for min. 1 minute.
This ensures that no air is left in the temperature control circuit.

7.7.3 Stirring

Bioreactor is running with temperature switched on

To test the stirrer, proceed as follows:

Procedure

1. On the operating panel for the parameter *Stirrer*, set a low setpoint.
For further information about the different ranges of rotation speed refer to the specification in main chapter "Technical Data".
2. Switch the parameter on.

For the rest of the procedure, allow the bioreactor to run with the temperature switched on and the stirrer running.

7.7.4 Heating and Adjusting Temperature

Bioreactor is running with temperature and stirrer switched on

To test the heating and adjust the temperature, proceed as follows:

Procedure

1. On the operating panel, set a high setpoint for parameter *Temperature*, e.g. 45 °C..
The water supply for cooling is stopped; the system heats up.
 - a) **Temperature control system with electrical heater pad and cold finger:**
The heater pad starts to heat up.
 - b) **Water temperature control system:**

Installation and Initial Operation

The temperature of the liquid (water) in the vessel jacket starts increasing.

2. Wait until the temperature has adjusted to the setpoint.

For the rest of the procedure, allow the bioreactor to run with the temperature switched on and the stirrer running.

7.7.5 Gassing

Bioreactor is running with temperature and stirrer switched on

To test the gassing, proceed as follows:

Procedure

1. If applicable, slowly open the rotameter needle valve.
2. If applicable, set a low setpoint in the appropriate parameter *Flow* (depending on the configuration) and switch the parameter on.
3. If applicable, ensure that all other gas parameters (e.g. *Gasmix*, *GM Flow* etc.) are switched off.

If the gassing is working, air bubbles now form in the water in the culture vessel.

7.7.6 End of Test

After all parameter setpoints have been reached, the test can end here.

Proceed as follows:

Procedure

1. Stop the bioreactor on the operating panel and shut down the system.
2. Switch the equipment off at the main switch.



ATTENTION

Switching the equipment off at the main switch without previously stopping the bioreactor and shutting down the system on the operating panel may lead to damage of the operating panel!

3. Shut off the supply lines.
4. Let the motor cool down.

Installation and Initial Operation**CAUTION**

Risk of minor burns if the motor is touched during operation or its cooling phase!

When the motor has cooled down:

5. Uncouple the motor from the vessel and place it on a clean and dry work surface.
6. Empty the culture vessel.

Before Fermentation/Cultivation

8 Before Fermentation/Cultivation

The following chapters describe all the preparatory work before starting the fermentation/cultivation process. This essentially comprises:

- Preparing and autoclaving the culture vessel:
 - Checking the gaskets (O-rings) on component parts and culture vessel
 - Mounting component parts
 - Filling or moistening the culture vessel
 - Preparing sensors and other accessories
 - Autoclaving
- Connecting the culture vessel and preparing for cultivation:
 - Connecting the cables and hoses between the culture vessel and the basic unit
 - Filling the vessel if necessary
 - Preparing sensors and other accessories

8.1 Preparing and Autoclaving the Culture Vessel

All accessories required for later cultivation must be prepared and mounted accordingly and autoclaved together with the culture vessel.

8.1.1 Checking Gaskets (O-Rings)

O-rings are used to seal all openings on the vessel and top plate. The top plate and all internal fittings or connections are thus equipped with O-rings. Before every use, the O-rings must be checked that they are present, undamaged and correctly seated. Damaged O-rings must be replaced.



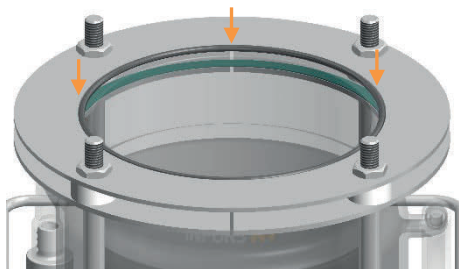
INFORMATION

Wet the O-rings with 70% alcohol or a little water to facilitate removing and replacing O-rings or component parts with O-rings. Do not use silicone grease; this can affect sterilisation results.

Carry out this check as follows:

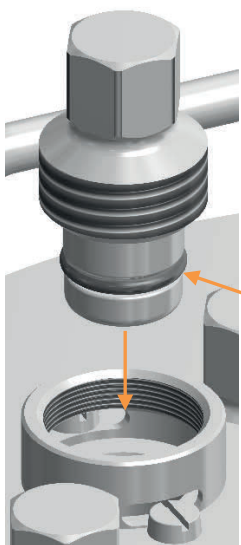
Before Fermentation/Cultivation

Procedure



1. Check the vessel seal (O-ring) for damage and on correct seat: it must rest firmly on the slightly prominent vessel rim within the metal ring.

Place it correctly as necessary.



2. Ensure that each mounting part is equipped with an intact O-ring: check that O-rings are correctly positioned and undamaged. Replace or reposition, if necessary.

The figure to the left shows a blanking plug with fixed O-ring for mounting into a 19 mm port with mounted threaded adapter.

If mounting parts have to be fitted into other mounting parts (clamping adapter), an O-ring must be placed between them, too.



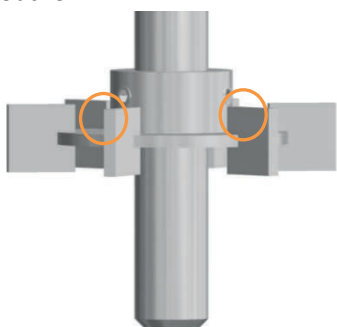
INFORMATION

Septum collars are sealed with a septum. No O-ring is used!

8.1.2 Mounting the Impellers

To mount the impellers to the stirrer shaft, proceed as follows:

Procedure



1. Slide the impeller onto the stirrer shaft.
2. Set the desired height.
3. Tighten the grub screws on the impeller with the Allen key.



INFORMATION

To avoid unnecessary foam formation, do not fit the impeller at the same height as the surface of the medium.

Before Fermentation/Cultivation

8.1.3 Mounting Dip Tubes and Spargers

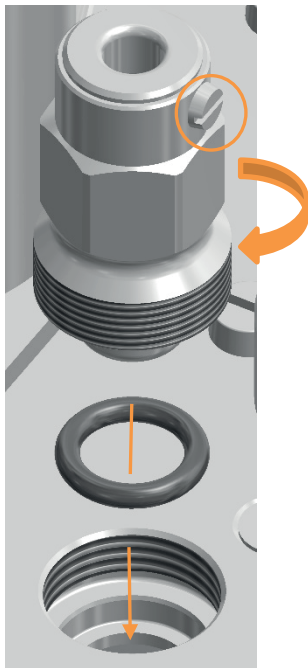
Straight spargers and dip tubes can be mounted to the outside of the vessel top plate. Curved spargers and dip tubes can only be mounted to the inside of the vessel top plate.

Mounting to the inside of the vessel top plate is described here. This means that the vessel top plate is still removed.

During mounting, ensure that the sparger or the dip tube does not come into contact with other mounting parts (stirrer). The sparger is positioned below the stirrer shaft.

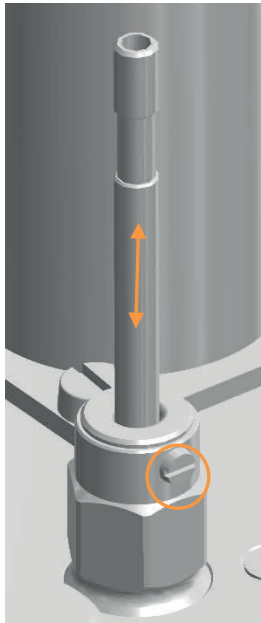
Proceed as follows:

Procedure



1. Equip the clamping adapter with an O-ring and screw it into the port in the vessel top plate by hand.
2. Loosen the slotted screw head at the clamping adapter.

Before Fermentation/Cultivation

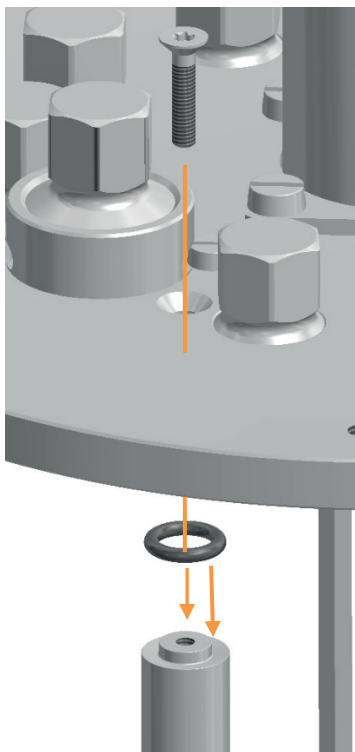


3. Insert the sparger/dip tube into the clamping adapter from below.
4. Set the desired mounting depth.
5. Tighten the slotted screw.

8.1.4 Mounting the Baffles

To mount the baffles, proceed as follows:

Procedure



1. Fit an O-ring to the baffles.
2. Fix the baffles with their hexalobular screws.

Before Fermentation/Cultivation



3. Ensure that the baffles are aligned correctly, so that they fit into the glass vessel (round bottom!).

8.1.5 Moistening/Filling the Culture Vessel

If the medium in the culture vessel is to be autoclaved, this can take place before the top plate is put in position and the additional component parts are mounted.

Note the following about filling the culture vessel before autoclaving:

- Before autoclaving, only top up with heat-resistant media.
- During autoclaving, evaporation may result in a loss of volume and thus to increased salt concentration in the medium. If necessary, top up with sterile water.



INFORMATION

Development of steam is not possible when autoclaving an empty and dry culture vessel. Successful sterilisation is not guaranteed.

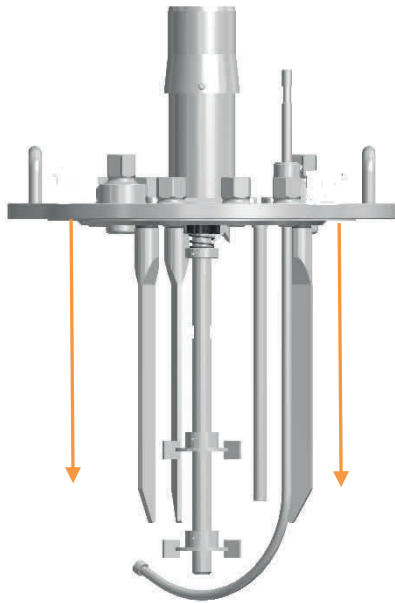
Ensure that there is liquid in the culture vessel (approx. 10 mL of water per litre of total volume).

8.1.6 Fitting the Vessel Top Plate

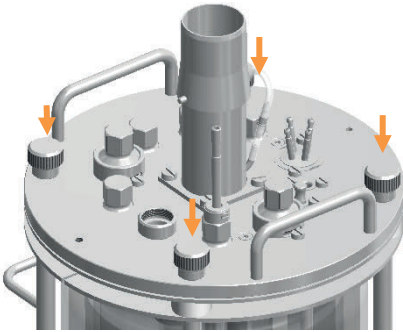
Proceed as follows to fit and fix the vessel top plate:

Procedure

1. Place the top plate carefully and with the correct alignment into position.



Before Fermentation/Cultivation



2. Tighten the knurled screws on the top plate by hand (no tool!) crossways.

ATTENTION

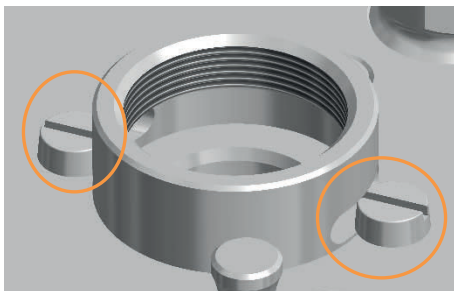
If the screws are tightened too much, components may be damaged, which can result in failure of the equipment. The screws may not be tightened with a tool under any circumstances.

This applies to all screw connections where the instructions specify that they must be tightened by hand.

8.1.7 Mounting a Threaded Adapter

To mount a threaded adapter into a 19 mm port, proceed as follows:

Procedure



1. Position the threaded adapter correctly aligned on the 19 mm port.
2. Fix it with the two slotted screws.

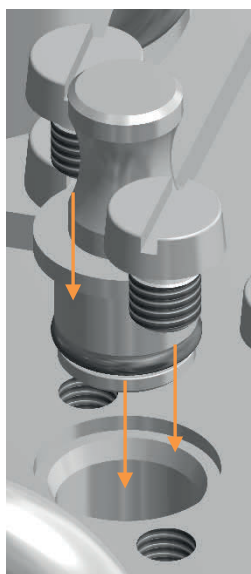
Before Fermentation/Cultivation

8.1.8 Mounting the Blanking Plugs

For mounting the different blanking plugs, proceed as follows:

Ø 10 mm Ports

Procedure



1. Insert the blanking plug with fixed O-ring into the port.
2. Fix it with both slotted screws.

Ø 12 mm ports

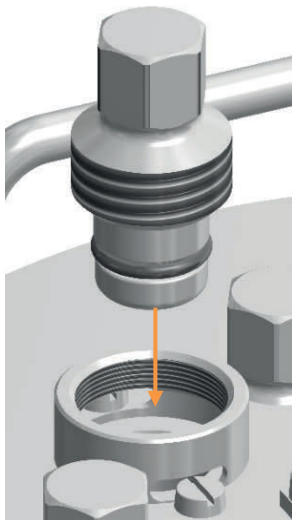
Procedure



1. Insert an O-ring into the port.
2. Insert the blanking plug and screw it in by hand.
3. Tighten it with the hexagon socket spanner hand tight.

Before Fermentation/Cultivation

Procedure



Ø 19 mm ports

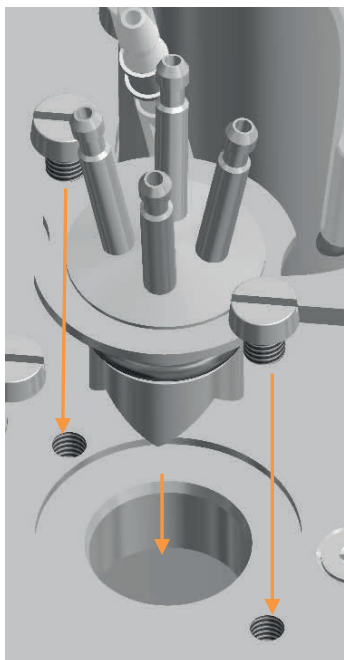
1. Screw the blanking plug with fixed O-ring into the threaded adapter.
2. Tighten it by hand.

8.1.9 Mounting Addition Port Adapters

Proceed as follows for mounting:

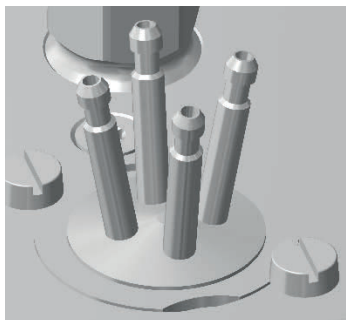
Addition port adapter, quadruple, for Ø 19 mm port

Procedure



1. Insert the addition port adapter with fixed O-ring into the port.
2. Fix it with the two slotted screws.

Before Fermentation/Cultivation



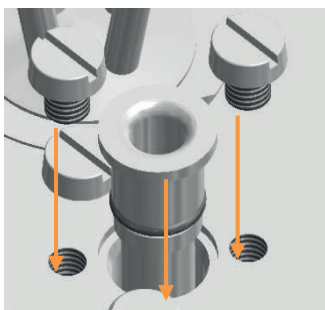
INFORMATION

The mounting procedure of further models of addition port adapters (refer to main chapter “Accessories” for details) is the same as for blanking plugs into their corresponding ports. That is why their mounting is not repeatedly described here.

8.1.10 Mounting the Pocket for Temperature Sensor (Pt100)

Proceed as follows:

Procedure



1. Insert the pocket with the fixed O-ring into the 10 mm port.
2. Fix it with both slotted screws.

8.1.11 Preparing an Inoculation Needle

To prepare an inoculation needle for later inoculation, proceed as follows:

Before Fermentation/Cultivation

Procedure



1. Remove protective caps from the inoculation needle.
2. Keep the septum collar ready for use.

3. Connect the inoculation needle via silicone hose with an appropriate container for the inoculum.
4. Put the inoculation needle in a sterile cover or wrap it up in some aluminium foil.

8.1.12 Preparing the Dip Tube/Addition Port Adapter for Inoculation

If later inoculation is to be carried out by means of a dip tube or addition port adapter, proceed as follows:

Procedure

1. Fit the dip tube with the clamping adapter or addition port adapter in the port.
2. Place a piece of silicon hose onto the dip tube/addition port adapter.
3. Equip the hose for a sterile hose connection. (Depending on the application: rapid coupling, sterile connector or weldable hose with sterile filter).
4. Secure the hose transition points with cable ties.

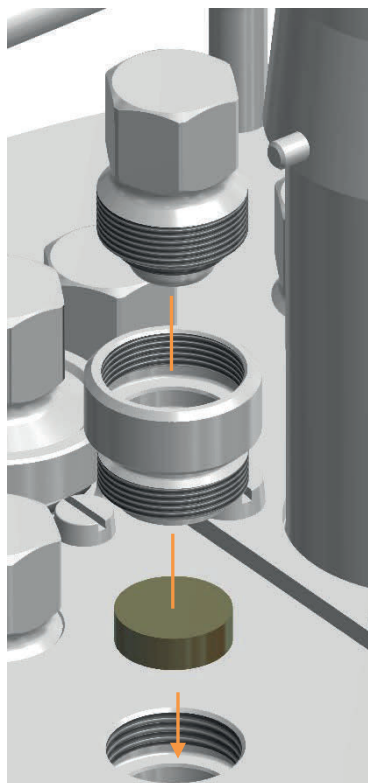
8.1.13 Equipping Port with Septum Collar and Septum for Inoculation

A port in the vessel top plate must be appropriately prepared for later inoculation. For this, it must be equipped with septum collar and septum.

Before Fermentation/Cultivation

Proceed as follows:

Procedure



1. Ensure that the port is not equipped with an O-ring, otherwise remove it.
2. Insert the septum into the port.
3. Screw the septum collar into the port by hand.



INFORMATION

If inoculation shall take place via 19 mm port, then mount a threaded adapter, first.

The picture to the left shows the procedure with a 12 mm / Pg13.5 port.

4. Ensure the blanking plug is equipped with an O-ring, fit one, if necessary.
5. Screw the blanking plug into the septum collar by hand.
If necessary, tighten it with the hexagon socket spanner hand-tight.

8.1.14 Mounting and Preparing the Exit Gas Cooler

To mount the exit gas cooler and prepare it for the autoclave, proceed as follows:

Procedure

1. Mounting the exit gas cooler into the port in the vessel top plate:
 - a) **Mounting in Ø 12 mm / Pg13.5 port**
Fit an O-ring to the thread of the exit gas cooler or fit it into the 12 mm / Pg13.5 port and screw the exit gas cooler into the port by hand.
OR
 - b) **Mounting in Ø 19 mm port**
Equip the 19 mm port with a threaded adapter first and then screw the exit gas cooler (with fixed O-ring) into the threaded adapter by hand.

Before Fermentation/Cultivation

2. Align the exit gas cooler to ensure that handling of other mounting parts is impaired as little as possible.
3. Check to ensure that the exit gas filter is fitted securely.
4. Cap the exit gas filter loosely with a little aluminium foil.



INFORMATION

A humidifier bottle with antifoam reagent can be installed between exit gas cooler and the exit gas filter if significant foam formation is expected.

Take the following into account for autoclaving:

- Only use a new, clean and dry exit gas filter and fix it in such a way that it cannot slip.
- ALWAYS keep the exit gas line - hose at the exit gas cooler with secured exit gas filter - open.



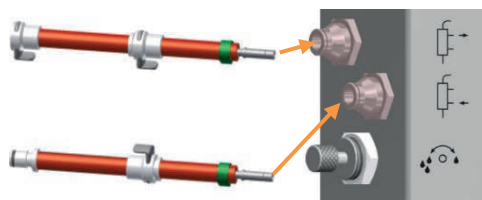
CAUTION

If pressure equalisation does not take place via a top plate opening or the mounted exit gas cooler, overpressure or vacuum in the culture vessel may occur during autoclaving.

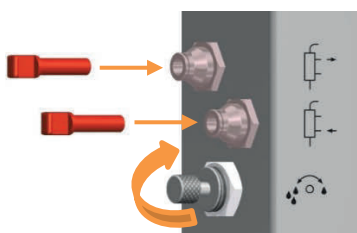
Connecting the hoses for the exit gas cooler to the basic unit

In order to connect the exit gas cooler to the water supply on the basic unit after autoclaving the culture vessel, the pressure hoses must be prepared as follows:

Procedure



1. Plug the pressure hoses for water inlet and outlet according to the symbols on the basic unit into their connectors.



If no exit gas cooler is used, close the manual control valve for water flow on the basic unit or close the hose connectors with the plugs provided with the equipment.

Before Fermentation/Cultivation

8.1.15 Mounting the Cold Finger

If applicable, i.e. temperature control system with electrical heater pad and cold finger is present (system for single walled culture vessels), the cold finger must be mounted in its appropriate port in the vessel top plate.

Proceed as follows:

Procedure

Mounting in Ø 12 mm / Pg13.5 port

1. Equip the 12 mm / Pg13.5 port with an O-ring.
2. Insert the cold finger into the port and tighten it by hand.
3. Adjust its mounting depth as desired.

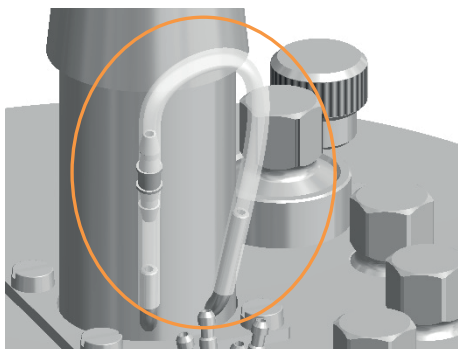
Procedure

Mounting in Ø 19 mm port

1. Equip the 19 mm port with a threaded adapter.
2. Insert the cold finger with fixed O-ring into the threaded adapter and tighten it with by hand.

8.1.16 Checking Lubrication of the Mechanical Seal

The mechanical seal must be lubricated at any time.



Therefore it must be ensured, that the silicone hose on the bottom of the drive hub is always entirely filled with glycerine. Top it up, if necessary.

For details refer to chapter „Cleaning and Maintenance“, „Lubricating the Mechanical Seal“.



ATTENTION

Risk of loss of property due to the mechanical seal running dry!

A mechanical seal, which has not been adequately lubricated, is destroyed when running dry.

8.1.17 Preparing the Sensors

All sensors that come into contact with the medium are mounted before autoclaving and are sterilised together with the culture vessel.

Note the following about all sensors:

- Mount all sensors by hand – do not use any tools!

Before Fermentation/Cultivation

- Mount the sensors in such a way that they cannot come in contact with other components or the glass vessel.
- If the mounting depth of is adjustable (mounting with electrode holder/clamping adaptor), make sure the mounting depth is set correctly prior to autoclaving, as later adjustment represents a contamination risk.

pH sensor

Calibrate the pH sensor on the operating panel before mounting and autoclaving.

pO₂ sensor

Mount the pO₂ sensor in such a way that it has good access to the flow and there is no risk of bubbles collecting. (Calibration is carried out AFTER autoclaving!)

pH sensor & pO₂ sensor METTLER

Cover the sensor heads of METTLER pH sensor and pO₂ sensors with aluminium foil during autoclaving.

pH sensor & pO₂ sensor HAMILTON



ATTENTION

Risk of damage to the (HAMILTON) pH and pO₂ sensor. Covering the sensor heads with aluminium foil during autoclaving may lead to water gathering under the film, thus damage the contacts on the sensor head.

pH and pO₂ sensor heads should **NOT** be covered with aluminium foil during autoclaving.

For details on the safety, technical data, usage and maintenance requirements for the pH and pO₂ sensors, see the separate documentation provided by the manufacturers.

8.1.17.1 Calibrating the pH Sensor

For a reliable pH measurement, a 2-point calibration with an upper and lower reference buffer must be carried out before each cultivation. The pH sensor must be calibrated before autoclaving. This is carried out on the operating panel and described in detail in the separate operating manual of the touch screen software.

Before Fermentation/Cultivation

Procedure

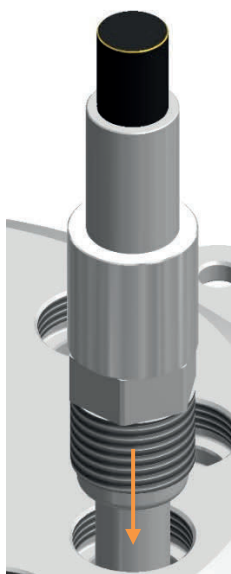
1. Connect the sensor cable. (For more details, see the chapter “Connecting the pH Sensor”).
2. Switch on the equipment using the main switch.
The operating panel is switched on automatically and the system is started.
3. Calibrate the pH sensor in accordance with the detailed description in the operating manual of the touch screen software.

8.1.17.2 Mounting a Sensor into a 12 mm Port

Depending on sensor length and vessel volume, sensors can be directly screwed into 12 mm / Pg13.5 ports. To do so, proceed as follows:

Procedure

1. Slide the O-ring onto the sensor.
2. Insert the sensor into the port.



3. Screw the sensor on its thread into the port by hand.

8.1.17.3 Mounting Sensors with Electrode Holder

To enable adjusting the mounting depth of a sensor in a 12 mm/Pg13.5 port, an electrode holder must be used for mounting.

Proceed as follows:

Before Fermentation/Cultivation

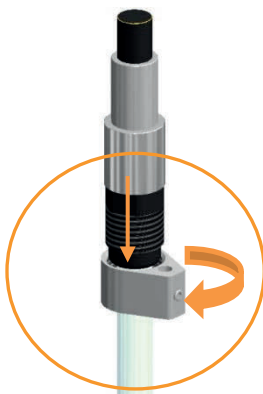
Procedure



1. On the electrode holder, lightly loosen the grub screw in the support guide with the key.

2. Pull the support guide from the guide bar.

3. Insert the sensor into the support guide and tighten it.



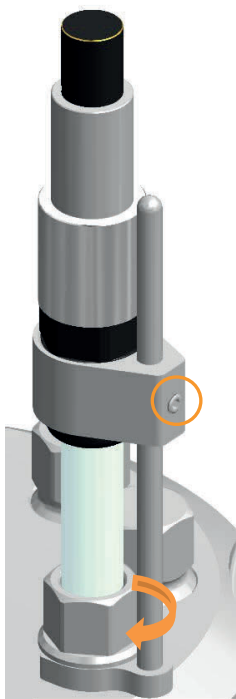
Before Fermentation/Cultivation



4. Insert the sensor into the hollow screw with the thread pointing in the downward direction.
5. Fit the fork of the guide bar into the groove of the hollow screw.
6. Push the hollow screw and the guide bar together upwards and insert the guide bar into the hole of the support guide.

7. Slide the O-ring onto the sensor and insert the sensor into the port.
8. Adjust the sensor to the desired height.

Before Fermentation/Cultivation



9. Screw the sensor on the hollow screw into the port and tighten it.
10. Tighten the grub screw in the support guide with the key.

8.1.17.4 Mounting the Antifoam Sensor

Note the following points for mounting:

- The antifoam sensor is equipped with transparent insulation that must be intact, as otherwise a continuous signal „Foam/liquid detected“ may be generated.



ATTENTION

If the sensor is fixed too tightly in the clamping adaptor, or the mounting depth of the sensor is changed while the screw on the clamping adapter is tightened, the sensor insulation may be damaged.

- The sensor head must not touch the clamping adaptor, otherwise a continuous short-circuit is generated, indicating “Foam/liquid detected”.
- The clamping adapter on the sensor must be equipped with an intact O-ring.

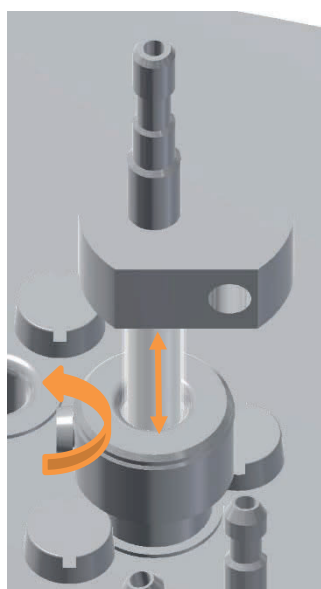
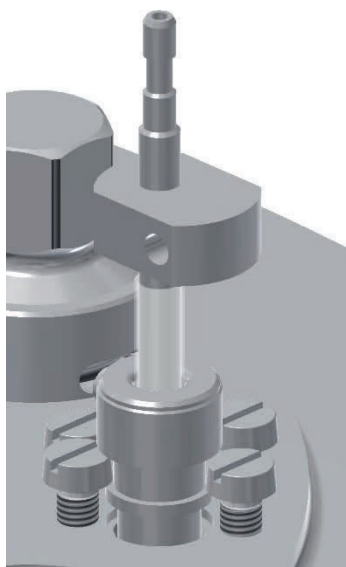
Mounting in 10 mm port

Proceed as follows:

Before Fermentation/Cultivation

Procedure

1. Remove the protective cap from the sensor.
2. Ensure the clamping adapter is equipped with an O-ring, fit one, if necessary.
3. Insert the sensor into the port.
4. Fix the clamping adapter with the two slotted screws.



5. Loosen the slotted screw at the clamping adapter.
6. Set the desired mounting depth of the sensor carefully.

7. Tighten the slotted screw carefully.

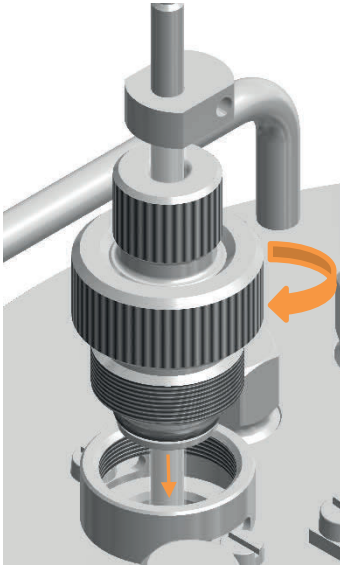
Mounting in 12 mm / Pg13.5 or 19 mm port

Proceed as follows:

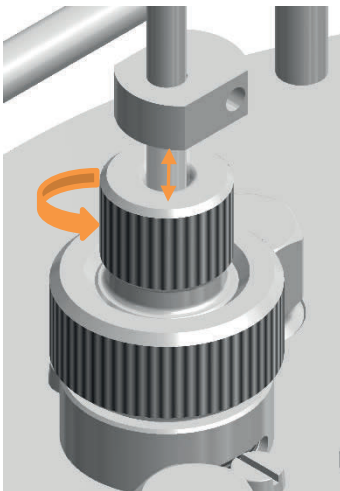
Before Fermentation/Cultivation

Procedure

1. Remove the protective cap from the sensor.
Depending on type of clamping adapter:
2. Ensure the clamping adapter or port is equipped with an O-ring, fit/place one, if necessary.
If 19 mm port: mount a threaded adapter.



3. Insert the sensor into the port and screw it in by hand.



4. Loosen the hollow screw on the clamping adapter.
5. Set the desired mounting depth of the sensor carefully.

6. Tighten the hollow screw on the clamping adapter carefully by hand.

8.1.18 Preparing the Super Safe Sampler



INFORMATION

The following figures are for general purposes of comprehension.

In order to prepare the Super Safe Sampler sampling system for autoclaving, proceed as follows:

Procedure

1. Attach the hose of the valve group on the dip tube.



2. Secure the hose with a cable tie.

3. Tighten the sample valve carefully by hand in a clockwise direction.

This ensures that the non-return valve/sample valve screw connection is tight.



Before Fermentation/Cultivation



4. Turn the sterile filter carefully by hand in a clockwise direction. This ensures that the non-return valve/sterile filter screw connection is tight.



5. Cover the valve group loosely with aluminium foil.

6. Clamp off the hose on the dip tube.

8.1.19 Mounting the Sparger Hose and the Inlet Air Filter

The sparger must be equipped with the hose and inlet air filter before autoclaving.

To do so, proceed as follows:

Procedure



1. Cut a short piece of silicone hose.
2. Place the inlet air filter, marked in red, onto the hose end in the direction of the air flow.
The nozzle with the red INLET marking remains exposed.

Before Fermentation/Cultivation

3. Place the silicone hose onto the sparger.

4. Secure the ends of the hose with the cable tie.
5. Clamp off the silicon hose with a hose clamp.
6. Lightly cap the inlet air filter with aluminium foil.

8.1.20 Preparing the Gassing Hose Line on the Basic Unit

An appropriate hose line must be prepared on the basic unit in order to connect the sparger to the gassing after autoclaving.

Proceed as follows:

Procedure

1. Cut a piece of thick walled silicone hose (Ø 5 x 8 mm, in the starter kit).
Choose its length so that the hose connection between sparger and gas supply on the basic unit does not have any tension or kinks.
2. Fit the hose to the hose nozzle of the gassing unit(s) on the basic unit.
3. Secure the hose with cable ties.

8.1.21 Calibrating the Pumps

Not calibrated pumps show the duration in seconds and the number of rotations. If the delivered volume (in mL) shall be indicated instead, the pumps must be calibrated before autoclaving.

A detailed description of how to calibrate the pumps can be found in the separate operating manual of the touch screen software.

Before Fermentation/Cultivation

8.1.22 Preparing the Reagent Bottles, Pumps and Hoses



ATTENTION

Damaged hoses and/or clogged filters may lead to undesired pressure conditions in the reagent bottles.

- Ensure each reagent bottle is equipped with an open pressure equalisation line with a clean and dry filter.
- Only use clean, intact hoses and ensure they are firmly attached.

The following sections contain a detailed description of how reagent bottles are equipped properly and connected to the pumps and culture vessel.

Connecting the reagent bottles to the pumps and culture vessel

Proceed as follows:

Procedure

1. Cut two long silicone hoses with appropriate diameter (refer to table with hoses in chapter „Accessories“, „Reagent Bottles“) per pump/reagent bottle.



INFORMATION

The length of the silicone hoses must be selected to ensure that the hose connections between the reagent bottles, pumps and culture vessel do not have any tensions or kinks.

2. Thoroughly rinse the silicone hoses with distilled water.

Before Fermentation/Cultivation



3. Connect the silicone hoses and pump hoses of the pump heads with hose connectors.



INFORMATION

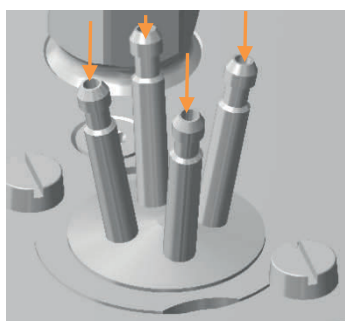
Note that the direction of rotation of the pumps is clockwise in operational state.

4. Secure with cable ties.

Connection between pumps and culture vessel

Proceed as follows:

Procedure



1. Fit silicone hoses for base, acid and feed to the addition port adapter(s) and secure them with cable ties.

2. Attach the silicone hose of the antifoam pump to the mounted antifoam sensor in the culture vessel and secure it with a cable tie.

Connection between reagent bottles and pumps

Proceed as follows:

Procedure

1. Ensure that a hose is fitted inside the reagent bottles at the exposed hose connection (without sterile filter); fit one if not:
 - a) the end of the hose does not touch the bottom of the bottle, otherwise the hose may get sucked against the bottom and no longer be able to pump liquid.
 - b) the end of the hose is cut diagonally. In this case the hose end can touch the bottom of the bottle.
2. Label the reagent bottles in accordance with their content.

Before Fermentation/Cultivation

- Depending on the application: Fill the reagent bottles with reagents and reclose them with their lid.



ATTENTION

Usage of the highly corrosive hydrochloric acid HCl as reagent leads to damage to components made of stainless steel such as e.g. component parts or the top plate.

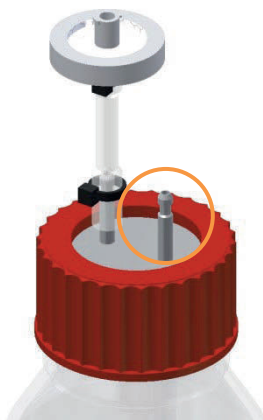
Use only non-corrosive acids, e.g. phosphoric acid, instead.



INFORMATION

Fill reagent bottles with heat-resistant reagents only. Sterilise non-heat-resistant feed solution separately and only transfer it to the reagent bottle after sterilising.

- Place the reagent bottles in reagent bottle and pump holders.
- Attach the correct silicone hoses to available hose connections of each reagent bottle and secure them with cable ties.



- Close silicone hoses with clamps as close as possible to the hose connections of the reagent bottles to ensure that no reagent can flow into the culture vessel.
- Ensure that:
 - each reagent bottle is connected with the appropriate pump according to its contents. (Base to base pump, etc.).
 - filters are clean and dry; short hose line is open.
- Cap the filter loosely with aluminium foil.

Before Fermentation/Cultivation

8.1.23 Sterile Hose Connections

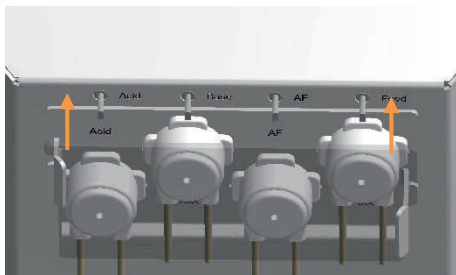
If additional vessels are needed and these can only be connected to the culture vessel after autoclaving, such as vessels for the inoculum or bottles for sampling etc., rapid couplings (male/female), sterile connectors or – if weldable hoses are used – a hose welding device can be used to form a sterile connection.

The connection pieces must be fitted to the appropriate hoses before autoclaving. Rapid couplings are connected after autoclaving in a sterile workbench. Sterile connectors and hose welding devices allow sterile connecting without a sterile workbench.

8.1.24 Removing the Pump Heads

To remove the pump heads from the basic unit, proceed as follows:

Procedure

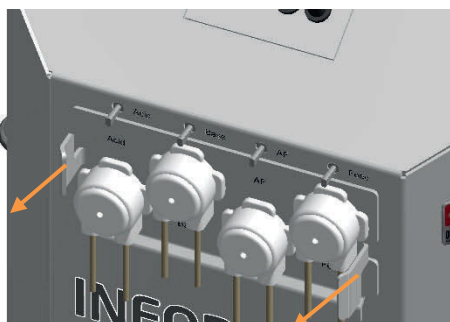


1. Pull up the pump cover plate and remove it from the holder.



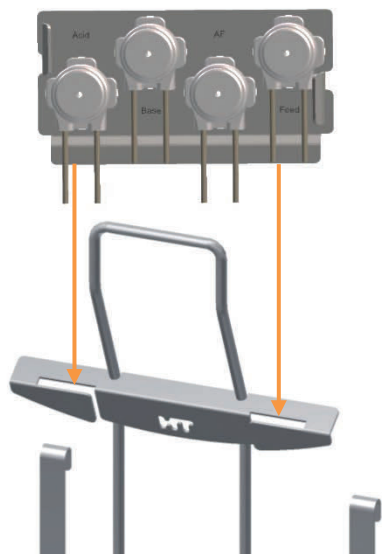
INFORMATION

The pump cover plate serves only as a protective device in operating mode. It is not heat proof and therefore it may not be autoclaved.



2. Pull the mounting plate with the pump heads off the drive shafts by the two handles.

Before Fermentation/Cultivation



3. Fit the mounting plate with the pump heads onto the reagent bottle and pump holder.

8.1.25 Checklist Before Autoclaving

Check and ensure the following items before autoclaving:

Culture vessel

All necessary O-rings are fitted.

All unused ports are closed with blanking plugs

Port for inoculation is equipped with septum, septum collar and blanking plug

There is liquid in the culture vessel (autoclavable medium or approx. 10 mL water per litre working volume).

Mechanical seal is lubricated.

Drive hub is lightly capped with aluminium foil.

Double walled culture vessels: The water overflow hose of the vessel jacket is open, it is **NOT** kinked or clamped off.

Reagent bottles, hoses and pumps

Reagent bottles are exclusively filled with autoclavable reagents, correctly labelled and connected with the culture vessel and the pump heads via hoses.

Reagent bottles are equipped with sterile filters for pressure equalisation

Reagent bottles are placed in reagent bottle and pump holder and pump heads are placed on the holder with a mounting plate.

Inoculation needles

Inoculation needle is connected to appropriate container for inoculum with a silicone hose.

Inoculation needle is packed in sterile cover or wrapped in aluminium foil.

Before Fermentation/Cultivation

Super Safe Sampler

The valve group is connected to the dip tube in the culture vessel by means of a hose.

The valve group is lightly capped with aluminium foil.

Sparger & exit gas cooler

The sparger is equipped with a hose and an inlet air filter.

The exit gas cooler is equipped with a new securely fastened exit gas filter.

Filters & hoses

All filters are clean, dry and lightly capped with aluminium foil.

There are no open hose ends.

All hose transition points are secured with an autoclavable cable tie or hose clamp to prevent them from slipping.

Hoses on the reagent bottles, for sampling and the gassing system (sparger) are clamped off with hose clamps.

The exit gas hose is **NOT** clamped off.

The hoses are undamaged; the hose lines show no kinks and are not able to kink.

Sensors

All sensors required are mounted and, if necessary, calibrated.

The antifoam sensor is mounted, set for the correct mounting depth and connected to the correct reagent bottle.

The temperature sensor of the autoclave is inserted into the pocket for the temperature sensor of the culture vessel.

pH and pO₂ sensors:

METTLER (analogue): are covered with aluminium foil.

HAMILTON: are **NOT** covered with aluminium foil.

8.1.26 Autoclaving

Before cultivation starts, the culture vessel is autoclaved in accordance with the application in question. The culture vessel can be autoclaved with or without medium.

Adhere to the following:

- Never autoclave the culture vessel dry; see also the chapter “Moistening/Filling the Culture Vessel”.

Before Fermentation/Cultivation



INFORMATION

Development of steam is not possible when autoclaving a completely empty and dry culture vessel. Successful sterilisation is not guaranteed.

Ensure that there is liquid in the culture vessel (approx. 10 mL of water per litre of total volume).

- If necessary, pump off any remaining water after autoclaving by means of the dip tube.
- Sterilise all liquid, heat-instable components separately and add them after autoclaving.
- If the medium is autoclaved in the culture vessel, you may then need to add sterile water to make up the volume.

When transporting the culture vessel to/from the autoclave, note the following:

- Always transport the culture vessel in the vessel holder.
- Always transport the culture vessel to/from the autoclave in pairs and use suitable auxiliary equipment when transporting the culture vessel.



WARNING

Depending on the design, accessories and fill level, the culture vessel may be too heavy to be carried by one person alone.

Proceed as follows to autoclave the culture vessel:

Procedure

1. Place the culture vessel into the autoclave.
2. Ensure that the culture vessel and the accessories do not touch the inner wall of the autoclave.
3. Ensure that the exit gas filter is open.
4. Insert the temperature sensor of the autoclave into the pocket for the temperature sensor.
5. Select the program for liquids.
6. Autoclave the culture vessel in accordance with the operating manual of the autoclave manufacturer.

Before Fermentation/Cultivation**8.2 Connecting the Culture Vessel and Preparing the Cultivation**

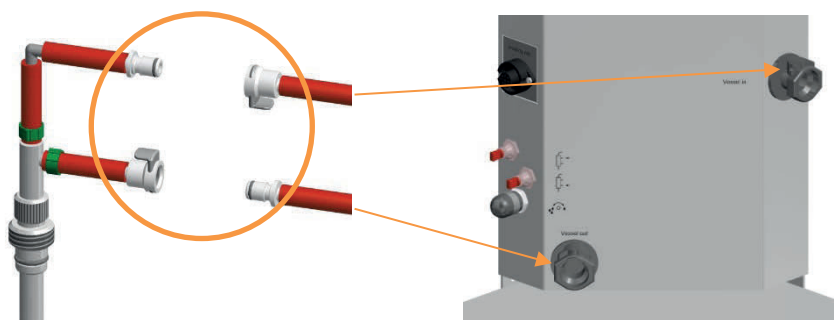
As soon as the culture vessel with the accessories has cooled sufficiently, the various cable and tube connections between the basic unit and the culture vessel can be established.

Depending on the present temperature control system, the following steps in the procedure are to be carried out:

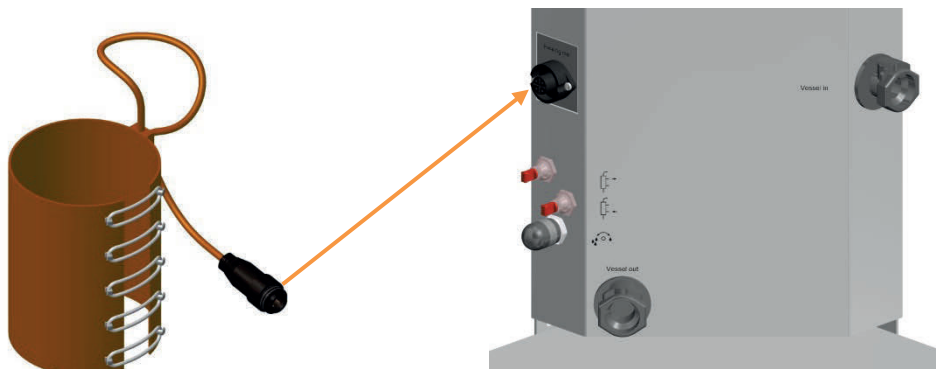
- Double walled vessels: connect the vessel jacket to the water connectors on the basic unit.
- Single walled vessels: connect the cold finger to the water connectors on the basic unit, fit the heater pad around the vessel and connect it to the basic unit.

8.2.1 Connecting a Single Walled Vessel

To connect a single walled vessel to the basic unit, proceed as follows:

Connecting the cold finger**Procedure**

1. Push the pressure hoses for water inlet and outlet (on cold finger and on basic unit) together via the rapid couplings.
2. Ensure the cold finger is connected to the basic unit as follows:
 - Lower hose with connector: outlet of the cold finger
 - Upper hose with connector: outlet of the cold finger

Before Fermentation/Cultivation**Connecting the heater pad**

Before doing so, check the heater pad and the cable connection for damages (cracks, breaks/kinks etc.) and ensure the pad is dry. Dry or replace the heater pad, if necessary.

**DANGER**

Danger of fatal electric shock!

The use of a damaged or wet/damp heater pad can be perilous!

Procedure

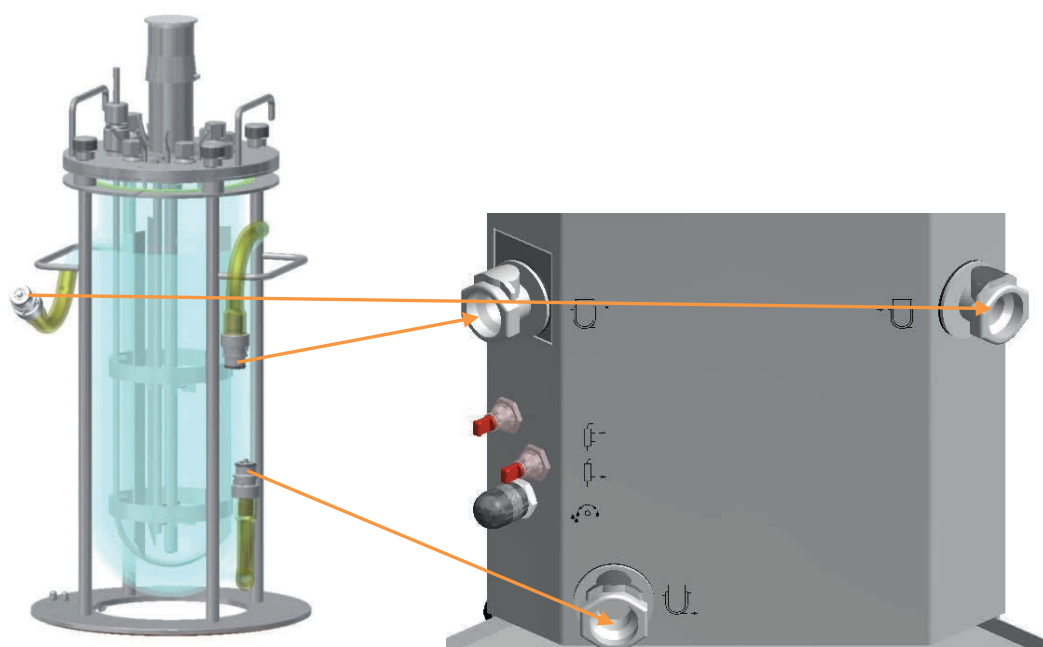
1. Fit the heater pad around the culture vessel and hook the tensioning springs.
2. Plug the cable into the connector labelled *Heating mat*.

Before Fermentation/Cultivation**8.2.2 Connecting a Double Walled Culture Vessel**

To connect a double walled vessel to the basic unit, the hoses for water inlet, outlet and overflow of the vessel jacket must be plugged into the appropriate connectors on the basic unit according the symbols.

**INFORMATION**

In order that the hose connections can be disconnected easily after cultivation, slightly moisten the rapid couplings on the silicon hoses prior to connecting them.



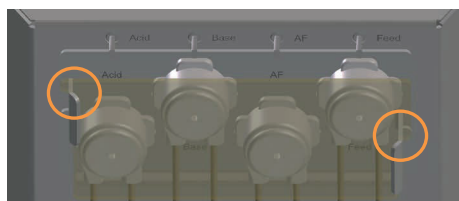
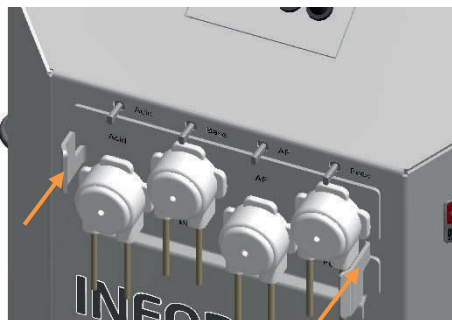
Before Fermentation/Cultivation

8.2.3 Mounting the Pump Heads

To mount the pump heads to the basic unit, proceed as follows:

Procedure

1. Pull off the mounting plate with the pump heads from the reagent bottle and pump holder.
2. Plug the mounting plate with the pump heads onto the pump motor drive shafts.



3. Insert the cover plate into the support.

8.2.4 Filling the Reagent Hoses

In order to prepare the reagent hoses for operation, they must be filled with reagent using the rocker switches on the basic unit.

WARNING

When using heavily corrosive reagents (acids and bases), it is particularly important only to use suitable and undamaged hoses. They must also be securely fastened. Furthermore, the exit gas filter must not be blocked. This ensures that no pressure builds up and no reagent escapes due to burst hoses.

Observe the following points:

- Remove the clamps from the reagent hoses, before filling.
- Ensure that no reagent escapes into the culture vessel, if possible.

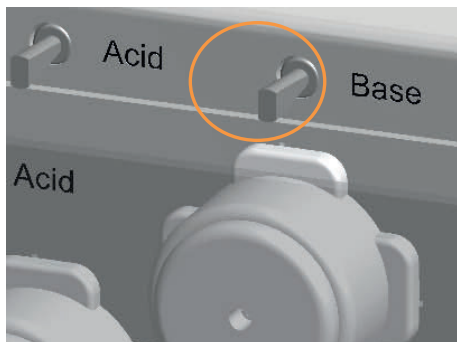
Proceed as follows for filling:

Before Fermentation/Cultivation

Procedure

1. Switch the equipment on at the main switch.
2. Open the clamps on the reagent hoses.
3. Fill the reagent hoses individually, successively and manually via the appropriate rocker switch.

Observe the following points:



- Press the rocker switch to the right side: the pump runs forward (clockwise), reagent is sucked in from the reagent bottle and is pumped in the direction of the vessel.
- Press the rocker switch to the left side: the pump runs backwards (counter clockwise), reagent is liquid is sucked in from the culture vessel and is pumped in the direction of the reagent bottle.

Release the rocker switch just before liquid visibly enters the addition port adapter(s), respectively the dosing needle of the antifoam sensor so that no corrective reagent can enter the culture vessel.

It is acceptable and time-saving to fill the reagent hoses automatically and simultaneously when operating several bioreactors. For details refer to the separate operating manual of the touch screen software.

8.2.5 Connecting the Gassing

To connect the sparger to the gassing, proceed as follows:

Procedure



1. Remove the aluminium foil from the inlet air filter.
2. Insert the gassing hose of the basic unit to the inlet air filter of the sparger and secure it with a cable tie.

3. Remove the hose clamp.

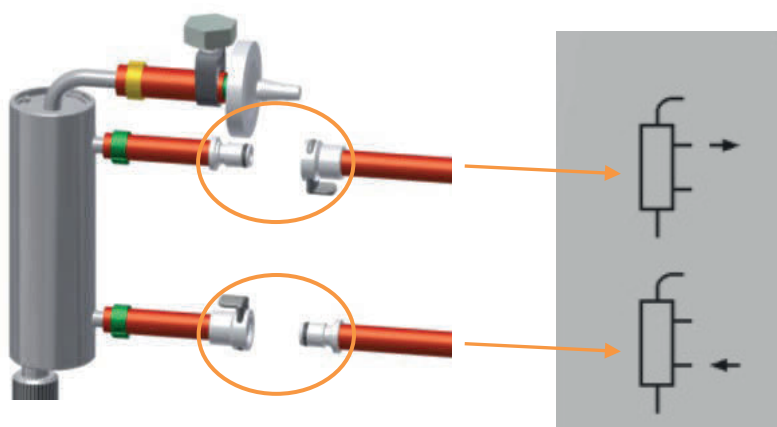
Before Fermentation/Cultivation

8.2.6 Connecting the Exit Gas Cooler

To connect the exit gas cooler to the basic unit, proceed as follows:

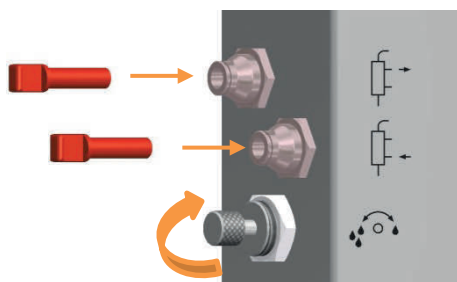
Procedure

1. Remove the aluminium foil from the exit gas filter.
2. Push the pressure hoses of the exit gas cooler and the basic unit together via the rapid couplings according the symbols on the basic unit.



3. If necessary, adjust the standard setting for water flow on the manual control valve on the basic unit.

The exit gas cooler only works with activated temperature control (Parameter *Temperature* switched *ON*).



If no exit gas cooler is used, close the manual control valve for water flow on the basic unit or close the hose connectors with the plugs provided with the equipment.

Before Fermentation/Cultivation

8.2.7 Coupling the Motor

For routine operation, it is not necessary to plug in and unplug the motor cable. The motor connected during installation is only coupled before cultivation.

Proceed as follows:

Procedure



1. Place the motor onto the drive hub with the groove aligned with the pin on the drive hub.

The motor is held in its position.

8.2.8 Filling the Culture Vessel

Depending on the application, the vessel can be filled after autoclaving. To prevent foam formation during filling, add the medium via a dip tube.

To do so, proceed as follows:

Procedure

1. Sterilise the medium separately.
2. If necessary, pump off any water that remains in the culture vessel.
3. Establish a sterile hose connection between the culture vessel and the medium container.
4. Pump the desired quantity of medium into the culture vessel.
5. Clamp off the medium hose; if necessary, apply a welded seal.
6. Disconnect the medium container from the culture vessel; if necessary, retain it as a harvest or waste container.



INFORMATION

If the stirrer is turning on the surface of the medium, foam will be formed. For this reason, only switch on the stirrer if it is fully covered by medium.

Before Fermentation/Cultivation

8.2.9 Inserting the Temperature Sensor (Pt100) into the Pocket

The temperature sensor is not in direct contact with the medium.

Procedure



1. Simply insert the sensor into the pocket in the vessel top plate as far as it will go.



CAUTION

Risk of burns and loss of property due to overheating of the temperature control circuit!

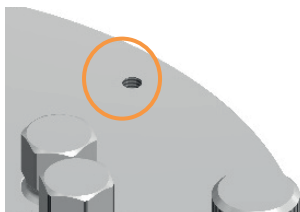
The temperature control circuit will overheat without an inserted temperature sensor and without liquid in the vessel. This can lead to burns and loss of property.

8.2.10 Connecting the Antifoam Sensor



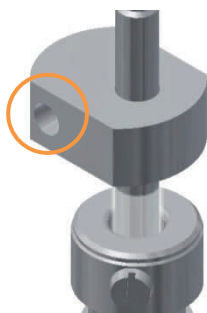
To connect the antifoam sensor, the two banana connectors of the sensor cable must be inserted as follows:

Procedure



1. Insert the black banana plug into the earth connection in the top plate.

Before Fermentation/Cultivation



2. Insert the red banana plug into the connector on the sensor head.

8.2.11 Connecting the pH Sensor

To connect the pH sensor, proceed as follows:

METTLER pH sensor

Procedure



1. Remove the protective cap or the aluminium foil from the sensor.
2. Place the connector of the sensor cable onto the sensor head.

3. Turn the ring on the connector and screw it tight.
Ensure the sensor cable is not twisted or buckled.



ATTENTION

The cable shield can be damaged by buckling or twisting. This may lead to faulty measurements.

Before Fermentation/Cultivation**Procedure****HAMILTON pH sensor**

1. Remove the red protective cap from the sensor cable.



2. Place the connector of the sensor cable onto the sensor head and screw into place.
Ensure the cable is not twisted or buckled.

8.2.12 Connecting the pO₂ Sensor

To connect the pO₂ sensor, proceed as follows:

METTLER pO₂ sensor**Procedure**

1. Align the orange mark on the connector of the sensor cable with the orange mark on the sensor.

Before Fermentation/Cultivation

2. Plug the cable connector onto the sensor.
3. Turn the bajonet cap of the sensor cable clockwise und push gently towards the sensor.

Ensure the cable is not twisted or buckled.

**ATTENTION**

The cable shield can be damaged by buckling or twisting. This may lead to faulty measurements.

HAMILTON pO₂ sensor

To connect the HAMILTON pO₂ sensor, proceed in the same manner as with the HAMILTON pH sensor; see the chapter “Connecting the pH Sensor”, section “HAMILTON pH sensor”.

8.2.13 Polarising the pO₂ Sensor (METTLER)

Polarographic pO₂ sensors must be polarised at initial operation or after disconnection from the voltage source. Correct calibration is not possible otherwise. This means that the pO₂ sensor must be polarised before calibration.

For polarisation, the sensor cable must simply be connected to the pO₂ sensor and the equipment must be switched on at the main switch.

Duration of polarisation (= polarisation time) depends on how long the pO₂ sensor has been disconnected from the voltage source (= depolarisation time)

As a general rule: if depolarisation time > 30 minutes, the minimum polarisation time is 360 minutes.

More details about polarisation can be found in the separate documentation form the manufacturer METTLER TOLEDO.

8.2.14 Calibrating the pO₂ Sensor

Generally speaking, the following applies: The pO₂ sensor should be calibrated after autoclaving has been performed because the sterilisation process may change the steepness of the pO₂ sensor. As a rule, a 1-point calibration to 100 % is usually sufficient for exact measurement, and should be carried out before each cultivation.

Depending on the specifications defined by the user, the pO₂ sensor is calibrated either before the vessel is filled with medium or afterwards, in the prepared medium.

Before Fermentation/Cultivation

A detailed description on the calibration can be found in the separate operating manual of the touch screen software.

8.2.15 Checking the Hoses and Hose Connections

Check and ensure the following items before each cultivation:

- Hoses show no kinks and are not able to kink.
- Hoses are undamaged and show no weaknesses.
- Gas hoses and connections do not show any leaks.
- Hose lines are as short as possible.
- Hoses are secured with cable ties and/or hose clamps.
- Only the pressure hoses supplied by the equipment manufacturer are connected as supply lines (water, gas) between the in-house connections and the equipment.

9 Fermentation/Cultivation

The following sections describe the work necessary for the performance of and after the completion of a fermentation/cultivation, before the culture vessel with accessories is thoroughly cleaned and then prepared for another cultivation.

This essentially comprises:

- Preparing the medium, starting the bioreactor
- Sampling
- Inoculation
- Harvest
- Stopping the bioreactor, if necessary emptying the vessel
- Autoclaving the culture vessel and accessories

The requirement for the first item is that the culture vessel and accessories are autoclaved, cooled and connected to the basic unit. All cable and hose connections between the equipment and the culture vessel, including the reagent bottles, are present, pump heads are mounted and the reagent hoses are filled. Depending on the user specifications, the pO_2 sensor is already calibrated.

9.1 Preparing the Medium

Before the first sampling, which usually takes place as a 'zero sample' before inoculation, and before the inoculation itself, the medium must be warmed to the desired temperature. If necessary, the pO_2 concentration and the pH are set. The time required for this depends on the working volume.

Set and activate the desired setpoint of the parameters in question on the operating panel, and start the bioreactor.

Depending on the specifications defined by the user, the pO_2 sensor is calibrated either before the vessel is filled with medium or afterwards, in the prepared medium.

Fermentation/Cultivation

CAUTION

If pressure equalisation does not take place via a top plate opening or the mounted exit gas cooler, overpressure in the culture vessel may occur during cultivation as a result of warming, gassing or fermentation processes.

- Exit gas line - hose at the exit gas cooler with secured exit gas filter - **ALWAYS** keep open.
- Only use clean and dry exit gas filters.

For details about calibration and operation in general refer to the separate operating manual of the touch screen software.

9.2 Sampling

Samples are taken from the culture vessel to gain material for off-line analysis. The method of sampling can vary due to the different analyses carried out by the operator.

The sampling procedure using the standard sampling system, Super Safe Sampler, is described below.

Before starting, observe the following:

WARNING

Culture solution could emerge from the vessel if the sample valve mechanically fails. This could lead to serious health risks in the event of applications with pathogenic organisms.

- When working with pathogenic organisms, always additionally clamp off the sampling hose with a metal (!) clamp.
- Only remove the clamp when sampling.
- Reattach the clamp before removing the syringe from the sample valve.

WARNING

Loose screws at components could lead to the penetration of unsterile air or contamination of the environment.

Before and after autoclaving: Check that all screws are tightly screwed in and, if necessary, tighten them manually.

Fermentation/Cultivation

If the sample is to be further aseptically processed, use a sterile syringe and sterile closing caps.

For details, see the main chapter “Accessories” chapter “Sampling System Super Safe Sampler”, section “Aseptic Sampling”.

Proceed as follows:

Procedure

1. Check that all screw connections of the valve group are tightly screwed in. If necessary, gently tighten the screw connections with two fingers.
2. Remove the clamp from the sampling hose.
3. If present: Remove the closing caps.
4. If desired: Disinfect the sample valve.
5. Screw open the Luer-Lock syringe on the sample valve.



6. Pull back the syringe plunger to remove the desired sampling volume.



If the dip tube was rinsed with air, air is sucked in first. Remove it as follows:

Fermentation/Cultivation

- a) Unscrew the syringe from the valve.
- b) Hold the syringe with the plunger downwards so that the medium remains in the syringe.
- c) Push the air out of the syringe.
- d) Screw the syringe onto the sample valve.
- e) Draw in again.

7. Attach the clamp to the sampling hose.

Rinsing the dip tube with sterile air

The dip tube and its sampling hose can be filled with sterile air after taking a sample.



INFORMATION

Only use a clean and dry syringe to avoid blocking the sterile filter. This syringe can be reused as often as desired, since air is provided via a sterile filter.

Procedure:



To do so, proceed as follows:

1. Insert the syringe onto the hose at the sterile filter and push air through.

The remaining liquid in the hose and in the dip tube is pushed back into the vessel.

2. Remove the syringe from the sterile filter to fill it with air again.
3. Repeat steps 1 and 2 as many times as necessary until bubbles rise out of the dip tube.

Removing residual fluid

To remove residual fluid from the system, proceed as follows:

Procedure:



1. Hold the syringe with sample downwards, pull back the plunger.

This removes all but a few μL of the residual fluid.



2. Hold the sample valve with one hand; unscrew the syringe with the other.

3. If desired: Place the closing caps on the sample valve and on the syringe with the sample.

9.3 Inoculation

Check and ensure the following items before inoculation:

- Medium has been filled.
- Heat-labile, separately sterilised substances are present.
- The reagent bottles are connected with the pumps and the culture vessel, and are filled with a sufficient amount of reagents and feed solution for the duration of the entire cultivation process.
- The hoses of the reagent bottles are filled.

Fermentation/Cultivation

- The correct operating temperature has been reached.
- The required stirring speed is set.
- The sensors are calibrated and the control is correct (or not yet switched on).
- All clamps have been removed (except for sampling system).
- Utensils for the inoculation and vessels with inoculum are ready.

Methods

There are a number of ways to add medium or inoculum before and during cultivation:

- With inoculation needle and septum collar with septum
- In a small volume, with the syringe via the septum
- Via an addition port adapter from the reagent bottle (a sterile hose connection is required for this method).
- Via a dip tube from the reagent bottle (a sterile hose connection is required for this method).

These methods are described in the following sections.

The implements for inoculation with inoculation needle are standard accessories for the equipment. This inoculation method is particularly suitable for all vessel sizes of the equipment. If separate addition of several different solutions is necessary, a second inoculation needle can be used with mounted septum collar in a spare port.

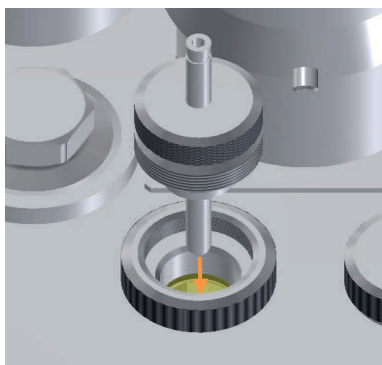
9.3.1 Inoculation with Inoculation Needle

Proceed as follows for inoculation:

Procedure

1. Fill the inoculum under sterile conditions into the prepared container.
2. Unscrew the blanking plug from the septum collar.
3. If appropriate, place a few drops of Ethanol (70 %) on the septum before piercing the septum.
If appropriate, briefly flame the septum collar.
4. Remove sterile cover/aluminium foil from the inoculation needle.
5. Briefly flame the inoculation needle.

Fermentation/Cultivation



6. Immediately pierce the inoculation needle through the septum.

7. Screw the inoculation needle into the septum collar.
8. Transfer the desired volume of inoculum into the culture vessel.
9. Clamp off the silicone hose.
Or: Pull the inoculation needle out and close the septum collar with the blanking plug. But this method is not secure regarding preventing contamination.

9.3.2 Inoculation with a Syringe

Proceed as follows for the inoculation:

Procedure

1. Fill the syringe with the required amount of inoculum.
2. Unscrew the blanking plug from the septum collar.
As a possible additional protection against contamination:
Before piercing, drop a few drops of ethanol (70 %) on the septum.
3. Pierce the septum and inject the inoculum.
4. Remove the needle from the septum and close the septum collar with a blanking plug.

9.3.3 Inoculation Using Dip Tube / Addition Port Adapter

Proceed as follows during inoculation:

Procedure

1. Fill the inoculum under sterile conditions into the prepared container.
2. Create a sterile hose connection with the dip tube/addition port adapter.
3. Transfer the desired volume of inoculum into the culture vessel. Pump it, if necessary.
4. Clamp off the hose with the hose clamp, weld it if necessary.

Fermentation/Cultivation

9.4 Harvest

The culture can be harvested at the end of the cultivation. To prevent possible sedimentation from the culture, the stirrer can be switched on during harvesting. If necessary, activate gassing for sensitive cultures. However, all other parameters should be switched off, provided there are no other specifications for the user.

The following possibilities exist for the harvest:

- a) Transfer to another vessel
To transfer the contents of the vessel to another container in a laminar flow cabinet.
- b) Pump-down via a sterile hose connection
To do so, proceed as follows:

Procedure

1. Make a sterile connection between the hose at the dip tube for harvest and the new vessel.
2. Connect the hose to one of the pumps on the equipment or to an external pump.
3. Pump the desired amount of culture into the new vessel.



INFORMATION

Only switch on the stirrer, if it is fully covered by medium, as foam otherwise forms.

4. Switch all parameters off on the operating panel, stop the bioreactor.



ATTENTION

Switching the equipment off on the main switch without stopping the bioreactor and shutting down the system on the operating unit beforehand may lead to damage of the operating unit!

9.5 Emptying the Culture Vessel

Depending on the user specifications, the culture vessel can be emptied either before or after autoclaving.

A previously emptied and culture vessel filled only with water for autoclaving is easier to clean afterwards.

For emptying the culture vessel, the same options as for harvesting are available. For more information, see the “Harvest” section.

If the culture will not be used further, it must be inactivated according to the current in-house instructions (e.g. by autoclaving or by lowering the pH value), and subsequently disposed of in an environmentally sound manner according to the local regulations.

9.6 Emptying the Reagent Hoses

Before autoclaving the culture vessel with accessories, all reagent hoses must be completely emptied using the corresponding pump.

This can either be done manually and individually for each pump using the rocker switch on the basic unit or all pumps are emptied time-controlled at once via the operating unit.

It is also recommended to thoroughly rinse the hoses with water after emptying and before autoclaving.

For details about automatic emptying of all pump hoses refer to the separate operating manual of the touch screen software.

9.7 Switching off the Equipment

When the harvest is finished or the culture vessel has been emptied and the reagent hoses are also empty, the equipment can be switched off.

Proceed as follows:

Procedure

1. Ensure that the bioreactor has been stopped. If necessary, stop it in the touch screen software on the operating panel.
2. Shutdown the system on the operating panel.
3. Switch off the equipment at the main switch.

Fermentation/Cultivation



ATTENTION

Switching the equipment off at the main switch without previously stopping the bioreactor and shutting down the system on the operating panel may lead to damage of the operating panel!!

4. Close the supply lines (water, gas).
5. Let the motor cool down.
6. Autoclave the vessel, component parts and accessories as per the user-specific specifications and then clean them.

9.8 Autoclaving the Culture Vessel After Fermentation/Cultivation

After emptying the culture vessel and before cleaning, the culture vessel must be autoclaved with all accessories.

When doing so, do not autoclave the culture vessel when completely dry and observe the same safety regulations as when autoclaving before cultivation.

Before starting, ensure:

- There is liquid in the culture vessel (autoclavable medium or approx. 10 mL water per litre working volume).
- Reagents and feed solution have been pumped back out of the hoses.
- The equipment is switched off.
- The motor has cooled down.

Proceed as follows to prepare the culture vessel and accessories for autoclaving after fermentation/cultivation:

Procedure

1. Clamp off the hoses of the reagent bottles.
2. Clamp off the hose of the sparger.
3. Remove all cable and hose connections between the basic unit and the culture vessel:
 - a) Uncouple the motor and place it to the side.
 - b) Unplug the sensor cables.
 - c) Pull the temperature sensor out of the pocket.
 - d) If an exit gas cooler is in use: disconnect the water inlet and water outlet hoses from the exit gas cooler.
 - e) Depending on the temperature control system:

Fermentation/Cultivation

- disconnect the water inlet / outlet / overflow hoses of the vessel jacket from the basic unit.

OR:

- disconnect the water inlet and outlet hoses of the cold finger. Unplug the heater pad and remove it from the vessel

- f) Remove the gassing hose (emerging from basic unit) from the inlet air filter on the sparger.

4. Lightly cover all filters and the drive hub with aluminium foil.

**ATTENTION**

HAMILTON pH and pO₂ sensors: **Do not** cover with aluminium foil!

5. Open the pump cover.
6. Remove the mounting plate with pump heads from the drive shafts on the basic unit and place on the pump holder.
7. Check and ensure that the exit gas filter is free and dry and the exit gas hose is **OPEN**.
8. Insert the temperature sensor of the autoclave into the pocket on the culture vessel and autoclave the culture vessel.

Cleaning and Maintenance

10 Cleaning and Maintenance

The following sections describe in detail how the culture vessel and accessories and the basic unit are cleaned and, as required, stored.

In addition, the section contains a maintenance plan and corresponding descriptions for the procedures to be performed by the operator.

10.1 Cleaning Agent and Disinfectant

Intended use	Allowed products/tools
Culture vessel	Water and a non-scratch, non-abrasive sponge or washing-up brush; lab washer with special washing agent (for industry and lab use)
Cleaning agent for denaturation of proteins (e.g. exit gas cooler)	0.1 N NaOH
Cleaning agent for smaller component parts (e.g. exit gas cooler, dip tube)	Ultrasonic bath
Cleaning agent for surfaces	Water
Disinfectant for surfaces	Ethanol, 70 %
Decalcifier for the equipment	Phosphoric acid or citric acid (max. 5 %)

10.2 Cleaning the Culture Vessel - Routine Cleaning

The culture vessel and accessories can be cleaned as soon as they have cooled down after autoclaving.



ATTENTION

Household washing-up liquid and soap (in particular cream soaps) can collect in glass pores and impair later cultivations.

Never clean culture vessels and accessories with household soap and use special cleaning agent (for industrial and lab use) in the lab washer.

Cleaning and Maintenance

The following method describes a routine cleaning between two fermentations/cultivations. It takes place with the culture vessel completely assembled and the accessories completely mounted.

This does not include the sensors, with the exception of antifoam or level sensors from the equipment manufacturer. To avoid damaging the other sensors during the routine cleaning, they are first removed and then cleaned separately according to the third-party manufacturer guidelines and then stored, if necessary. Also see the “Removing Sensors” section and “Cleaning Sensors”.

Proceed as follows to carry out a routine cleaning of the culture vessel:

Procedure

1. Carefully unscrew the sensors (except antifoam/level sensors) by hand (no tools!) from the vessel top plate ports and place them to the side for separate cleaning according to the manufacturer guidelines.
2. Completely fill the culture vessel with 0.1 N NaOH.
3. Fit the top plate on the vessel and secure it.
4. Connect the culture vessel to the basic unit (vessel jacket or cold finger and heater pad).
5. Couple the motor.
6. Switch on the equipment at the main switch.
7. At the operating panel in the touch screen software, start the bioreactor and stir strongly for 2 hours with the stirrer function (parameter *Stirrer*).



INFORMATION

It is recommended to warm the 0.1 N caustic soda to 60 °C and to prolong the duration of stirring for dealing with persistent residue of foam or protein.

8. Stop the bioreactor in the touch screen software at the operating panel.
9. Shutdown the system at the operating panel.
10. Switch the equipment off at the main switch.
11. Let the motor cool down.
When the motor has cooled down:
12. Uncouple the motor.
13. Remove the top plate and carefully place it so that it does not(!) lie on top of components.
14. Empty the culture vessel.
15. Thoroughly rinse the culture vessel with distilled water.

Cleaning and Maintenance

10.3 Removing the Vessel Top Plate and Accessories

All accessories must be removed for thorough cleaning of the individual parts of the culture vessel. This is described in the following sections. The cleaning itself is described in the chapter “Cleaning and Storing Individual Parts”.

The cleaning of the hoses with pump heads, the basic unit, operating panel and the exit gas cooler are described in separate sections.

Sensors from third-party manufacturers are cleaned according to their manufacturer's specifications.

10.3.1 Removing the Exit Gas Cooler

Proceed as follows:

Procedure

1. Unscrew the exit gas cooler from the vessel top plate port by hand.
Ensure that the O-ring does not get lost.
2. Gently release the hose clamp with the hand wheel, pull off the exit gas filter and dispose of it.
3. Remove the pressure hose piece to thoroughly clean the exit gas cooler. (For details see the chapter “Cleaning the Exit Gas Cooler”.)

10.3.2 Removing the Sensors

Sensors are either mounted directly into the ports or by means of an electrode holder or clamping adapter. For removal of the sensors, proceed as follows:

Sensors without holder/clamping device

Procedure

1. Carefully unscrew the sensor by hand (no tools!) from the vessel top plate port.

Sensor with electrode holder

Procedure

1. Carefully loosen and unscrew the sensor on the hollow screw of the electrode holder from the port by hand.
2. Carefully unscrew the sensor from the guide bar and gently pull it out of the electrode holder.

Sensor with clamping adapter (antifoam and level sensor)

Procedure

1. Loosen both slotted screws next to the sensor in the port.

Cleaning and Maintenance**INFORMATION**

This step is only necessary for the type of clamping adapter for 10 mm ports. All other clamping adapters can be directly unscrewed and pulled out from the port or threaded adapter in the port by hand.

2. Carefully pull the clamping adaptor together with the sensor out of the port / threaded adapter in the port.
3. Ensure the O-ring of the clamping adapter does not get lost.
As required:
4. Depending on the type of clamping adapter, loosen the slotted screw or the hollow screw and carefully pull the sensor out of the clamping adapter by hand.
5. Ensure that the insulation on the sensor does not get damaged.

10.3.3 Removing Hoses, Filters and Pump Heads

To later clean reagent hoses and pump heads, they must be removed from the reagent bottles and from components of the culture vessel.

**INFORMATION**

To avoid damage, never dismantle the pump heads. Always replace a damaged pump head along with the pump hose, and vice versa.

Proceed as follows:

Procedure

1. Remove cable ties (e.g. with a side cutter) so that the hoses are not damaged.
2. Pull hoses off the culture vessel and the reagent bottles.
3. Remove and dispose of filters for pressure equalisation and hoses from reagent bottles.
4. Ensure that the inlet air filter is clean, dry and not blocked. If this is not the case, dispose of it.

**INFORMATION**

If the filter for pressure equalisation and the corresponding hoses have been used several times, ensure that the filters are always dry and clean.

Cleaning and Maintenance

5. Dispose of the exit gas filter (see also chapter “Removing the Exit Gas Cooler”).

10.3.4 Removing Blanking Plugs

Proceed as follows:

Blanking plugs in 10 mm ports

Procedure

1. Loosen both slotted screws next to the blanking plug in the port.
Ensure the screws do not get lost.
2. Pull the blanking plug out of the port by hand.
Ensure that the O-ring on the blanking plug does not get lost.

Blanking plugs in 12 mm/Pg13.5 ports

Procedure

1. Loosen the blanking plug with the hexagon socket spanner and remove it by hand.
Ensure that the O-ring does not get lost.

Blanking plugs in 19 mm ports

Procedure

1. Loosen the blanking plug with the hexagon socket spanner in the threaded adapter in the port and remove it by hand.
Ensure that the O-ring does not get lost.

10.3.5 Removing Threaded Adapters

Proceed as follows:

Procedure

1. Loosen both slotted screws next to the threaded adapter in the 19 mm port.
Ensure the screws do not get lost.
2. Remove the threaded adapter.

10.3.6 Removing the Inoculation Needle, Septum Collar and Septum

Proceed as follows:

Procedure

1. Unscrew the inoculation needle from the septum collar by hand.
Ensure that the O-ring does not get lost.
2. Unscrew the septum collar out of the port or threaded adapter (in 19 mm port) by hand.

Cleaning and Maintenance

3. Remove the septum from the port and dispose of it.

10.3.7 Removing Addition Port Adapters

Proceed as follows:

Procedure

Addition port adapter, quadruple, in 19 mm port

1. Loosen the two slotted screws next to the addition port adapter.
Ensure the screws do not get lost.
2. Remove the addition port adapter.
Ensure the O-ring on the adapter does not get lost.

**INFORMATION**

The removal procedure of further models of addition port adapters (refer to main chapter “Accessories” for details) is the same as for blanking plugs in their corresponding ports. That is why their removal is not repeatedly described here.

10.3.8 Removing the Vessel Top Plate

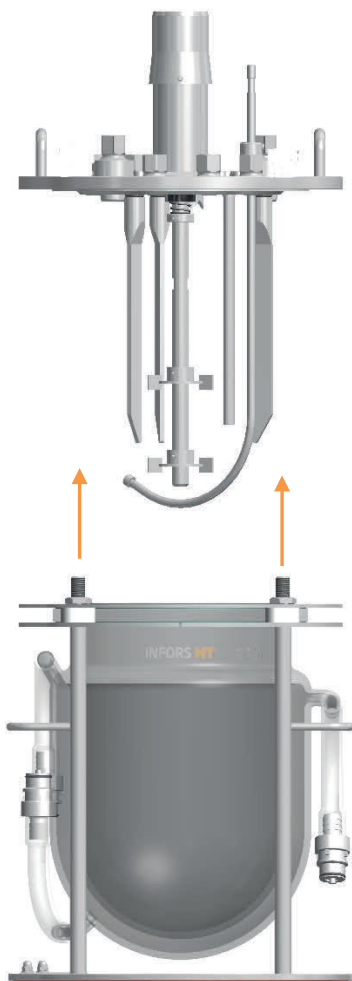
Proceed as follows to remove the vessel top plate:

Procedure



1. As far as possible, remove mounted parts before lifting the top plate.
2. Loosen and remove the knurled screws on the top plate by hand (no tool!) and place them to the side.

Cleaning and Maintenance



3. Carefully lift the top plate vertically upwards from the vessel until the stirrer shaft and other long built-in components can no longer come into contact with the glass vessel.



ATTENTION

If the vessel top plate presses against long components they could bend because of the weight of the top plate.

Always position the vessel top plate so that it does not lie on top of components.

4. If necessary, now remove components that have not yet been removed.
5. Check the glass vessel for damage (cracks, fissures, scratches) and replace if necessary.

10.3.9 Removing the Pocket for Temperature Sensor (Pt100)

Proceed as follows:

Procedure

1. Loosen both slotted screws next to the port.
Ensure the screws do not get lost.
2. Push the pocket from the inside of the vessel top plate up, so that it can be pulled out of the port from the outside of the top plate.
Ensure the O-ring on the pocket does not get lost.

10.3.10 Removing the Sparger and the Dip Tube(s)

Straight spargers and dip tubes can be removed from the outside of the vessel top plate. Curved spargers and dip tubes can only be removed from the inside of the vessel top plate.

Since this equipment uses ring spargers and straight dip tubes, removal from the inside of the vessel top plate is described here. This means that the vessel top plate is already removed.

Proceed as follows:

Procedure

1. Loosen the slotted screw on the clamping adapter.
2. Carefully pull the sparger/dip tube from the bottom out of the clamping adapter.
3. Unscrew the clamping adapter out of the port by hand.
Ensure that O-ring does not get lost.

10.3.11 Removing the Baffles

The four baffles can be removed, once the vessel top plate is removed.

Proceed as follows:

Procedure

1. Loosen and remove the hexalobular screw from the vessel top plate.
2. Pull the baffle off and put aside.
Ensure that the O-ring does not get lost.
3. Proceed the same way with the remaining baffles.

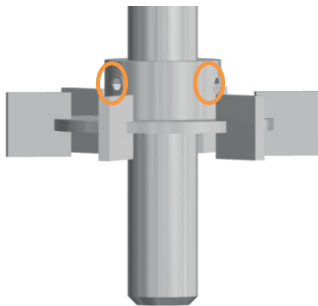
Cleaning and Maintenance

10.3.12 Removing the Impellers

Before removing the impellers, it is recommended to measure and record the positions to aid later mounting.

Proceed as follows to remove:

Procedure:



1. Loosen the grub screws on the impeller with an Allen key – do not remove!

2. Carefully remove the impeller from the stirrer shaft.

10.3.13 Removing the Stirrer Shaft

If needed, the stirrer shaft can be removed for cleaning. Particular care shall be taken, to do so.

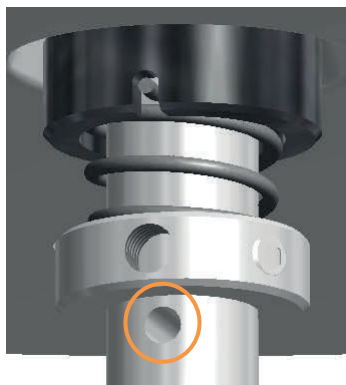
ATTENTION

The mechanical seal is sensitive to applied forces. Manipulation on it may lead to its damage!

To remove the stirrer shaft from the vessel top plate, proceed as follows:

Cleaning and Maintenance

Procedure



1. Insert an Allen key or a thin metal bar into the opening on the upper end of the stirrer shaft.
This locks the stirrer in its position.



2. Position an adjustable spanner on the two recesses on the upper end of the stirrer shaft.



3. Unscrew the stirrer shaft with the spanner counter clockwise from the drive shaft.
4. Check the O-ring on the drive shaft for damages, replace as necessary.

10.4 Cleaning and Storing Individual Parts

The procedure described here applies to the following individual parts:

- Vessel
- Accessories such as blanking plugs, spargers, dip tubes, addition port adapters etc.
- Reagent bottles

Cleaning and Maintenance

- Vessel top plate, with regard to its particular characteristics

Particulars when cleaning the top plate

- Do not place the top plate on the stirrer shaft (if stirrer shaft is not removed).
- Never remove the drive hub and the mechanical seal! This may only be carried out by qualified personnel.
- **NEVER** clean the vessel top plate in the dishwasher!



ATTENTION

The mechanical seal is very delicate. No water/cleaning agent may enter it and the silicone hose on the bottom of the drive hub may not be pulled off during cleaning of the vessel top plate.



INFORMATION

Cleaning of the sensors, hoses and pump heads as well as the basic unit and the exit gas cooler are described in separate sections.

Proceed as follows for cleaning:

Procedure

1. Clean parts with distilled water and a soft sponge or in the dishwasher (except for the vessel top plate!).
Ensure that the deposits in the dip tubes are removed. Use 0.1 N caustic soda solution followed by distilled water as necessary. For this, see the “Cleaning the Culture Vessel” section.
2. Dry all parts, including the inner parts of the dip tubes, spargers and feed needles.
3. Check all O-rings for cracks or damage. Replace them if necessary.
4. Store the vessel, vessel top plate and accessories in a clean, dry state in a location where they cannot be physically damaged (e.g. by falling), or prepare them for the next fermentation/cultivation.

10.5 Cleaning the Sensors

Apart from antifoam and level sensor, all sensors are cleaned and maintained according to the descriptions of the sensor manufacturer.

Cleaning and Maintenance

Procedure

1. Clean the sensors according to the sensor manufacturer guidelines.
2. Prepare the sensors for the next cultivation or, if necessary, service and/or store them according to the sensor manufacturer guidelines.

10.6 Cleaning the Hoses and Pump Heads

Proceed as follows to clean the reagent hoses and pump heads:

Procedure

1. Thoroughly rinse the hoses with the pump heads with water.
2. Carefully dry all hoses and, if necessary, blow out with compressed air.



INFORMATION

To avoid damage, never dismantle the pump heads. Always replace a damaged pump head along with the pump hose, and vice versa.

10.7 Cleaning the Super Safe Sampler



ATTENTION

Risk of damage to the sampling system from unsuitable cleaning methods or cleaning agent (such as acids, bases or solvents, for example).

- Only use water or a mild soap solution for cleaning.
- The sterile filter must remain dry at all times.

Proceed as follows to clean the sampling system:

Procedure

1. Fill the culture vessel with water or a mild soap solution.
Or: Remove the sampling hose from the dip tube and hold it in a vessel, e.g. a beaker, with water or a soap solution.
2. Place the syringe on the automatic valve and pull out the plunger to rinse the sampling system.
When using a soap solution:
3. Then rinse the sampling system thoroughly with water.

Cleaning and Maintenance



INFORMATION

If the test record requires that the culture is killed off after cultivation by autoclaving the culture vessel, the valves of the sampling system may become stuck due to residue of the culture solution. In such a situation, it would be better to autoclave the sampling system separately in a beaker of water (hoses filled with water, filter removed).

10.8 Cleaning the Exit Gas Cooler

If the exit gas cooler is only lightly soiled, an ultrasonic bath for approx. 15 minutes is sufficient to clean it.

However, if foam has entered the exit gas cooler during cultivation, it must be cleaned thoroughly.

To do so, proceed as follows:

Procedure

1. Put the exit gas cooler into 0.1 N NaOH for 4 hours.
2. Rinse the exit gas cooler thoroughly with water.
3. Put the exit gas cooler into an ultrasonic bath for 2 to 5 minutes.
4. Flush the exit gas cooler with ethanol (70%).
5. Thoroughly rinse the exit gas cooler with distilled water.

10.9 Cleaning the Basic Unit and Operating Panel

Proceed as follows to clean the surface of the basic unit and the operating panel as required:

Procedure

1. Switch the equipment off at the main switch.
2. Disconnect the equipment from the mains supply.
3. Wipe all surfaces with a damp cloth.
Clean with an appropriate disinfectant as necessary.
4. Clean the screen with a wipe suitable for computer or laptop screens.

Cleaning and Maintenance**10.10 Cleaning the Heater Pad****DANGER**

Damp cleaning of a heater pad, which is connected to energised equipment, can be perilous.

- Always disconnect the heater pad from the basic unit before cleaning.
- Preferably clean the heater pad dry.
- Always let the heater pad completely dry after cleaning with a damp cloth and before next use.

If required, clean the heater pad as follows:

Procedure

1. Unplug the heater pad from the basic unit.
2. Wipe the heater pad with a dry cloth.
If necessary, use a damp cloth (water only!).

**ATTENTION**

Cleaning the heater pad with soap or aggressive detergents may damage the silicone sheathing.

3. Let the heater pad completely dry after cleaning with a damp cloth.
4. Check the heater pad and cable for damages (cracks, kinks etc.), replace as necessary.

10.11 Maintenance Plan**WARNING**

Non-compliance of this maintenance plan contains a high risk!

It is the responsibility of the user, that this maintenance plan is complied with. Non-compliance will lead to exclusion of liability (see General Terms and Conditions).

The required maintenance for reliable operation is described in the following chapters.

Reduce the maintenance intervals in case increased abrasion is detected during regular checks.

Cleaning and Maintenance

Contact the manufacturer for questions concerning maintenance.
For contact details, see page 2.

To be carried out by operator

Interval	Maintenance work
Before each fermentation/cultivation	Check all hoses and hose connections. Replace hoses, if necessary. Supply hoses may be replaced by qualified personnel.
	Check cables for damage and kinks.
	Check that O-rings and gaskets are leak-proof, replace if necessary.
	Check the integrity of all glass parts (vessel, reagent bottles) and replace if necessary.
	Check all sterile filters and replace if necessary. Replace the exit gas filter.
	If necessary, calibrate the sensors.
	Single walled vessels: check heater pad and its cable connection on visible damages, replace the heater pad, if necessary.
	Check lubrication of mechanical seal and lubricate as necessary.
After every fermentation/cultivation	Autoclave and clean the culture vessel and accessories.
As required	Clean the basic unit and operating panel.
	Single walled vessels: clean the heater pad.
	Equipment with water temperature control system: decalcify the equipment via the vessel jacket.

To be carried out by qualified personnel

Interval	Maintenance work
Every 6 months	Check and calibrate measuring sections (temperature, pH, etc.) with a simulator
As required	Replace supply hoses.

To be carried out by operator, ONLY AFTER CONSULTATION OF MANUFACTURER

Interval	Maintenance work
As required	Decalcify the equipment (practicable for both temperature control system variants)

10.12 Lubricating the Mechanical Seal

The two-part silicone hose on the drive hub must always be filled with liquid (Glycerine, for details see the chapter “Operating Materials” of the main chapter “Technical Data”) to ensure the mechanical seal is lubricated.



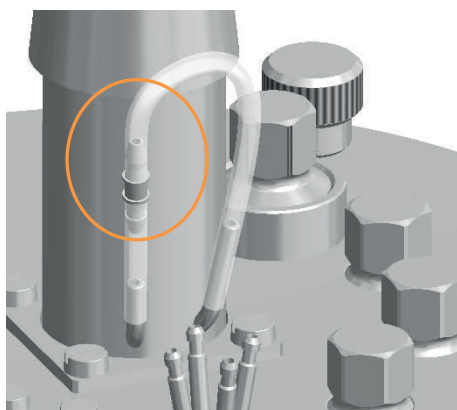
ATTENTION

Risk of loss of property due to the mechanical seal running dry!

A mechanical seal, which has not been adequately lubricated, is destroyed when running dry.

Proceed as follows for lubrication:

Procedure



1. Pull off the longer piece of hose from the coupling on the shorter piece.
2. Fill a syringe with glycerine and plug it onto the open hose end.
3. Fill Glycerine into the hose.
4. Plug the longer piece of hose onto the coupling of the shorter piece.
If Glycerine has come off the tubing, wipe off as necessary.

10.13 Decalcifying the Equipment

Calcification could block mounting parts, lines or valves in the basic unit. It may be necessary to decalcify the equipment if certain faults occur in the temperature control system.

Note the following points, before begin of the procedure:

Cleaning and Maintenance



ATTENTION

Inappropriate decalcifying of the equipment may lead to loss of property.

Only decalcify the equipment **AFTER CONSULTATION** of the manufacturer or licensed dealer!



INFORMATION

A turbid or milky coloured appearance of the glass of the vessel jacket may be a sign of lime scale in the equipment with water temperature control system. A first possibly already sufficient procedure may be to decalcify the equipment via the vessel jacket. Refer to chapter “Decalcifying the Equipment via Water Jacket” for details in this case.

- Use phosphoric or citric acid (max. 5 %) as decalcifying agent.
- Be sure to respect the in chapter “Technical Data” specified inlet pressure.
- To warm up the decalcifier and pump it into the basic unit, use a chiller or a water bath and an external pump.
- During decalcification, the decalcifier flows in a circuit between the basic unit and the chiller/water bath.

Proceed as follows:

Procedure

1. If applicable, mount the exit gas cooler into the port of the vessel top plate and connect to the basic unit.
2. If applicable, mount the cold finger.
3. Connect the culture vessel to the basic unit.
4. Let the water drain off from the water outlet on the basic unit.
5. Fill the chiller/water bath with decalcifier.
6. Connect the chiller or water bath to the water inlet and outlet on the basic unit.
7. To open the corresponding valves in the basic unit, set the temperature on the operating panel to 5 °C (cool).
8. Set the chiller/water bath to 20 °C to 40 °C.
9. Switch on the pump at the chiller/water bath.
10. Let the decalcifier flow through the equipment for an hour.
11. Connect the water inlet hose on the equipment to tap water.
12. Hang the water outlet hose of the equipment at the spout.
13. Rinse the equipment for an hour.

10.14 Decalcifying Equipment via Vessel Jacket

A turbid or milky coloured appearance of the glass of the vessel jacket may be a sign of lime scale in the equipment with water temperature control system. A first possible procedure may be to decalcify the equipment via the vessel jacket.

If there are still some interferences observed with the temperature control system after doing so, then a thorough decalcification of the equipment may be necessary. Refer to chapter “Decalcifying the Equipment” in this case.

Prepare the following things and note the following points before begin of the procedure:

- Use phosphoric or citric acid (max. 5 %) as decalcifying agent.
- Prepare a funnel and piece of hose for connection to the water overflow of the vessel jacket.
- Be sure to respect the in chapter “Technical Data” specified inlet pressure.

Proceed as follows:

Procedure

1. Completely empty the vessel jacket.
2. Fit the piece of hose to the water overflow connection of the vessel jacket.
3. Fit the funnel to the hose end.
4. Fill the decalcifying agent into the vessel jacket.
5. Connect the vessel to the basic unit.
6. Completely fill the vessel jacket with water.
7. Heat the vessel at a temperature of 50 °C for an hour.
8. Decrease the temperature and thoroughly rinse the jacket with cooling water.

Interferences

11 Interferences

The following section describes possible reasons for interferences and how to resolve them. Reduce the service intervals in correspondence with the actual loads if interferences become increasingly common. Contact the manufacturer for interferences that cannot be resolved by following the above instructions. For service contact details, see page 2.

11.1 Interferences Basic Unit and Operating Panel

Interference		
Equipment does not work. Power indicator of the main switch is not illuminated; monitor of the operating unit remains dark.		
Possible cause	Remedy	By
Power cable not connected.	Connect the power cable.	Operator
Main switch not switched on.	Switch on the main switch.	Operator
Fuses blown	Check fuses of mains connection. Check fuses of basic unit.	Qualified electrician
Break in power connections.	Check power plug. Check power cable on damages or kinks. Check socket and cable on basic unit.	Qualified electrician

Interference		
Power indicator of the main switch is illuminated; monitor of the operating unit remains dark.		
Possible cause	Remedy	By
Monitor of operating unit is switched off.	Switch the monitor of the operating unit on at the ON/OFF key.	Operator
Power supply cable not connected to the operating unit.	Plug the power supply cable in at the DC socket on the rear side of the operating unit	Operator

Interference		
No communication between equipment and operating unit.		
Possible cause	Remedy	By
iDDC-bus cable (display cable) not connected to the operating unit.	Plug the round connector of the iDDC-bus cable in at the COM1 socket on the rear side of the operating unit. Plug the flat connector of the iDDC-bus cable in one of the two sockets on the rear side of the basic unit.	Operator

Interferences

11.2 Interferences Drive System

Interference		
Stirrer does not start.		
Possible cause	Remedy	By
Parameter <i>Stirrer</i> is not activated.	Activate the parameter.	Operator
Setpoint of parameter <i>Stirrer</i> = 0.	Set setpoint > 0.	Operator
Parameter <i>pO₂</i> is activated and set to oxygen control via the stirrer (cascade).	Switch cascade off and test operation via parameter <i>Stirrer</i> .	Operator

Interference		
Motor control is volatile, irregular or stops.		
Possible cause	Remedy	By
PID settings of parameter <i>Stirrer</i> are not correct	Reset to default settings	Operator

Interference		
Unusual sounds when the stirrer is activated.		
Possible cause	Remedy	By
Stirrer is in contact with other vessel built-in components.	Stop the bioreactor. Shutdown the system and turn off the equipment. Correctly mount the mounting parts of the culture vessel while observing internal safety regulations.	Operator

11.3 Interferences Temperature Control System

Interferences		
No temperature control.		
Possible cause	Remedy	By
Parameter <i>Temperature</i> is not activated.	Activate the parameter.	Operator
Parameter <i>Stirrer</i> is not activated.	Activate the parameter.	Operator

Interferences

Interference		
No heating or inadequate heating.		
Possible cause single-walled culture vessels	Remedy	By
Heater pad is not connected.	Connect the heater pad.	Operator
Faulty heater pad.	Check function of heater pad. Check heater pad and cable connections for damages (cracks, kinks etc.). Replace heater pad as necessary	Operator
Possible cause double-walled culture vessels	Remedy	By
Circulation not filled or air bubbles in circulation are obstructing the circulation flow	Enter low setpoint for parameter temperature to open the cooling valve and to fill the circulation (check acoustically) then enter a higher setpoint to heat up. Fully open the water supply for a moment. Check whether there is sufficient primary pressure on the water supply, adjust as necessary.	Operator
Cooling valve is blocked	Decalcify the equipment	Operator

Interference		
No cooling or inadequate cooling.		
Possible cause	Remedy	By
No water supply or inadequate flow.	Check the water supply and turn the supply tap if necessary.	Operator
Temperature sensor is not inserted.	Insert the temperature sensor into the pocket in the vessel top plate.	Operator
Incorrect Negative factor in option <i>PID</i> of parameter <i>Temperature</i>	Check Negative factor: Value must be positive. Adjust as necessary.	Operator

Interference		
Temperature fluctuations		
Possible cause	Remedy	By
Incorrect PID settings parameter <i>Temperature</i>	Check PID settings and adjust as necessary, especially <i>P-term</i> .	Operator

Interferences

11.4 Interferences Gassing System

Interferences		
No gassing / air bubbles in the culture vessel.		
Possible cause	Remedy	By
The on-site gas supply has been interrupted.	Stop the bioreactor. Check the on-site gas supply and switch it on, if necessary.	Operator
Depending on the configuration of the gassing system: The rotameter valve(s) is/are not open. And/or: The <i>Flow</i> parameter(s) is/are not activated. And/or: Setpoint in the <i>Flow</i> parameter(s) = 0. Or: Parameter <i>GMFlow</i> = 0 and/or <i>GasMix</i> is/are not activated.	Slowly open the rotameter needle valve(s). And/or: Activate the <i>Flow</i> parameter(s). And/or: Set the setpoint(s) in the <i>Flow</i> parameter(s) > 0. Or: Set parameter <i>GMFlow</i> > 0 and activate parameter- <i>GasMix</i> .	Operator
Hose connection(s) between the basic unit and the culture vessel is/are kinked or clamped.	Check whether the hose connection(s) is/are clamped; if necessary open the clamp(s). Check hose connection(s) for kinks, if necessary route them again or replace them under observation of the sterility requirements.	Operator
Inlet air filter blocked.	Replace the inlet air filter under sterile conditions.	Operator

Interference		
The desired gas flow rate is not reached.		
Possible cause	Remedy	By
Blocked holes on the sparger.	Stop the bioreactor and clean the sparger.	Operator

Interferences

Interference		
Sudden increase in evaporation losses in the culture vessel.		
Possible cause	Remedy	By
The exit gas cooler does not cool. The control valve for water flow is closed.	Open the control valve.	Operator
The exit gas cooler does not cool, parameter <i>Temperature</i> is activated.	Check the water supply to the exit gas cooler. Re-store it, if necessary. The basic unit is calcified. Decalcify the equipment, if necessary.	Operator

11.5 Interferences pH-System

Interference		
No display or incorrect display of pH		
Possible cause	Remedy	By
Sensor cable not connected or not properly connected.	Connect properly if necessary.	Operator
<u>Measuring system METTLER (analogue)</u> Function <i>Temperature compensation</i> is not activated.	Activate this function in option <i>Setpoint</i> of parameter pH ¹ .	Operator
pH drift during long cultivation.	Recalibrate pH with offline values. Refer to the separate operating manual of the touch screen software for details: <u>(Analogue) measuring system METTLER</u> : chapter "Recalibrating a METTLER pH Sensor". <u>(Digital) measuring system HAMILTON</u> : chapter "HAMILTON pH Sensor Product Calibration".	Operator
Faulty pH-sensor.	Test calibration with pH 4 and pH 7 buffer. Regenerate or replace the sensor. Consult the documentation of the sensor manufacturer!	Operator

¹⁾ This does **not apply** to the measuring system HAMILTON (digital): this function **MUST** be **deactivated** there!!

Interferences

Interference		
No pH control.		
Possible cause	Remedy	By
Parameter <i>pH</i> is not activated.	Activate the parameter.	Operator
Incorrect dead band setting.	Check the dead band (Dead Band in PID settings): Switch off or enter a small value.	Operator
No addition of reagents (acids and base).	Check the reagent bottles: Refill if necessary. Check the hose connections between the reagent bottles and the culture vessel: Connect properly if necessary. Open/remove hose clamps if necessary.	Operator
Pump(s) (base/acid) do/does not operate properly.	Check operation using the rocker switch.	Operator
Pump hose is damaged.	Replace pump head.	Operator
Incorrect hose type connected.	Replace if necessary.	Operator

Interference		
pH value drifts up and down over time or acid and base are added almost continuously in turn.		
Possible cause	Remedy	By
Incorrect PID setting in <i>pH</i> parameter.	Check the PID settings and adjust as necessary. Change the special proportional factor (<i>Prop. Term</i>) or <i>Dead band</i> setting.	Operator
Incorrect strength of reagents: Concentration is too weak or too strong.	Check the strength of reagents. Adjust if necessary: 0.1 mol to 2.0 mol.	Operator

11.6 Interferences pO₂ System

Interferences		
No display or incorrect display of pO ₂ .		
Possible cause	Remedy	By
Sensor cable not connected or not properly connected.	Connect properly if necessary.	Operator
pO ₂ sensor is not calibrated	Calibrate the pO ₂ sensor. Refer to the separate operating manual of the touch screen software for details.	Operator
<u>Measuring system METTLER (analogue)</u> pO ₂ sensor is not polarised.	Polarise the pO ₂ sensor	Operator
Faulty pO ₂ sensor.	Check the calibration of the pO ₂ sensor. Consult the documentation of the sensor manufacturer.	Operator

Interferences

Interference		
No pO_2 control.		
Possible cause	Remedy	By
The pO_2 parameter and/or cascaded parameter is/are not activated.	Activate parameters.	Operator
The cascade settings are incorrect.	Check the cascade settings and change as necessary.	Operator.
No gas flow into culture vessel.	Refer to interferences in the gassing system.	Operator

Interference		
pO_2 value fluctuates strongly or the stirrer speed fluctuates.		
Possible cause	Remedy	By
Incorrect PID settings in the pO_2 parameter.	Check the PID settings (<i>PID</i> parameter option) and adjust as necessary. Special proportional factor (<i>Prop. Term</i>) and dead band. Dead band value must be 0 (zero).	Operator

11.7 Interferences Antifoam or Level Sensor and Antifoam Pump

Interference		
Foam/medium is not detected.		
Possible cause	Remedy	By
Sensor is not properly connected.	Check connections and connect properly as necessary.	Operator

Interference		
Foam/medium is always/frequently detected.		
Possible cause	Remedy	By
Sheathing of sensor is damaged.	Have the sheathing of the sensor replaced.	INFORS HT service technician or licensed dealer

Interference		
Antifoam pump does not work.		
Possible cause	Remedy	By
Parameter <i>Antifoam</i> is not activated.	Activate the parameter.	Operator
Dosing time of parameter <i>Antifoam</i> = 0 (zero).	Set dosing time > 0.	Operator

Interferences

Interference		
No antifoam agent or medium supply or inadequate flow.		
Possible cause	Remedy	By
Reagent bottle is empty.	Refill if necessary.	Operator
Wrong antifoam agent or incorrect concentration.	Replace if necessary.	Operator
Hose line blocked or clamped.	Check the hose connection between the reagent bottle and the culture vessel: If necessary, connect them correctly. Open/remove hose clamps if necessary.	Operator
Antifoam pump does not work.	Check operation using the rocker switch.	Operator
The pump hose is damaged.	Replace pump head.	Operator
Incorrect hose type connected.	Replace if necessary.	Operator

11.8 Interferences Feed and Pump

Interference		
No feed solution or inadequate feed solution.		
Possible cause	Remedy	By
Parameter <i>Feed</i> is not activated.	Activate the parameter.	Operator
Setpoint of parameter <i>Feed</i> = 0.	Set setpoint > 0.	Operator
Reagent bottle empty.	Refill if necessary.	Operator
Hose line blocked or clamped.	Check the hose connection between the reagent bottle and the culture vessel: If necessary, connect them correctly. Open/remove clamp if necessary.	Operator
Feed pump does not work.	Check operation using the rocker switch.	Operator
The pump hose is damaged.	Replace pump head.	Operator
Incorrect hose type connected.	Replace if necessary.	Operator

Interferences

11.9 Returning for Repair

The provider must return the equipment or the faulty component part(s) to the manufacturer if, after consulting the service department of the local dealer or the manufacturer, on-site diagnosis and/or repair is not possible.



INFORMATION

When returning the equipment, the component part or accessory for repair, it is required for the safety of all parties involved and because of legal provisions that a lawful declaration of decontamination is present. Refer to main chapter “Safety and Responsibility”, chapter “Declaration of Contamination” for details.

12 Disassembly and Disposal

The equipment must be disassembled and disposed of in an environmentally friendly manner if it is no longer in use.



INFORMATION

When returning the equipment for disassembly or disposal, it is required for the safety of all parties involved and because of legal provisions that a lawful declaration of decontamination is present. Refer to main chapter “Safety and Responsibility”, chapter “Declaration of Contamination” for details.

12.1 Disassembly

Prior to disassembly:

- Switch off the equipment and lock any isolation switch in the ‘off’ position.
- Physically disconnect the main energy supply from the equipment and wait for components to fully discharge.
- Remove and dispose of all additional consumable items, auxiliary components and/or spent processing material in an environmentally acceptable manner.

Clean and disassemble component parts professionally with regard to any local regulations concerning employment and environmental protection. If possible, separate materials.

12.2 Disposal

Recycle disassembled components if no agreement is made concerning reclaim or disposal.

- Send metals for scrap.
- Send plastic components for recycling.
- Sort and dispose of the remaining components according their material composition.

Disassembly and Disposal



WARNING

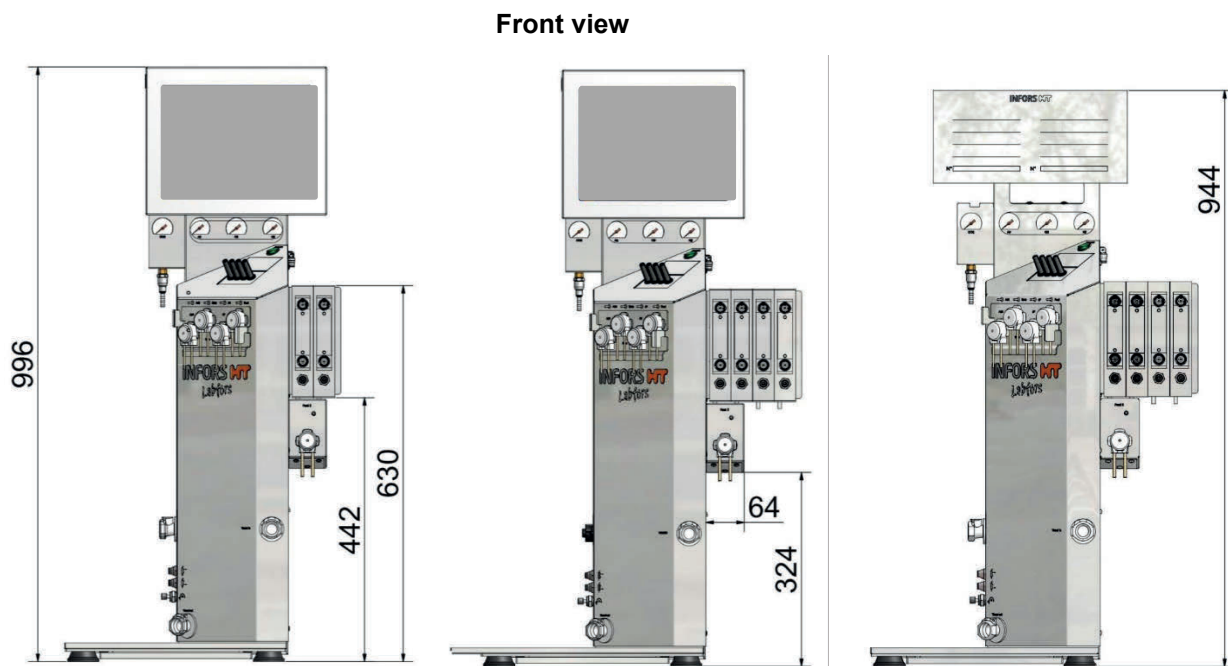
Electronic waste, electronic components, lubricants or other auxiliary materials/supplies are subject to hazardous waste regulations and may only be disposed of by registered specialist disposal firms.

For disposal, the system units are to be disassembled and dismantled into individual material groups. These materials are to be disposed of according to the applicable national and local legislation. Local authorities or specialist disposal firms can provide information regarding environmentally acceptable disposal.

If no special arrangements have been made for return, INFORS HT units with the required declaration of decontamination can be sent back to the manufacturer for disposal.

13 Technical Data

13.1 Dimensions 1 Unit



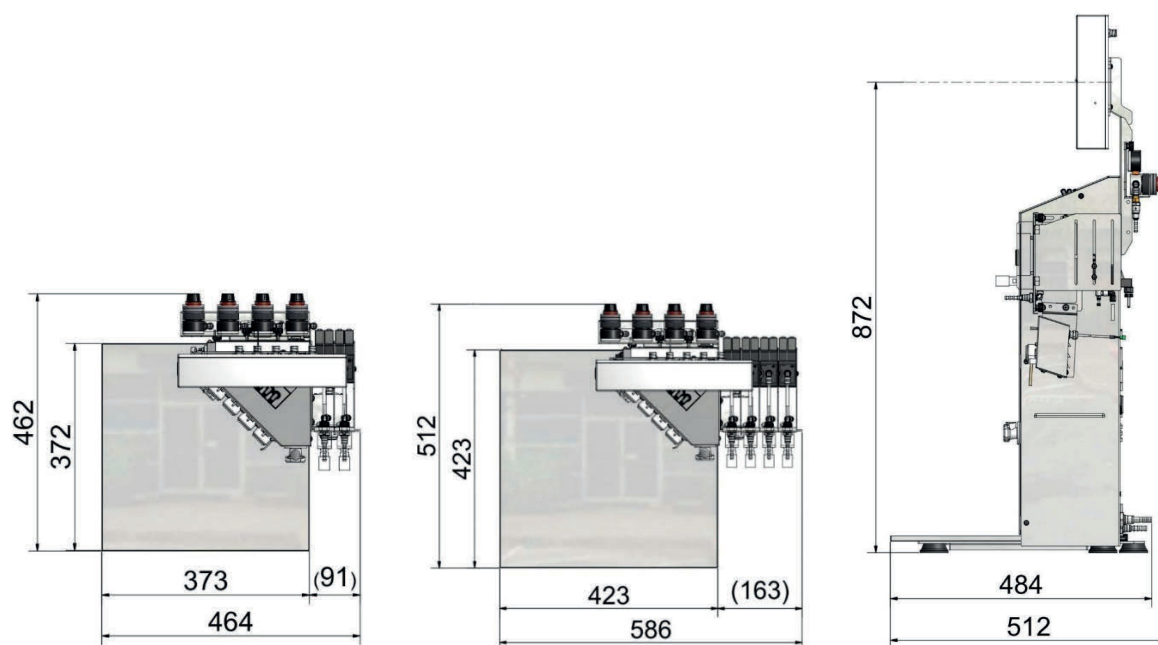
Dimensions in mm

- To the left: equipment with operating unit, holder for up to 2 gassing units, 5 pumps, and standard base tray
- Middle: equipment with operating unit, holder for up to 4 gassing units, 5 pumps, and base tray for vessels with DN¹ 200 mm
- To the right: satellite unit, holder for up to 4 gassing units, 5 pumps and standard base tray

¹⁾ DN = diameter nominal (= inner diameter)

Technical Data

Top view and side view

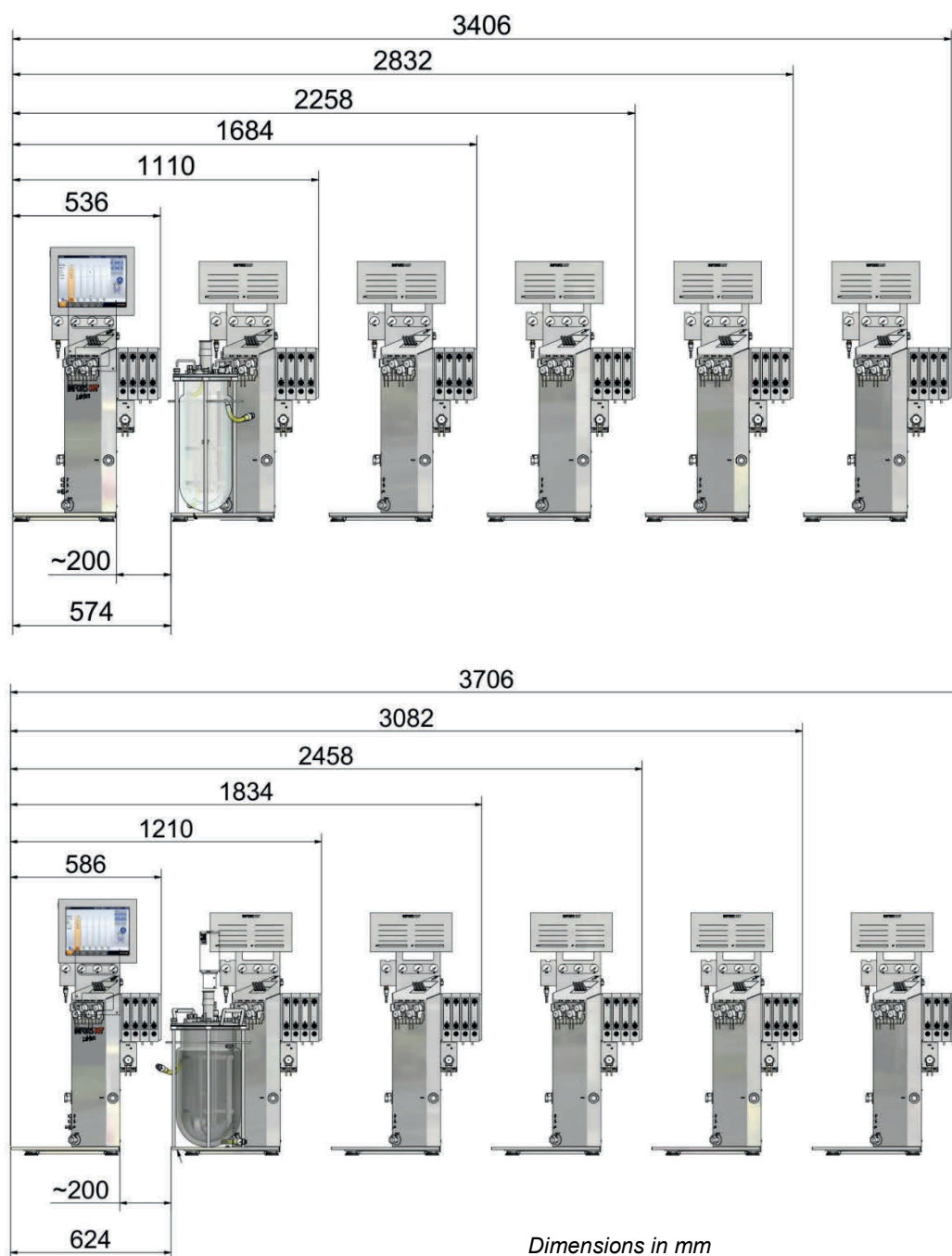


Dimensions in mm

- To the left: equipment with holder for up to 2 gassing units and standard base tray
- Middle: equipment with holder for up to 4 gassing units and base tray for vessels DN200
- To the right: equipment with operating unit and standard base tray

13.2 Dimensions Master Unit and Satellite Units

Front view master unit with 5 satellite units

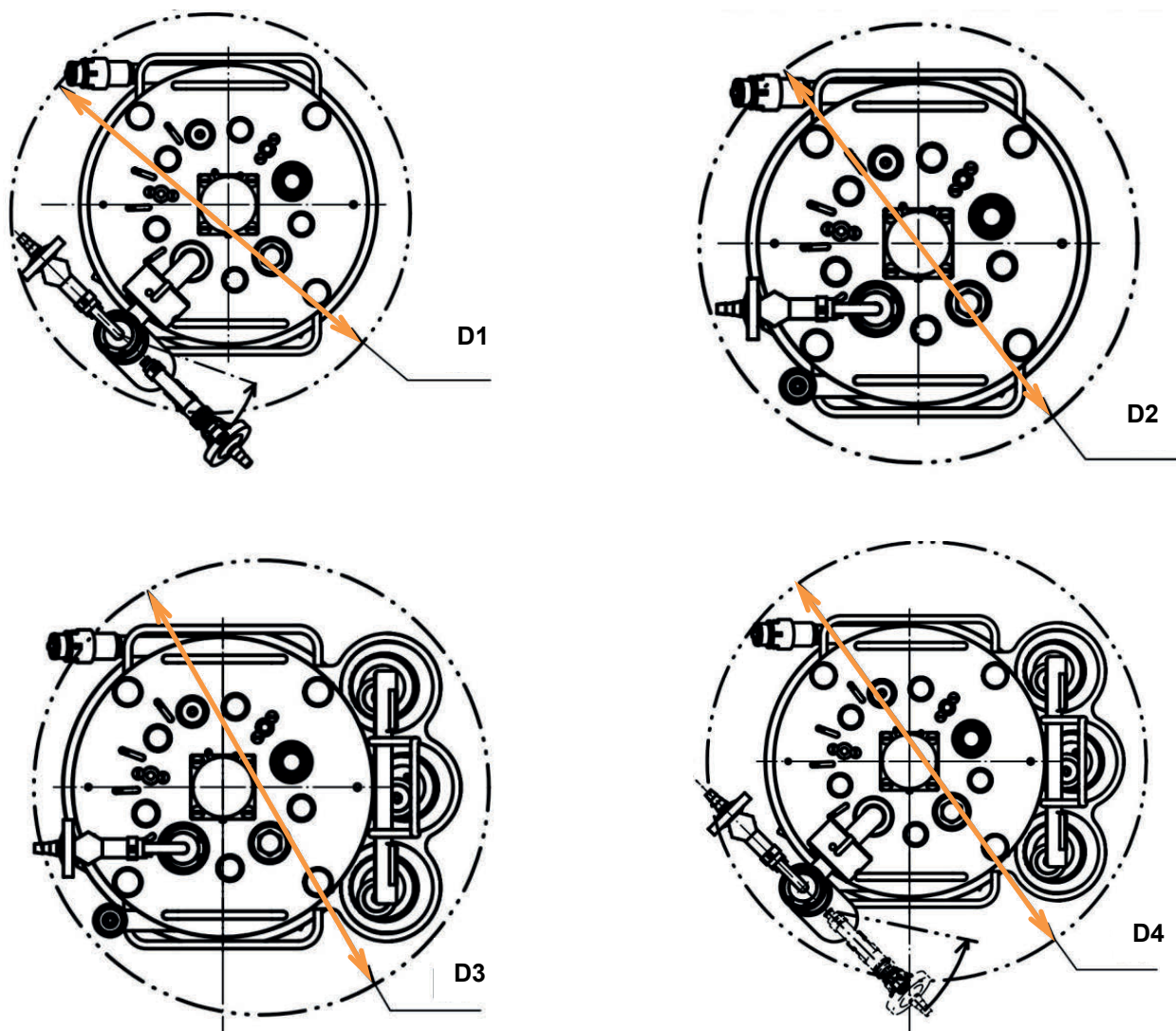


- Above: 6 units with holder for up to 4 gassing units, 5 pumps and standard base tray
- Below: 6 units with holder for up to 4 gassing units and base tray for vessels with DN200

Technical Data

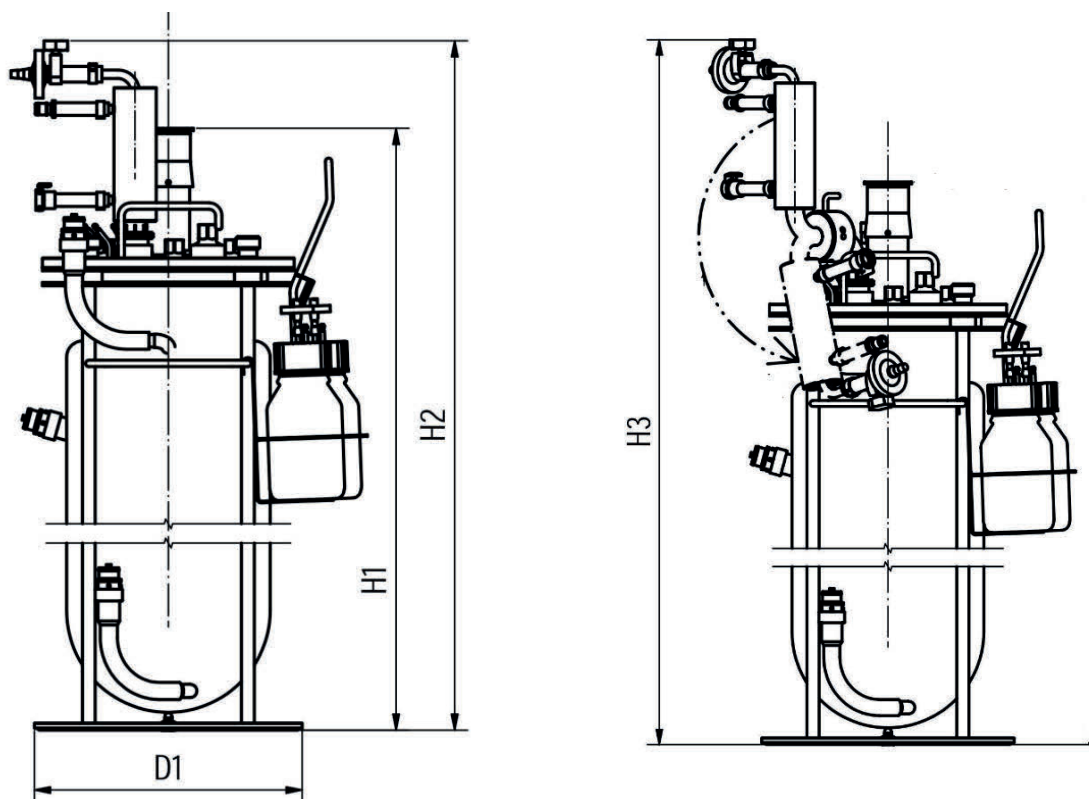
13.3 Dimensions of Culture Vessels in Vessel Holder

Top view



The figures above show top view of the culture vessel with standard exit gas cooler and with swivelling exit gas cooler and, with / without reagent bottle und pump holder.

Ø	Total volume (L) / diameter nominal of vessels (mm)				
	2 / 115	3.6 / 115	3.6 / 150	7.5 / 150	13 / 200
	Dimensions in mm				
D1	330	330	335	335	365
D2	300	300	320	320	365
D3	340	340	355	355	420
D4	365	365	380	380	435

Technical Data
Side view


The figures show the culture vessel with standard exit gas cooler (left) and with swivelling exit gas cooler (right), both with reagent bottle and pump holder.

Ø and height	Total volume (L) / diameter nominal of vessels (mm)				
	2 / 115	3.6 / 115	3.6 / 150	7.5 / 150	13 / 200
	Dimensions in mm				
D1	250	250	250	250	290
H1	373	538	405	635	616
H2	453	618	487	717	700
H3	514	679	546	776	760

Technical Data

13.4 Weights (net)

Description	Value	Unit
Basic unit	25	kg
Touch screen operating unit	5	kg

Culture vessels

Total volume L	Diameter nominal mm	Weight kg ¹
2.0	115	10
3.6	115	12
3.6	150	15
7.5	150	18
13.0	200	22

¹⁾ Empty weight of double walled culture vessels in delivery state (equipped with default mounting parts)

13.5 Connection Values

13.5.1 Electrical

Description	Type 230 V	Type 115 V	Unit
	Value		
Voltage	230	115	V
Frequency range	50 / 60	60	Hz
Current	4	8	A

13.5.2 Water IN

Description	Value	Unit
Connection pressure	2 ± 1	bar
Inlet temperature	10 - 20	°C
Connection: OD of hose nozzle	8.3	mm
Max. flow cooling vessel	1.6	L/min
Max. flow cooling exit gas cooler	1.6	L/min
Water quality	„Very soft“ / „soft“ (CaCO ₃ concentration 0 mmol L ⁻¹ to 1.5 mmol L ⁻¹)	

Technical Data



INFORMATION

The heating system has protection against dry running, which is based on measurement of conductivity. The heating will not work when using demineralised or distilled water as cooling agent!

13.5.3 Water OUT

Description	Value	Unit
Connection pressure	No back pressure	
Temperature	up to 80	°C
Connection: OD of hose nozzle	10	mm

13.5.4 Gas(es) IN

Description	Value	Unit
Connection pressure	2 ± 0.5	bar
Connection: OD of hose nozzle	7	mm
General gas quality	Dry, clean and free of oil and dust	
Recommended compressed air quality	Class 1,2,3,4 As per DIN ISO 8573-1	

13.5.5 Exit Gas

Description	Value	Unit
Connection pressure	No back pressure	
Connection: OD of hose nozzle	8	mm

13.6 Specifications

13.6.1 Operating Unit

Description	Value
HMI	Colour touch screen 12"
Protection	IP 66

Technical Data

13.6.2 Culture Vessel

Description	Value	
Form	Cylindrical with round bottom	
Models	Single walled: for temperature control with electrical heater pad and cold finger Double walled: for temperature control with water	
Material	Glass vessel	Borosilicate glass
	Top plate and mounting parts	Stainless steel, AISI 316L, electro polished
	O-rings	EPDM

Vessel sizes

TV ¹	VV max. ²	VV min. ³	DN ⁴ mm	Height mm
2.0	1.2	0.5	115	205
3.6	2.3	0.5	115	370
3.6	2.3	1.0	150	235
7.5	5.0	1.0	150	465
13.0	10.0	2.2	200	445

¹). Total volume in L

²). Min. working volume in L

³). Max. working volume in L

⁴). Diameter nominal = inner diameter of the vessel

Ports in top plate

Ø mm	Thread	Number per diameter nominal of vessel		
		DN 115	DN 150	DN 200
10	None	2	2	2
12	Pg13.5	6	6	5
19	None	2	3	6

13.6.3 Stirrer

Description	Value
Drive	Shaft with mechanical seal
Motor	Type: DC, brushless Nominal power: 140 W Nominale torque: 0.4 Nm

Technical Data

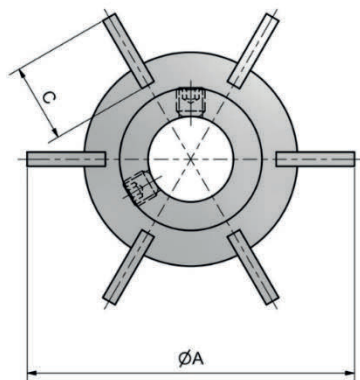
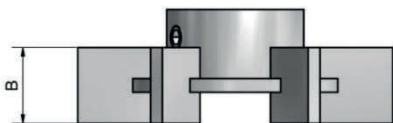
Range of rotation speed with 2 impellers (Standard)	2 L and 3.6 L / NW 115 vessel: 80 up to 1500 min ⁻¹ 3.6 L and 7.5 L / NW 150 vessel: 80 up to 1200 min ⁻¹ 13 L / NW 200 vessel: 80 up to 700 min ⁻¹
Range of rotation speed with 3 impellers (Option)	2 L and 3.6 L / NW 115 vessel: 80 up to 1500 min ⁻¹ 3.6 L and 7.5 L / NW 150 vessel: 80 up to 1000 min ⁻¹ 13 L / NW 200 vessel: 80 up to 600 min ⁻¹
Accuracy	Measurement: ± 5 min ⁻¹ at 100 - 1000 min ⁻¹ 1 % setpoint at > 1000 min ⁻¹ Control: ≤ ± 5 min ⁻¹ at 100 - 1000 min ⁻¹ ≤ 1 % setpoint at > 1000 min ⁻¹
Direction of rotation	Counter clockwise (top view vessel)
Bearing	Outside of vessel, in drive hub



INFORMATION

Rotation speed is valid for viscosity similar to water, without aeration. Vessels are equipped with two impellers by default. The max. adjustable rotation speed on the operating panel is set for 2 impellers.

Technical Data



Impellers

Type / Number	Material
Rushton impellers with 6 blades Standard: 2 pieces Option: 3 pieces	316L stainless steel, electro polished

Vessel	A	B	C
2 L and 3.6 L / NW 115	46 mm	11 mm	11 mm
3.6 l and 7.5 L / NW 150	54 mm	11 mm	11 mm
13 L / NW 200	70 mm	13 mm	19 mm

13.6.4 Temperature

Description	Value
Sensor	Type: Pt100 1/3 DIN-B
Heating	Double walled vessels: Water circulation in vessel jacket. Pump and heating 500 W integrated in basic unit. Single walled vessels: With electrical heater pad
Cooling	Double walled vessels: With tap water via water circuit into vessel jacket Option: with circulation chiller Single walled vessels: With tap water via cold finger in vessel
Range of measurement	-5 °C up to +150 °C

Technical Data

Range of control	System with water circulation: from 5 °C above inlet temperature up to 70°C System with electrical heater pad and cold finger: from 1 °C up to 95 °C
Accuracy	Measurement: ± 0.2 °C at +10 °C up to +70 °C Control: ≤ ± 0.2 °C

¹⁾ Temperature depends on energy output (stirrer, gassing temperature, chemical and biological reaction)

13.6.5 Gassing

The entire gas entry takes place via the sparger.

The specific gassing rate, calculated for the max. working volume is for each vessel size and each variant 2 min⁻¹.

Variant Basic

Gas(es)	Gas flow control	Accuracy Rotameter	Gas mix control
Air	1 Rotameter	± 4 %	----
Air + O ₂	1 Rotameter		2 solenoid valves
Air + N ₂	1 Rotameter		2 solenoid valves
Air + O ₂ + N ₂	1 Rotameter		3 solenoid valves

Variant Standard

Gas(es)	Gas flow control	Accuracy MFC	Gas mix control
Air	1 MFC	± 1 %	----
Air + O ₂	1 MFC		2 solenoid valves
Air + N ₂	1 MFC		2 solenoid valves
Air + O ₂ + N ₂	1 MFC		3 solenoid valves

Technical Data

Variant High End

Gas	Gas flow control	Accuracy MFC
Air	1 MFC	± 0.3 % (final value) ± 0.5 % (measured value)
Gases	Gas flow control and gas mix control	
Air + O ₂	2 MFC	
Air + N ₂	2 MFC	
Air + O ₂ + N ₂	3 MFC	

Measuring ranges of MFCs ¹ and rotameters

Vessel max. WV ² (Litres)	Measuring range Rotameter L min ⁻¹ (Variant Basic)	Measuring range MFC L min ⁻¹ (Variant Standard)	Measuring range MFC L min ⁻¹ (Variant High End)
1.2	0.25 up to 2.4	0.05 up to 2.5	0.025 up to 2.5
2.3	0.30 up to 4.7	0.10 up to 5.0	0.05 up to 5.0
5.0	0.50 up to 11.0	0.20 up to 10.0	0.10 up to 10.0
10.0	1.00 up to 22.0	0.40 up to 20.0	0.20 up to 20.0

¹) Mass flow controllers

²) Working volume

13.6.6 Antifoam

Description	Value
Sensor (optional!)	Conductive with dosing needle Adjustable in height
Control	Peristaltic pump AF™ (Antifoam)
Range	0 / 100 % (ON/OFF)

Technical Data

13.6.7 pH

Description	Value
Control	2 peristaltic pumps (acid, base) and/or CO ₂ valve
Control range	pH 2 up to 12
Measuring accuracy	pH ± 0,1

Variants

Measurement system	Sensor (optional)
METTLER (analogue)	Traditional pH sensor (potential measurement against reference) Manufacturer: METTLER TOLEDO Measuring range: pH 2 up to 12
HAMILTON (digital)	Traditional pH sensor (potential measurement against reference) with integrated electronics, type Easyferm Plus ARC Manufacturer: HAMILTON Measuring range: pH 0 up to 14



INFORMATION

HAMILTON pH sensors are preconfigured before dispatch by the equipment manufacturer INFORS HT. Replacement sensors of this type must be reconfigured before use!

Details on technical data, use and maintenance of the pH sensors can be found in the separate documentation of the sensor manufacturer.

13.6.8 pO₂

Description	Value
Control	Cascaded stirrer Cascaded flow Cascaded gasmix Cascaded O ₂ addition <i>The functionality of the parameters depends on the hardware configuration of the equipment</i>
Control range	0 – 100 %
Measuring accuracy	1 % FS

Technical Data

Variants

Measurement system	Sensor (optional)
METTLER (analogue)	Traditional amperometric/polarographic pO ₂ sensor Manufacturer: METTLER TOLEDO Measuring range: 0 - 150 %
HAMILTON (digital)	pO ₂ sensor with integrated optical electronics of the type Typ Visiferm DO ARC Manufacturer: HAMILTON Measuring range: 0.05 % - 300 % air saturation



INFORMATION

HAMILTON pO₂ sensors are pre-configured from the equipment manufacturer INFORS HT. Replaced sensors must be configured again before use!

Details about technical data, use and maintenance of the pO₂ sensors are in the separate documentation from the sensor manufacturers.

13.6.9 Pumps

Description	Value	
Type	Peristaltic	
Standard	Digital (3 pieces)	Acid Base AF = Antifoam
	Analogue (1 piece)	Feed
Rotation speed	Digital	74 min ⁻¹ / fixed rotation speed
	Analogue	74 min ⁻¹ / max. rotation speed, adjustable within range of 0 % up to 100 %
Accuracy	± 1 % FS	

Technical Data

Pump hoses & flow rates

Description	Value
Material	PharMed BPT
Standard	iD: 1.0 mm Wall thickness: 1.1 mm Flow rate: 3.5 ml min ⁻¹
Option 1	iD: 0.5 mm Wall thickness: 1.15 mm Flow rate: 1.2 ml min ⁻¹
Option 2	iD: 2.5 mm Wall thickness: 1,0 mm Flow rate: 17.2 ml min ⁻¹
Flow rates	All flow rates at 74 min ⁻¹ (100 % rotation speed)

13.6.10 Sterile Filters

Description	Value
All filters	Autoclavable Disposable
Inlet air filter (red label) ¹	Retention rate: 0.2 µm Diameter: 37 mm
Inlet air filter (no label) ²	Retention rate: 0.2 µm Diameter: 25 mm
Exit gas filter (green label) ³	Retention rate: 0.3 µm dry, 1.0 µm wet Diameter: 37 mm

¹) for vessels with DN 115 and 150

²). for vessels with DN 200

³) for all vessel sizes

Technical Data

13.6.11 Heater Pads for Single Walled Vessels

Description	Value			
Material	Silicone			
IP protection class	X4			
Electrical voltage	230 V	115 V	Dimensions mm	
Vessels Total volume (L) Diameter nominal (mm)	Electrical power W		Length	Width
2.0 / 115	200	200	370	90
3.6 / 115	400	400	370	170
3.6 / 150	400	400	475	140
7.5 / 150	400	400	475	140
13 / 200	1000	500	655	250

13.7 Operating Conditions

Description	Value
Temperature range	5 °C up to 40 °C
Relative air humidity, non-condensing	20 % up to 90 %
Min. distance from walls, ceilings and other appliances	150 mm

13.8 Emissions

Description	Value	Units
Noise emission	<70	dB (A)

13.9 Utilities

Glycerine

Lubricant for mechanical seal.

Permitted product:

- Medicinal Glycerine 85 %
- Quality: PhEur

Bottles of 150 mL are available.

13.10 Auxiliary Supplies

pH Buffers

pH buffers are used to calibrate the pH sensors. 250 mL bags are available for the following buffers:

- pH 4.04
- pH 7.01

