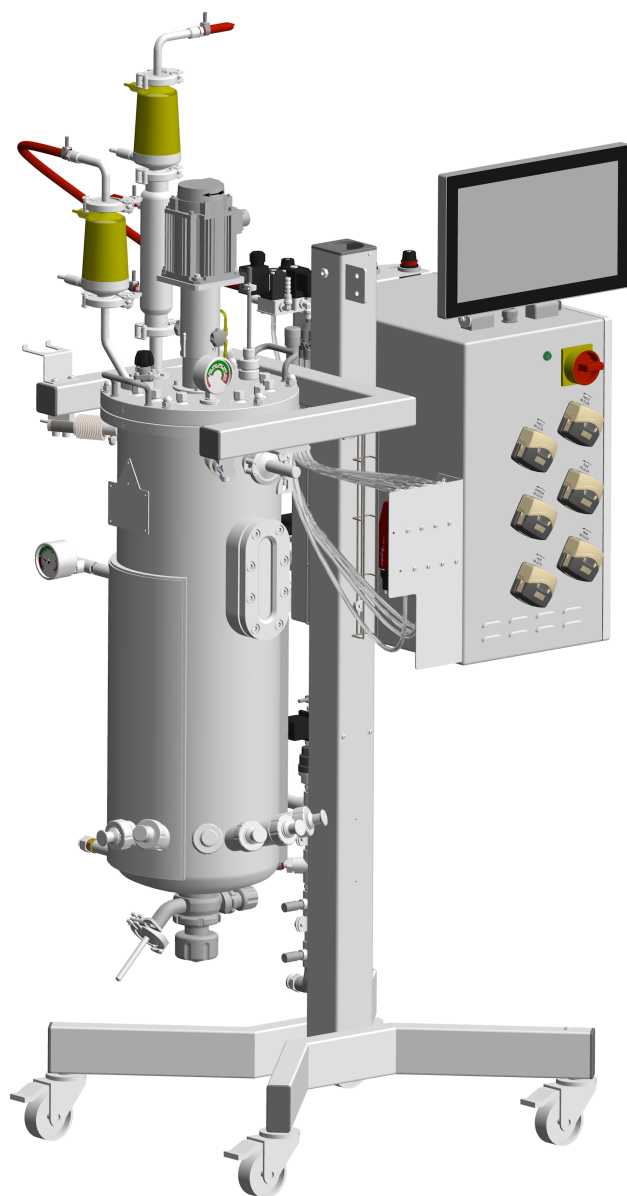


Techfors-S

Operating manual



Techfors-S – Rel. 2.1

Pilot scale bioreactor

SW: 3.6

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Art. 7003918

More information about the product is
available online at:
<http://www.infors-ht.com/en/techfors-s>



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Supplemental directives

About this Manual



This manual enables the safe and efficient handling of the device. All the information and instructions in this operating manual comply with the current standards, legal regulations and the latest technological developments.

This operating manual is a component part of the device. It must be kept near the device unit and be accessible to staff at all times. All persons working on or with the device must read the operating manual thoroughly and fully understand its contents before beginning any work. Adhering to all the safety notes 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 device as supplied.

Customer Service and Services

The customer service of the manufacturer or the local licensed dealer is at your disposal for technical advice and specialist enquiries (contact details see ➔ <https://www.infors-ht.com/en/contact/>). Due to their familiarity with the potential applications of the device, the Customer Service team is able to provide information on whether the unit can be used for a specific application or modified to handle the planned process.

Declaration of Conformity

The device meets the general requirements of the following standards:

- Machinery Directive 2006/42/EC
- EMC Directive 2014/30/EU
- Pressure Equipment Directive 2014/68/EU ¹⁾

The declarations of conformity in the sense of the Machinery Directive and Pressure Equipment Directive ¹⁾ are included in the overall documentation supplied with the device.

¹⁾ The Pressure Equipment Directive does not apply to devices with vessels manufactured in accordance with the ASME Boiler and Pressure Vessel Code.

Table of contents

Table of contents

1	Safety and Responsibility.....	16
1.1	Explanation of Special Displays.....	16
1.1.1	Warning Messages.....	16
1.1.2	Other Messages.....	16
1.2	Intended Use, Incorrect Use and Misuse.....	17
1.3	Qualified Personnel.....	18
1.3.1	Operator.....	18
1.3.2	Technician.....	18
1.3.3	INFORS HT Service Technician or Licensed Dealer.....	19
1.4	Unauthorized Persons.....	19
1.5	Responsibility of the Provider.....	19
1.6	Residual Risks.....	19
1.7	Warning Symbols on the Device.....	22
1.8	Declaration of Decontamination.....	23
2	Basic Unit.....	24
2.1	Overview Basic Unit.....	24
2.2	Device Stand.....	25
2.3	Tray for Reagent Bottles.....	26
2.4	Operating and Display Elements.....	26
2.4.1	Main Switch.....	26
2.4.2	Operating Panel.....	27
2.5	Pumps.....	28
2.5.1	Setup and Function.....	28
2.5.2	Adjusting the Position of the Hose Holders.....	30
2.5.3	Inserting the Pump Hoses.....	30
2.6	Vessel.....	32
2.6.1	Setup and Function.....	32
2.6.2	Removing and Mounting the Vessel Top Plate.....	37
2.6.3	Checking Baffles, Impellers, Sparger and Top Plate Seal.....	40

Table of contents

2.6.4	Equipping the Ports with the Septum and Septum Collar.....	41
2.6.5	Closing Unused Ports and Nozzles.....	43
2.6.6	Cleaning the Vessel.....	44
2.6.7	Cleaning the Vessel Top Plate.....	45
2.7	Harvest Valve (Bottom Valve).....	46
2.7.1	Setup and Function.....	46
2.7.2	Using the Harvest Valve (Bottom Valve).....	47
2.8	Vessel Pressure Display (Manometer).....	49
2.8.1	Setup and Function.....	49
2.8.2	Mounting the Manometer.....	49
2.9	Stirrer.....	50
2.9.1	Setup and Function.....	50
2.9.2	Uncoupling and Coupling the Motor.....	52
2.9.3	Lubricating the Mechanical Seal.....	54
2.10	Temperature Control System and Sterilization.....	56
2.10.1	Setup and Function.....	56
2.11	Gassing System.....	60
2.11.1	Setup and Function.....	60
2.11.2	Removing and Mounting the Inlet Air Filter.....	63
2.12	Exit Gas System.....	65
2.12.1	Setup and Function.....	65
2.12.2	Removing and Mounting the Exit Gas Cooler with Exit Gas Filter.....	66
2.12.3	Cleaning the Exit Gas Cooler.....	69
2.13	pH Control.....	72
2.13.1	Setup and Function.....	72
2.13.2	Mounting and Connecting the pH Sensor.....	73
2.14	pO ₂ Control.....	75
2.14.1	Setup and Function.....	75
2.14.2	Mounting and Connecting the pO ₂ Sensor.....	76

Table of contents

2.15	Antifoam Control.....	79
2.15.1	Setup and Function.....	79
2.15.2	Preparing the Antifoam Sensor for Cultivation.....	80
2.15.3	Mounting and Connecting the Antifoam Sensor.....	83
2.16	Safety Valves.....	84
2.16.1	General Information.....	84
2.16.2	Safety Valve Temperature Control Circuit.....	84
2.16.3	Safety Valve Vessel.....	85
2.16.4	Mounting the Vessel Safety Valve	85
2.17	Identification of the Device.....	89
2.17.1	Identification Plate.....	89
2.17.2	Plant Identification Plate.....	89
2.17.3	Vessel Identification Plate.....	90
3	Options.....	91
3.1	Overview of the Options.....	91
3.2	Sample Valve.....	92
3.2.1	Setup and Function.....	92
3.2.2	Using the Sample Valve.....	94
3.3	Resterilizable Feed Line.....	95
3.3.1	Setup and Function.....	95
3.3.2	Preparing the Resterilizable Feed Line for Cultivation.....	96
3.4	Resterilizable Transfer Line.....	99
3.4.1	Setup and Function.....	99
3.4.2	Preparing the Resterilizable Transfer Line for Cultivation.....	100
3.5	Steam Generator.....	102
3.6	Switching between Tap Water / Chilled Water.....	103
3.7	Recirculating Chiller.....	103
3.8	Lifting Device for Vessel Top Plate.....	104
3.9	Level Detection.....	105
3.9.1	Setup and Function.....	105
3.9.2	Mounting and Connecting the Level Sensor.....	106

Table of contents

3.10	Foam Detection Exit Gas.....	109
3.10.1	Setup and Function.....	109
3.11	Pressure Control.....	111
3.11.1	Setup and Function.....	111
3.11.2	Mounting and Connecting the Pressure Sensor.....	112
3.12	Weight Measurement Vessel – Load Cell.....	114
3.13	Turbidity Measurement.....	115
3.13.1	Setup and Function.....	115
3.13.2	Mounting and Connecting the Turbidity Sensor.....	116
3.14	Exit Gas Analysis.....	117
3.15	pCO ₂ Measurement.....	119
3.16	Redox Measurement.....	120
3.17	Permittivity Measurement.....	121
3.18	Pumps.....	121
3.19	Balances.....	122
3.20	Base Tray.....	122
3.21	Mobile CIP Unit TechCIP.....	123
4	Accessories, Material and Hoses.....	124
4.1	Overview of the Accessories.....	124
4.2	Starter Set.....	125
4.3	Connection Set.....	125
4.4	Reagent Bottles.....	126
4.4.1	Setup and Function.....	126
4.4.2	Preparing Reagent Bottles for Cultivation.....	127
4.4.3	Specifications.....	129
4.5	Push Valves.....	130
4.5.1	Setup and Function.....	130
4.5.2	Preparing Push Valves for Cultivation.....	131
4.5.3	Specifications.....	133

Table of contents

4.6	Inoculation Needles.....	134
4.6.1	Setup and Function.....	134
4.6.2	Preparing Inoculation Needles for Cultivation.....	135
4.6.3	Specifications.....	136
4.7	Vessel Light.....	137
4.7.1	Setup and Function.....	137
4.7.2	Mounting the Vessel Light.....	138
4.8	Sampling Set.....	139
4.8.1	Setup and Function.....	139
4.8.2	Using the Sampling Set.....	140
4.9	Sensor Insertion Housing.....	142
4.9.1	Setup and Function.....	142
4.10	Using the Sensor Insertion Housing.....	142
4.11	Pitched Blade Impeller.....	144
5	Transport and Storage.....	145
5.1	Transport.....	145
5.2	Transportation Safety Device.....	145
5.3	Storage.....	146
6	Installation and Commissioning.....	147
6.1	Operating Conditions at the Installation Location.....	147
6.2	Minimum Distances to the Device.....	148
6.3	Requirements for the Mains Connection.....	148
6.4	Requirements for Connections and Interfaces.....	148
6.5	Safety Valves.....	151
7	Cultivation.....	152
7.1	Preparing the Bioreactor.....	152
7.2	In Situ Sterilization.....	155
7.3	Preparing the Medium.....	155
7.4	Sampling.....	156
7.5	Inoculation.....	156
7.6	Harvest.....	156

Table of contents

7.7	Emptying the Vessel.....	157
7.8	Sterilization after Cultivation.....	157
8	Operation.....	159
8.1	Overview Screen, Menu Navigation and Control Elements	160
8.2	Main Menus.....	164
8.2.1	Main – Overview.....	164
8.2.2	Batch – Start Menu.....	167
8.2.3	Controller – Value Display.....	168
8.2.4	Cascades.....	170
8.2.5	Trends – Trend Lines.....	171
8.2.6	System – System Settings.....	172
8.2.7	Alarms – Alarm Display.....	174
8.2.7.1	Menu Overview.....	174
8.2.7.2	Parameter Alarms.....	175
8.2.7.3	Overview System Alarms.....	175
8.3	Submenus.....	177
8.3.1	Valves – Digital Controller Outputs.....	177
8.3.2	Security – User Administration.....	178
8.3.2.1	Menu Overview.....	178
8.3.2.2	User Groups.....	178
8.3.2.3	Access Rights.....	179
8.3.2.4	Login/Logout – Logging in to/out of the System.....	183
8.3.2.5	Change Own Password – Changing the (Own) Password.....	184
8.3.2.6	New User – Adding a New User.....	185
8.3.2.7	Edit User – Changing User Settings.....	186
8.3.2.8	Remove User – Deleting a User.....	187
8.3.2.9	Set / Clear Default User – Setting up Automatic User Login.....	187
8.3.2.10	Password Security – Setting Password Rules.....	188

Table of contents

8.3.3	Settings – Basic Settings of the Device.....	190
8.3.3.1	Menu Overview.....	190
8.3.3.2	IP-Settings – Network Settings.....	191
8.3.3.3	Change Time – Changing the Date and Time.....	192
8.3.3.4	Backup – Saving Data.....	193
8.3.3.5	Restore – Restoring Data Backups.....	194
8.3.3.6	Export Logs – Exporting Log Files.....	196
8.3.3.7	Balance Settings.....	197
8.3.4	Wipe Screen – (Temporarily) Locking the Screen.....	198
8.3.5	Shutdown – Shutting Down the System.....	199
8.4	Recipes.....	200
8.4.1	General Information.....	200
8.4.2	Save Recipe.....	200
8.4.3	Load/Start Recipe.....	200
8.4.4	Delete Recipe.....	201
8.5	Parameters.....	203
8.6	Parameter Options.....	209
8.6.1	Overview of Settings Menu.....	209
8.6.2	Setpoint.....	210
8.6.2.1	Menu Content.....	210
8.6.2.2	Setting Setpoints, Activating and Deactivating Parameters.....	211
8.6.2.3	Setting Alarm Limits and Critical Values.....	213
8.6.3	Calibrate.....	214
8.6.3.1	Menu Content.....	214
8.6.3.2	General Information on Calibrating.....	214
8.6.3.3	Calibrating a Digital pH Sensor.....	215
8.6.3.4	Product Calibration of a Digital pH Sensor...	218
8.6.3.5	Calibrating an Analog pH Sensor.....	220
8.6.3.6	Recalibrating an Analog pH Sensor.....	223
8.6.3.7	Calibrating Digital a pO ₂ Sensor.....	224

Table of contents

8.6.3.8	Calibrating an Analog pO ₂ Sensor.....	226
8.6.3.9	Calibrating the Turbidity Sensor.....	228
8.6.4	PID Controller Settings.....	229
8.6.4.1	Menu Content.....	229
8.6.4.2	Table with Settings for the PID Controller....	229
8.6.4.3	PID Control Explained.....	230
8.6.4.4	Tips for Readjusting a PID Controller.....	232
8.6.5	Tare Weight Function - Taring the Weight Display....	232
8.7	Cascade Control.....	233
8.7.1	Cascade Control Explained.....	233
8.7.2	Setting a Cascade.....	234
8.7.2.1	Menu and Functions.....	234
8.7.2.2	Cascade Progress Display.....	236
8.7.2.3	Deleting a Cascade.....	237
8.7.2.4	Special Configurations.....	238
8.8	Pumps.....	239
8.8.1	Control and Settings.....	239
8.8.2	Calibrating the Pumps.....	239
8.8.3	Resetting the Pump Counter to Zero.....	241
8.8.4	Filling and Emptying the Pump Hoses.....	241
8.9	Processes.....	244
8.9.1	General Information.....	244
8.9.2	Safety Notes.....	245
8.9.3	Full Sterilization.....	245
8.9.3.1	Process Sequence.....	245
8.9.3.2	Process Configuration.....	247
8.9.3.3	Before Starting the Process.....	248
8.9.3.4	Executing the Process.....	248
8.9.3.5	Terminating the Process.....	249
8.9.3.6	Aborting the Process.....	249

Table of contents

8.9.4	SIP Harvest Valve – Sterilization Harvest Valve.....	250
8.9.4.1	Process Sequence.....	250
8.9.4.2	Process Configuration.....	250
8.9.4.3	Before Starting the Process.....	250
8.9.4.4	Executing the Process.....	250
8.9.4.5	Aborting the Process.....	251
8.9.5	SIP Sample Valve – Sterilization Sample Valve.....	252
8.9.5.1	Process Sequence.....	252
8.9.5.2	Process Configuration.....	252
8.9.5.3	Before Starting the Process.....	252
8.9.5.4	Executing the Process.....	252
8.9.5.5	Aborting the Process.....	253
8.9.6	SIP Feed Line – Sterilization Feed Line.....	253
8.9.6.1	Process Sequence.....	253
8.9.6.2	Process Configuration.....	254
8.9.6.3	Before Starting the Process.....	254
8.9.6.4	Executing the Process.....	254
8.9.6.5	Aborting the Process.....	256
8.9.7	SIP Transfer Block Valve – Sterilization Transfer Block Valve.....	256
8.9.7.1	Process Sequence.....	256
8.9.7.2	Process Configuration.....	256
8.9.7.3	Before Starting the Process.....	257
8.9.7.4	Executing the Process.....	257
8.9.7.5	Aborting the Process.....	258
8.9.8	SIP Transfer Line – Sterilization Transfer Line.....	258
8.9.8.1	Process Sequence.....	258
8.9.8.2	Process Configuration.....	258
8.9.8.3	Before Starting the Process.....	258
8.9.8.4	Executing the Process.....	258
8.9.8.5	Aborting the Process.....	260

Table of contents

8.9.9	Bioreactor Operation – Cultivation.....	260
8.9.9.1	Process Sequence.....	260
8.9.9.2	Process Configuration.....	260
8.9.9.3	Before Starting the Process.....	261
8.9.9.4	Starting the Process.....	261
8.9.9.5	Terminating the Process.....	263
8.9.10	Harvest.....	263
8.9.10.1	Process Sequence.....	263
8.9.10.2	Process Configuration.....	264
8.9.10.3	Before Starting the Process.....	264
8.9.10.4	Executing the Process.....	264
8.9.10.5	Aborting the Process.....	265
8.9.11	Transfer.....	266
8.9.11.1	Process Sequence.....	266
8.9.11.2	Process Configuration.....	266
8.9.11.3	Before Starting the Process.....	266
8.9.11.4	Executing the Process.....	267
8.10	Shutting Down the System; Switching off the Device.....	269
8.11	Emergency Shut-Off – Shut Down in Case of an Emergency.....	270
8.12	Switching On Again after Emergency Shut-Off.....	270
9	Rectifying Faults.....	271
9.1	Fault Tables.....	271
9.1.1	General Faults.....	271
9.1.2	Faults Drive System.....	272
9.1.3	Faults Temperature Control System.....	273
9.1.4	Faults Gassing System.....	274
9.1.5	Faults pH Control.....	275
9.1.6	Faults pO ₂ Control.....	277
9.1.7	Faults Antifoam Control.....	278
9.1.8	Faults Feed and Pump.....	279

Table of contents

9.1.9 Interferences Turbidity Measurement.....	280
9.1.10 Behavior in Case of a Power Interruption.....	280
9.2 Returning for Repair.....	281
10 Cleaning and Maintenance.....	282
10.1 Cleaning Agent and Disinfectant.....	282
10.2 Cleaning the Bioreactor.....	283
10.3 Maintenance Plan.....	284
11 Disposal.....	287
12 Technical Data.....	288
12.1 Dimensions.....	288
12.2 Connections and Connection Values.....	289
12.3 Specifications of the Basic Unit.....	291
12.3.1 Instrumentation Cabinet.....	291
12.3.2 Operating Panel.....	291
12.3.3 Vessel.....	292
12.3.4 Temperature Control System.....	294
12.3.5 Stirrer.....	294
12.3.6 Gassing System.....	296
12.3.6.1 Components.....	296
12.3.6.2 Gassing Variants.....	297
12.3.7 Exit Gas System.....	297
12.3.8 pH Control.....	298
12.3.9 pO ₂ Control.....	299
12.3.10 Antifoam Control.....	301
12.3.11 Pumps.....	301
12.3.12 Vessel Pressure Display (Manometer).....	302
12.3.13 Safety Valves.....	303
12.4 Specifications of the Options.....	303
12.4.1 Steam Generator.....	303
12.4.2 Recirculating Chiller.....	304
12.4.3 Level Detection.....	304
12.4.4 Pressure Control.....	305

Table of contents

12.4.5 Weight Measurement Vessel – Load Cell.....	305
12.4.6 Turbidity Measurement.....	306
12.4.7 Exit Gas Analysis.....	306
12.4.8 pCO ₂ Measurement.....	307
12.4.9 Redoxmessung.....	307
12.4.10 Permittivity Measurement.....	308
12.5 Operating Conditions.....	308
12.6 Operating Materials.....	308
12.7 Emissions.....	309

Safety and Responsibility

1 Safety and Responsibility

This chapter contains general information on safety when using the device. In the remaining chapters, warning messages are used only to highlight particular hazards directly arising from the actions being described.



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

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

1.1 Explanation of Special Displays

1.1.1 Warning Messages

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



WARNING

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



CAUTION

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



NOTICE

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

1.1.2 Other Messages



Texts that are marked in this way provide useful tips and recommendations for ensuring efficient, fault-free operation of the device.

1.2 Intended Use, Incorrect Use and Misuse

Intended Use

The pilot scale bioreactor Techfors-S that can be sterilized in situ has been specially developed for the cultivation of microorganisms for research and development in a biotechnology laboratory. It is designed for use with fluids in fluid groups 1 and 2, as defined in Article 13 of the Pressure Equipment Directive 2014/68/EU.



WARNING

The device is designed and built exclusively for the intended use described above.

Each instance of non-conventional use of the device is considered incorrect use and may lead to dangerous situations.

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

- The installation site
- Personnel qualifications
- Correct operation and maintenance
- The use of undamaged reagent bottles and hoses

Incorrect Use/Misuse

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

Any use of the device outside the scope of the intended use as described above will be deemed misuse.

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

To use the device for special applications not covered by conventional, intended use, the manufacturer must configure and certify the device accordingly.

Any use of the device outside of a biotechnology laboratory, i.e. in any environment in which the conditions required for the safety of personnel cannot be met or cannot be met to their full extent, will also be deemed misuse.

Safety and Responsibility

1.3 Qualified Personnel

1.3.1 Operator

The operator operates the device in the context of the intended use. Only persons who have been trained for working in a biotechnology laboratory can be considered for the role of operator. These include, for example:

- Process technicians in the fields of biotechnology and chemistry
- Biotechnologists (biotechnicians)
- Chemists with a specialization 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

To be allowed to operate the device, the operator 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.

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

1.3.2 Technician

The technician is an individual who, by virtue of their relevant professional education, training and/or experience, is competent to identify risks and prevent hazards arising from the use of the device. The technician is familiar with the environment in which they are operating and knows the relevant standards and regulations.

Technicians include, for example, the following groups of people:

- Qualified electricians
- Decontamination specialists
- Disassembly, disposal and recycling specialists

1.3.3 INFORS HT Service Technician or Licensed Dealer

Certain work may only be performed by the manufacturer's skilled personnel or by skilled personnel authorized by a licensed dealer. Other persons are not authorized to perform this work.

1.4 Unauthorized Persons

The term "unauthorized persons" applies to all persons who can access the work area but are not qualified to use the device in accordance with the aforementioned requirements.

Unauthorized persons are not permitted to operate the device or use it in any other way.

1.5 Responsibility of the Provider

Provider

The term "provider" applies to all persons who are responsible for making the device and the necessary infrastructure available. The provider bears a special level of responsibility with regard to the processes and the qualification and safety of the operators.

Provider Obligations

The device is used for industrial and scientific purposes. As such, the provider of the device 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 device remains in safe and proper working condition throughout its entire term of use.
- The provider must ensure that all safety devices are fully functional and not disabled.
- The provider must ensure that the device is only operated by qualified personnel, and that said personnel receive sufficient training.
- The provider must ensure that the protective equipment required for working with the device is available and worn.
- The provider must ensure that this operating manual remains in the immediate vicinity of the device throughout its entire term of use.

1.6 Residual Risks

This chapter covers residual risks that are always present when using the device in accordance with normal, intended use.

Safety and Responsibility

Electric Current



The device is operated electronically. 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 device from the power supply immediately and arrange for it to be repaired.
- Disconnect the device from the power supply before commencing any work on the electrical components.
- Always use qualified electricians for any work on the electrical components.
- Keep moisture away from live parts. It could cause a short circuit.

Hot Surfaces



The vessel, the piping and the motor can get hot during operation. There is a risk of burns if you come into contact with hot surfaces.

- Avoid contact with hot surfaces.
- Always use appropriate protection for applications with high temperatures.

Dangerous Gases



The use or production of dangerous – i.e. toxic or asphyxiant – gases entails a significant health risk, especially in small rooms. To prevent high emissions of dangerous gases, the following measures must be taken:

- The gas connections on the device must be checked before any cultivation using dangerous gases are initiated.
- Check the seals on the device at regular intervals and replace them if necessary.
- Check gas-carrying hoses for leaks at regular intervals.
- Safely discharge exit gases.

Flammable or Explosive Substances



The use or production of flammable or explosive substances does not fall under the intended use, as the device is not explosion-proof. If the provider intends to use the device for such applications, it is essential to check the suitability of the device with the relevant local authorities.

There is a risk of explosions when using impure process gases: you must therefore only use process gases without impurities.

Safety and Responsibility

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 personnel.

- Safely discharge contaminated condensate.
- Check liquid-carrying hoses for leaks at regular intervals.
- When using or producing corrosive or toxic substances, use appropriate protection.
- Comply with internal safety regulations when handling corrosive and toxic substances.

Bioactive or Pathogenic Organisms



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

- Safely discharge condensate.
- Follow internal safety regulations when handling bioactive substances, pathogenic organisms or genetically modified cultures.

Excess Pressure or Vacuum



The vessel may be pressurized. Incorrect manipulation or exceeding the permissible working pressure can cause built-in-parts to be flung away. This can result in liquids and gases being expelled at high pressure.

- Observe the working pressure specified on the vessel identification plate.
- Observe the specified inlet pressures. The factory-set pressures of the pressure reducing valves preset must not be changed.
- Never operate the device without having the safety valve installed.
- Prior to each manipulation of built-in-parts and the vessel top plate, make sure that the vessel depressurized.
- Prior to working on pressurized components ensure that the system is depressurized.
- Before use, ensure that the built-in-parts und pressurized components are mounted correctly.
- Check pressurized lines and connections for leaks at regular intervals.

Steam or Hot Liquid



Escaping steam or hot liquids can lead to severe scalding and burns.

- Check all steam-carrying components for damage and correct seating before each use.
- Safely discharge tap water and condensate.

Safety and Responsibility

Environmental Hazards



Inappropriate handling of environmentally hazardous substances, especially where disposal is involved, may lead to severe environmental damage.

- Contaminated liquids must be disposed of in an environmentally suitable way.

Accessories and Spare Parts



Incorrect spare parts, imitations or spare parts that have not been authorized by the manufacturer and unauthorized accessories represent a significant safety risk. As such, we recommend procuring all spare parts and accessories from a licensed dealer or directly from the manufacturer.

1.7 Warning Symbols on the Device

The following warning symbols (stickers) are placed on the device:

Warning symbol	Position	Meaning
A yellow rectangular sticker with a black border. On the left is a black triangle containing a lightning bolt. To the right of the triangle, the text reads: "High leakage current! Earth connection essential before connecting supply!"	On the instrumentation cabinet	Danger due to high leakage current. Before connecting to the supply circuit, a ground connection must be established.
A yellow rectangular sticker with a black border. On the left is a black triangle containing a lightning bolt. To the right of the triangle, the text reads: "Pull power supply plug prior to opening the casing!"	On the instrumentation cabinet	Danger due to electrical voltage. Turn off the device and pull out the power plug before opening the housing of the device.
A yellow triangular sticker with a black border. Inside the triangle are three wavy vertical lines above a horizontal line, representing heat.	■ Vessel ■ Heating element (temperature control system)	Caution, there is a risk of severe burns due to hot surfaces.

WARNING

Illegible or missing warning symbols on the device will lead to the personnel being exposed to risks that the warning symbols in question were designed to make them aware of.

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

1.8 Declaration of Decontamination

When returning the device for repair, disassembly or disposal, a legally compliant declaration of decontamination is required for the safety of all involved and due to legal requirements. The following must be observed if this is the case:

- The device, component or accessory which is to be repaired must be entirely decontaminated before being sent 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 device is sent back.
- These forms can be obtained from the licensed dealer or the manufacturer.

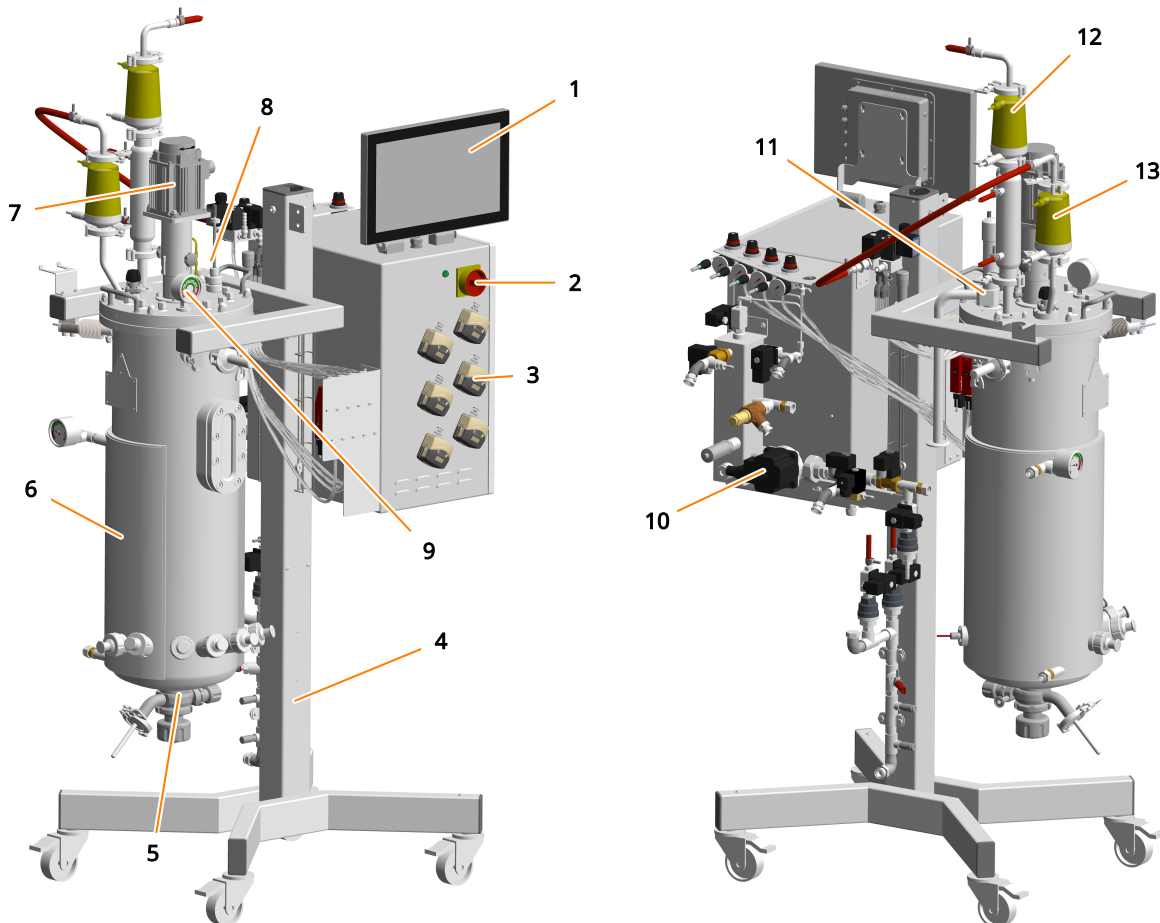


If the return shipment is not accompanied by a signed and complete declaration of decontamination or it is not affixed to the outer packaging, the shipment will be returned unopened to the sender at their expense (see also T&C).

Basic Unit

2 Basic Unit

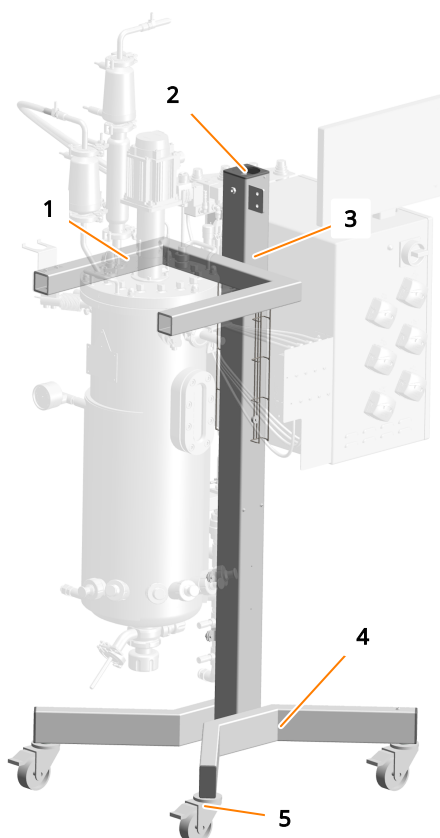
2.1 Overview Basic Unit



Pos.	Designation	Additional Information
1	Operating panel	↪ Chapter 2.4.2, page 27
2	Main switch	↪ Chapter 2.4.1, page 26
3	Pumps	↪ Chapter 2.5, page 28
4	Device stand	↪ Chapter 2.2, page 25
5	Harvest valve (bottom valve)	↪ Chapter 2.7, page 46
6	Vessel	↪ Chapter 2.6, page 32
7	Motor (stirrer)	↪ Chapter 2.9, page 50
8	Antifoam sensor for antifoam control	↪ Chapter 2.15, page 79

Pos.	Designation	Additional Information
9	Vessel pressure display (manometer)	➔ Chapter 2.8, page 49
10	Circulation pump (temperature control system)	➔ Chapter 2.10, page 56
11	Safety valve vessel	➔ Chapter 2.16, page 84
12	Exit gas filter (exit gas system)	➔ Chapter 2.12, page 65
13	Inlet air filter (gassing system)	➔ Chapter 2.11, page 60
--	Tray for reagent bottles	➔ Chapter 2.3, page 26
--	pH sensor (not shown) for pH control	➔ Chapter 2.13, page 72
--	pO ₂ sensor (not shown) for pO ₂ control	➔ Chapter 2.14, page 75

2.2 Device Stand



- 1 Frame
- 2 Motor holder
- 3 Central column
- 4 Floor stand
- 5 Swivel castor with brake (4 x)

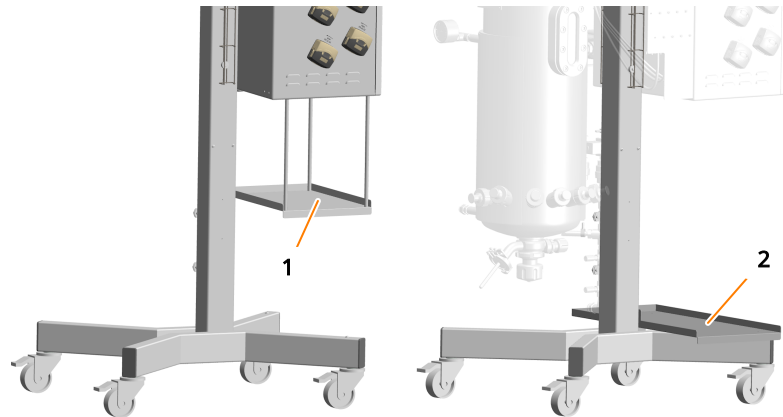
The device stand consists of a central column (3) with a U-shaped frame (1) and a floor stand (4) with four swivel castors with brakes (5). The brakes must always be locked. The opening in the central column serves as a holder (2) for the stirrer motor or for mounting the optional lifting device for the vessel top plate.

Dummy load cells are mounted on the underside of the frame (not shown). Three bolts on the underside of the vessel flange are hooked into the dummies, thereby suspending the vessel. If the device is equipped with the optional weight measurement, the actual load cells are mounted on the frame. For more details, see ➔ Kapitel 3.12, Seite 114.

The instrumentation cabinet, the temperature control system, and most of the other components of the device are mounted around the central column and connected to the vessel or its built-in-parts via cables and hoses.

Basic Unit

2.3 Tray for Reagent Bottles



- 1 Small tray
- 2 Large tray

For storing the reagent bottles, two different tray sizes are available, either individually or in combination:

- Small tray, attached to the bottom of the instrumentation cabinet
- Large tray, mounted on the floor stand

The optional steam generator includes the large tray and a holder for five 500 mL reagent bottles. For more information about the steam generator, see ➔ Chapter 3.5 'Steam Generator' on page 102.

2.4 Operating and Display Elements

2.4.1 Main Switch



The main switch is located on the top right-hand corner on the front of the instrumentation cabinet.

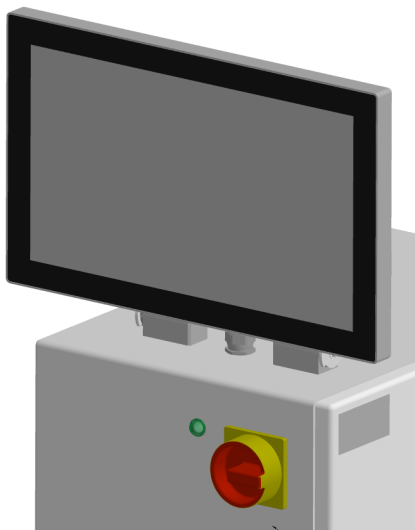
- To switch on the device, turn the main switch clockwise (90 degrees) into position *I/ON*.
The green power indicator light next to it lights up. The device is switched on and in idle state.
- To switch on the device, turn the main switch counter-clockwise (90 degrees) into position *0/OFF*.
The green power indicator light switches off. The device is cut off from the power supply. Only the main power supply terminal is powered.

If necessary, for maintenance purposes, secure the main switch against being switched on again by attaching a lock (not included in the scope of delivery) and also disconnect the power plug.

! NOTICE

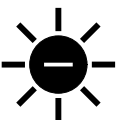
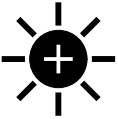
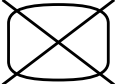
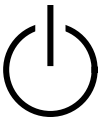
Switching off via the main switch without first stopping the running process and/or shutting down the system at the operating panel can result in damage to the operating panel!

2.4.2 Operating Panel



The operating panel is mounted on the instrumentation cabinet using a vertically swiveling bracket. It has a 15.6" color touch screen with protection type IP66. The operating panel is switched on using the main switch.

Monitor Keys Operating Panel

Key Symbol	Function
	DARK key, setting the screen illumination to darker.
	LIGHT key, setting the screen illumination to brighter.
	DISPLAY key, switching the screen on or off.
	ON/OFF key

Basic Unit



The **ON/OFF** key lights up when the operating panel is switched on. Since switching on/off takes place via the main switch, there is no need for separate switching on/off via the **ON/OFF** key. Switching off via the **ON/OFF** key while a process is running has the same effect as a power failure.

Operating Panel Connections

Four connections are labeled and are used as follows:

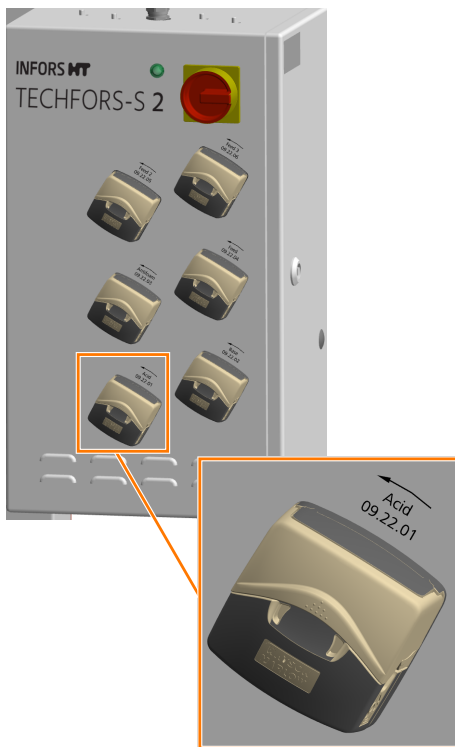
- *LAN*: Ethernet
- *COM*: Display cable
- *USB2.0*: for backups and service purposes
- *DCin*: power supply cable

Two additional connections are unlabeled and must not be used.

2.5 Pumps

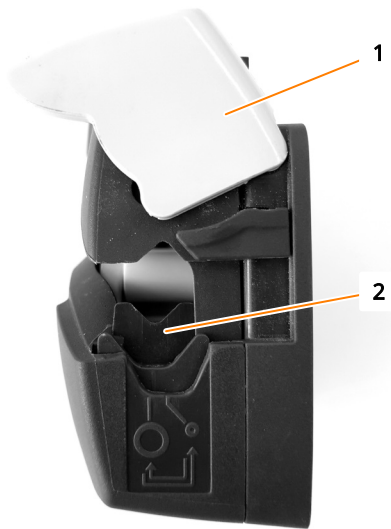
2.5.1 Setup and Function

Overview



The peristaltic pumps are located at the front of the instrumentation cabinet. Their angled arrangement facilitates the routing of the hose from the pump to the bioreactor.

Components



- 1 Cover
- 2 Hose holder

The pumps have a hinged cover (1). The hose holder (2) in the housing can be adjusted in two positions and is designed for hoses with 1.6 mm wall thickness and internal diameters of 0.5 mm to 4.8 mm. Depending on the hose size used, the hose holder must be adjusted to its appropriate position:

Position  (inside): hoses with inner diameter 0.5 mm / 0.8 mm / 1.6 mm / 2.4 mm / 3.2 mm	Position  (outside): hoses with inner diameter 4.0 mm / 4.8 mm
	

Function

The pumps are driven by stepper motors and run counter-clockwise in normal operation. This is also indicated by the corresponding arrow symbol next to each pump. Three digital pumps with fixed speed and one analog pump with variable speed are standard. Two additional analog pumps can be integrated.

Filling and emptying the pump hoses is done in the touch screen software, see ➔ Chapter 8.8.4 'Filling and Emptying the Pump Hoses' on page 241.

Basic Unit

Configuration

The pumps are labelled according to their function. They are configured ex-factory as follows:

Designation	Communication	Function	Control by
<i>Acid 09.22.01</i>	digital	Addition of acid	Parameter <i>pH</i>
<i>Base 09.22.02</i>	digital	Addition of base	Parameter <i>pH</i>
<i>Antifoam 09.22.03</i>	digital	Addition of antifoam agent	Parameter <i>Antifoam</i> with adjustable wait and dose time
<i>Feed 09.22.04</i>	analog	Addition of nutrient solution	Parameter <i>Feed</i> with adjustable setpoint
<i>Feed 2 09.22.05</i> (option)	analog	Addition of nutrient solution	Parameter <i>Feed 2</i> with adjustable setpoint
<i>Feed 3 09.22.06</i> (option)	analog	Addition of nutrient solution	Parameter <i>Feed 3</i> with adjustable setpoint

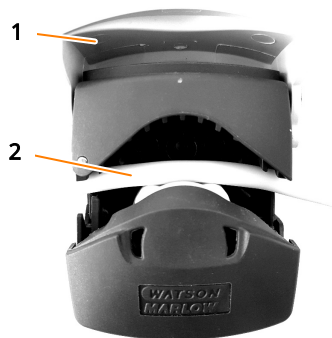
2.5.2 Adjusting the Position of the Hose Holders

The set position of the hose holders must correspond to the hose size used. Use a ballpoint pen or similar for adjustment.

Setting position for large hose sizes	Setting position for small hose sizes
 - Place the tip of the ballpoint pen in the small round recess of the outer clamping jaw and thus press it downwards and at the same time pull it forward (front view pump) until the clamping jaw engages (fig. 1). - The hose holder is now set to the position for larger hose sizes (fig. 2). - Repeat the same procedure on the other side of the pump.	 - Place the tip of the ballpoint pen in the small round recess of the outer clamping jaw and thus press it downwards and at the same time push it backwards (front view pump), until the clamping jaw engages (fig. 1). - The hose holder is now set to the position for smaller hose sizes (fig. 2). - Repeat the same procedure on the other side of the pump.

2.5.3 Inserting the Pump Hoses

To insert the pump hoses into the pump heads, proceed as follows:



1. ➤ Fold up the pump cover (1).

2. ➤ Insert the pump hose (2) into the hose holder.

When inserting the hose, observe the direction of rotation of the pump (counter-clockwise) and ensure that the hose is not twisted or stretched over the rollers.

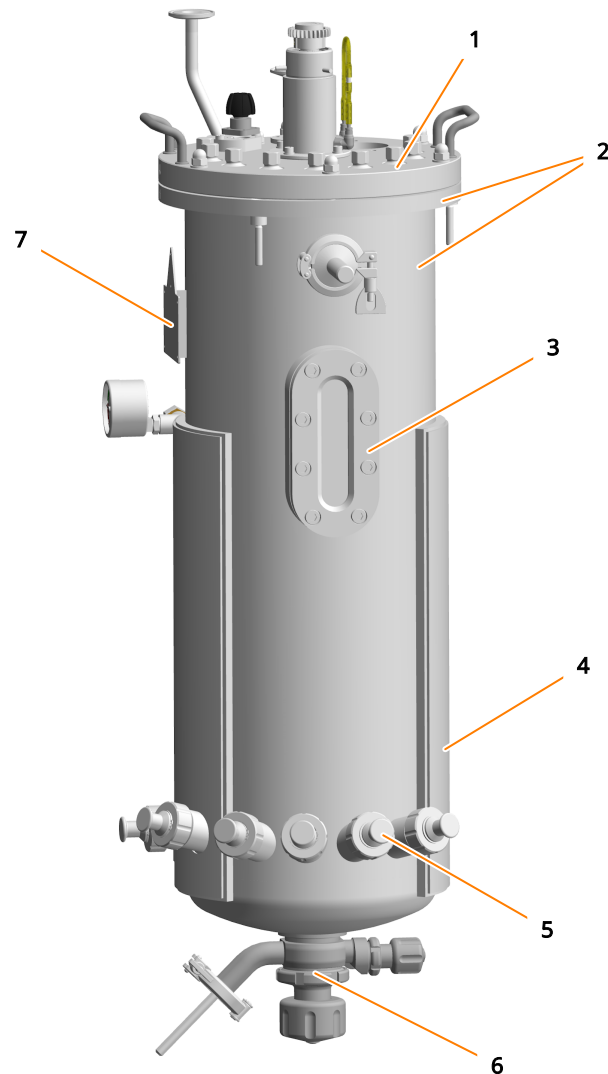
3. ➤ Fold the cover down until it closes with an audible clicking noise.

Basic Unit

2.6 Vessel

2.6.1 Setup and Function

Overview



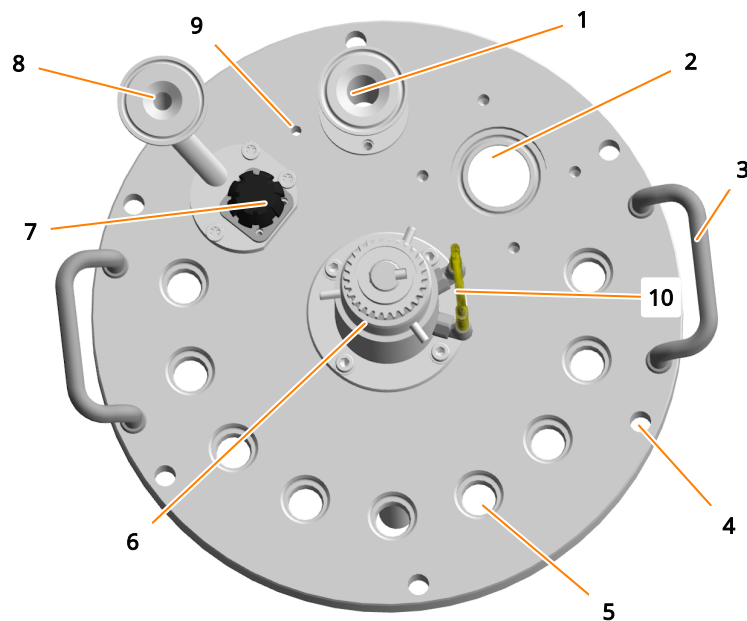
- | | |
|--|--------------------------------|
| 1 Vessel top plate | 4 Vessel jacket |
| 2 Vessel flange and upper vessel part | 5 Ingold nozzle |
| 3 Sight glass (center of the sight glass = working volume) | 6 Harvest valve (bottom valve) |
| | 7 Vessel identification plate |

The Techfors-S pilot bioreactor is available in three vessel sizes with max. working volumes of 10 L, 20 L, and 30 L (see figure). They differ only slightly in the number and type of ports and Ingold nozzles.

All three vessel sizes are also available in an ASME-compliant version. This version may differ from the standard version in certain details.

The standard features of the three vessel sizes are described in the following sections.

Vessel Top Plate

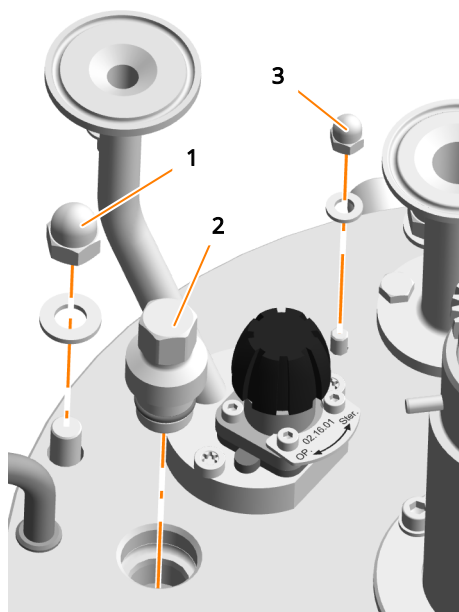


- | | |
|---|--|
| 1 Tri-Clamp ISO DN25/1 for exit gas | 6 Drive hub for motor |
| 2 Tri-Clamp 1 1/2" with NA connect ¹⁾ for safety valve | 7 Valve 02.16.01 (air deviation sterilization/cultivation) |
| 3 Handle (2 x) | 8 Tri-Clamp ISO DN08 for inlet air/gassing |
| 4 Bore hole (6 x) for affixing the vessel top plate | 9 Bore hole for affixing sparger holder |
| 5 19 mm port (8 or 9 x) for built-in-parts/accessories | 10 Silicone hose for mechanical seal lubrication |

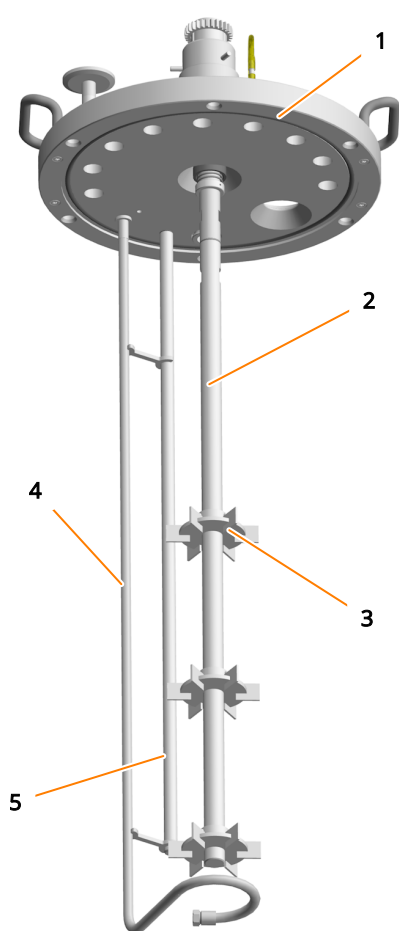
¹⁾ Vessels with 10 liter working volume: Tri-Clamp 1 1/2"

The vessel top plate is also equipped with the following components:

Basic Unit

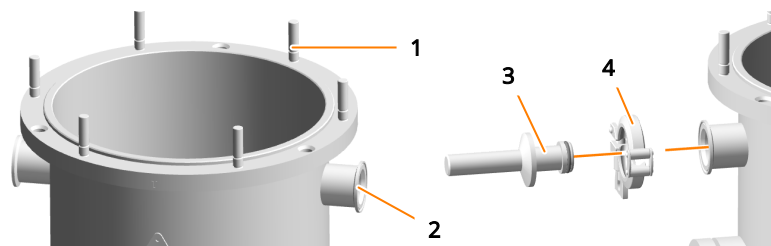


- 1 M10 cap nuts (6 x) with washers for affixing the top plate
- 2 Blanking plug with O-rings for 19 mm ports (8 or 9 x)
- 3 M6 cap nut (1 x) with washer for affixing the sparger holder



- 1 O-ring (top plate seal)
- 2 Stirrer shaft
- 3 Rushton impeller (2 or 3 x)
- 4 Ring sparger
- 5 Sparger holder (welded with sparger)

Vessel Flange and Upper Vessel Section



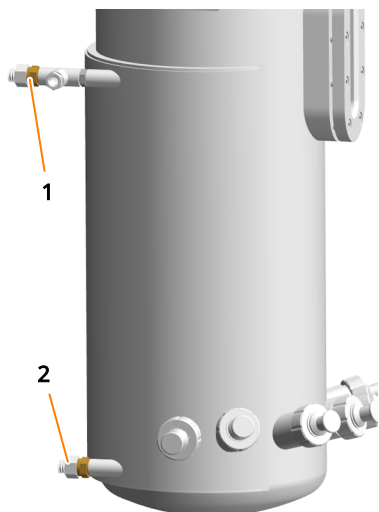
- 1 Stud bolt (6 x)
- 2 Tri-Clamp 1 1/2" (2 x)
- 3 Blanking plug with O-ring
- 4 Clamp

The stud bolts are (1) used to secure the vessel top plate. The two lateral Tri-Clamp connections (2) can be used with the manufacturer's (optional) mobile CIP unit. Both Tri-Clamp connections are sealed with blanking plugs (3) and clamps (4).



Vessels with 10 liter working volume also feature a 19 mm port, which is used for the manometer (vessel pressure indication).

Vessel Jacket

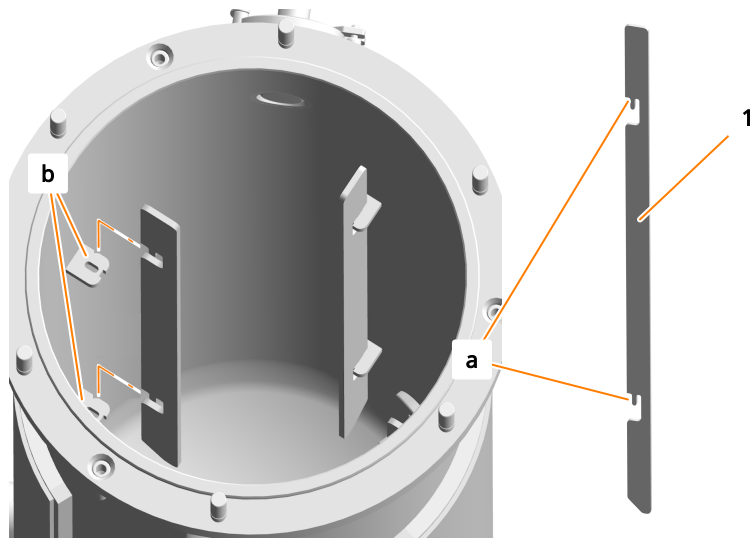


- 1 Water outlet
- 2 Water inlet

The temperature of the medium in the vessel is controlled by the water circulating in the vessel jacket. Depending on the chosen temperature control system, the water is heated electrically or with steam. (For details, see ➔ Chapter 2.10 'Temperature Control System and Sterilization' on page 56). The hoses for the water inlet (2) and water outlet (1) of the vessel jacket are connected ex-factory.

Basic Unit

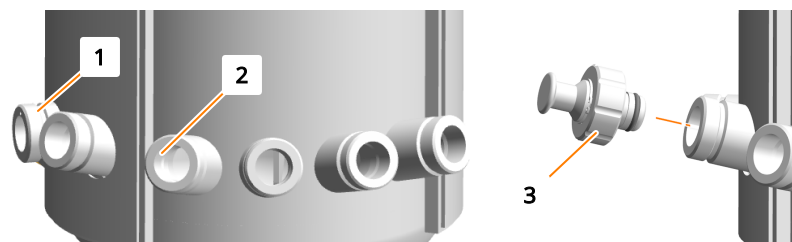
Vessel Inside – Baffles



- 1 Baffle (4 x)
- a Pin
- b Lug

Four numbered baffles (1) with two pins (a) are hooked into the correspondingly numbered lugs (b) in the vessel.

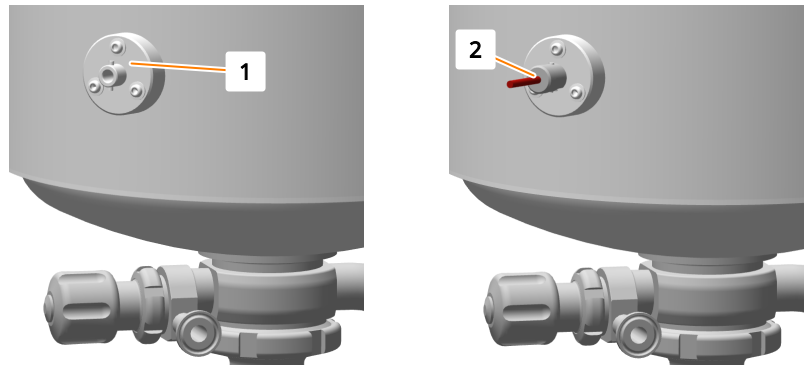
Ingold Nozzles



- 1 Ingold nozzle, ID = 25 mm, straight (1 x)
- 2 Ingold nozzle ID = 25 mm, angled (4 or 5 x)
- 3 Blanking plug

The Ingold nozzles are easily accessible on the bottom of the front of the vessel. The angled Ingold nozzles (2) are, by default, intended for the pH and pO₂ sensors. The straight Ingold nozzle (1) is used for the (optional) sample valve 17.13.01. Each Ingold nozzle has a blanking plug (3) with an O-ring.

Nozzle for Temperature Sensor



- 1 Nozzle ID = 15 mm
- 2 Temperature sensor

The nozzle (1) for connection of the temperature sensor (2), a plug-in Pt100 sensor with bayonet lock, is located on the back of the vessel. The temperature sensor is connected when the device is commissioned and remains connected during normal operation. For details about the temperature control system, see ➔ Chapter 2.10 'Temperature Control System and Sterilization' on page 56.

2.6.2 Removing and Mounting the Vessel Top Plate

General Information

The vessel top plate can be lifted either manually or by using a suitable lifting device. This is a two person job in either case.

An optional lifting device for lifting and lowering the vessel top plate is available from the device manufacturer (for details, see ➔ Chapter 3.8 'Lifting Device for Vessel Top Plate' on page 104). We recommend using the lifting device due to the weight of the vessel top plate. The following section describes the procedure without lifting device. Mounting, operation and maintenance of the lifting device are described in detail in the separate operating manual.

CAUTION

The vessel top plate is heavy. There is a risk of injury in case of incorrect handling!

Basic Unit

Removing the Vessel Top Plate

Before removing the vessel top plate, ensure the following:

- The device is switched off at the main switch.
- The vessel is de-pressurized.
- All cables and hose connections between the vessel top plate and the basic unit or instrumentation cabinet have been disconnected.
- The hose/pipe line (on the provider side) on the safety valve's overpressure venting pipe has been removed, or the safety valve is removed.
- Built-in parts of the vessel top plate that protrude into the vessel (e.g., antifoam sensor) have been removed.
- The motor is removed from the drive hub.
- The inlet air filter and the exit gas cooler with exit gas filter have been removed.

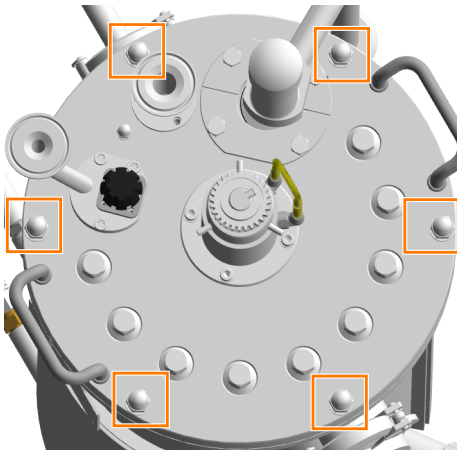
! NOTICE

Cables, hoses or pipes of built-in-parts connected to the instrumentation cabinet or the device stand can tear or be damaged if the connection is not separated or the built-in-parts are not removed before lifting off the vessel top plate.

Non-removed built-in-parts that protrude into the vessel can break, bend or otherwise be damaged when the vessel top plate is swung away.

To remove the vessel top plate, proceed as follows:

1. Use a wrench (size 17 mm) to loosen the cap nuts (M10).
2. Remove the cap nuts and washers.





3. Carefully and vertically lift the vessel top plate from the vessel using the two handles. In doing so, ensure that the sparger and the stirrer shaft do not touch the inside of the vessel.

! NOTICE

If built-in-parts hit the inside of the vessel, this can result in micro scratches. In this case, the specified surface roughness on the inside of the vessel can no longer be guaranteed.

4. Carefully place the vessel top plate on a suitable support surface. When doing so, make sure that:
 - The stirrer shaft and sparger are not subjected to any load.
 - The vessel top plate cannot roll away or fall down.

! NOTICE

The stirrer shaft is sensitive and can be bent by impact. This causes an imbalance during operation, which can damage the mechanical seal and the bearings in the stirrer shaft hub.

Mounting the Vessel Top Plate

To mount the vessel top plate, proceed as follows:

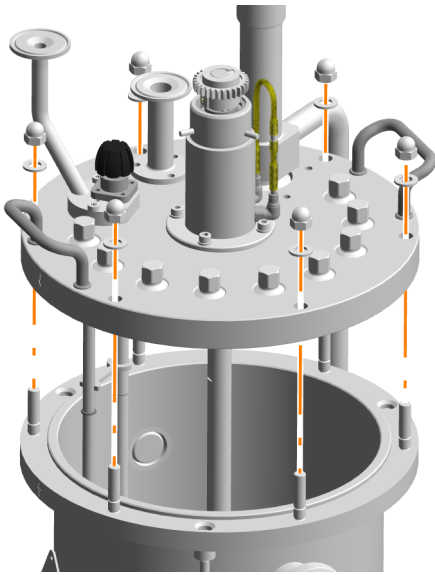
1. Lift the vessel top plate using the two handles.
2. Align the vessel top plate above the center of the vessel and lower it slowly.

Ensure that the sparger and the stirrer shaft do not hit the inside of the vessel.

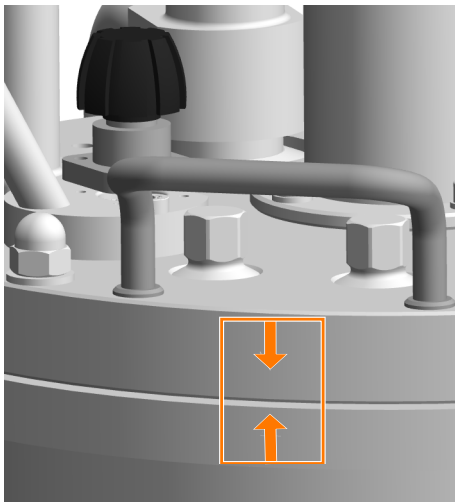
! NOTICE

If built-in-parts hit the inside of the vessel, this can result in micro scratches. In this case, the specified surface roughness on the inside of the vessel can no longer be guaranteed.

Basic Unit



- 3.** → Fit the stud bolts on the vessel flange into the bore holes in the vessel top plate.



- 4.** → Check correct position: the two engraved arrows on the vessel top plate and the vessel flange must be aligned.
- 5.** → Attach the washers.
- 6.** → Attach the cap nuts (M10) and tighten them crossways using the wrench (size 17 mm).

2.6.3 Checking Baffles, Impellers, Sparger and Top Plate Seal

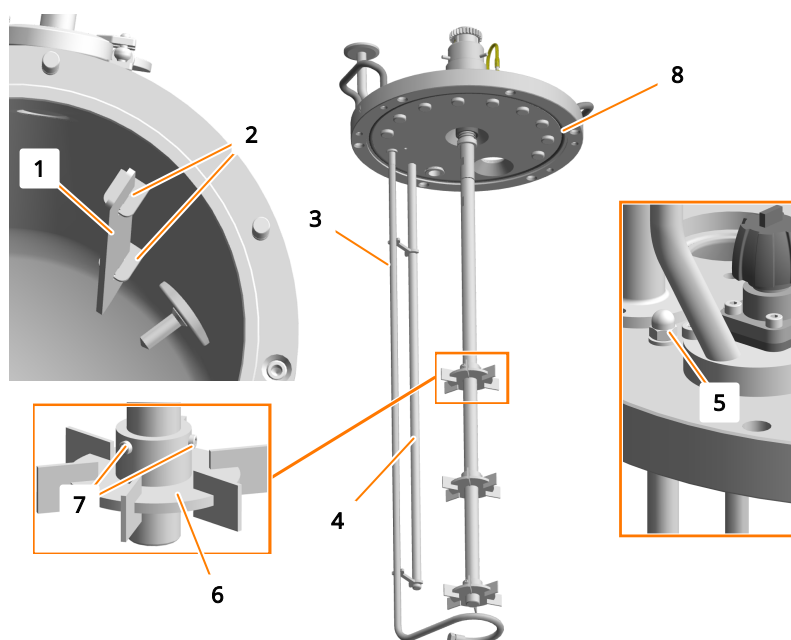
! NOTICE

Manipulations on the mechanical seal can damage it.

Requirement:

- The vessel top plate has been removed.

Before cultivation, the correct fit of the impellers, baffles, the sparger and the top plate seal must be checked. To do so, proceed as follows:



Baffles

1. Ensure that the four numbered baffles (1) are hooked into the equally numbered lugs (2) inside the vessel and that they are securely fastened.

Sparger

2. Ensure that the sparger (3) is securely in place and that the sparger holder (4) is correctly mounted to the outside of the vessel top plate: the washer is in place and the cap nut (5) is tightened.

Stirrer Shaft and Impellers

3. Ensure that the impellers (6) on the stirrer shaft are set to the desired height and sit tightly.
If necessary, loosen the two grub screws per impeller (7) on the impellers, correctly position the impellers and re-tighten the grub screws.

Top Plate Seal (O-ring)

4. Ensure the O-ring (top plate seal) (8) is intact and firmly seated in the groove on the inside.

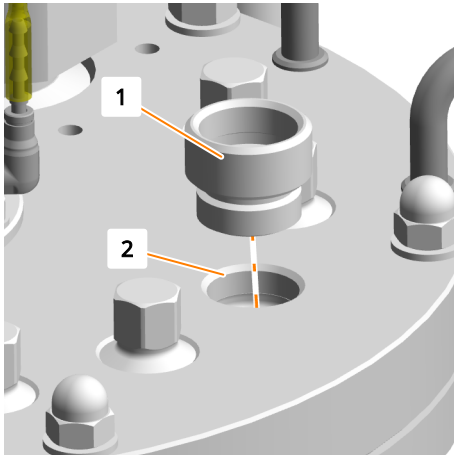
2.6.4 Equipping the Ports with the Septum and Septum Collar

If the piercing method is used for inoculation, addition of reagents, antifoam agents and nutrient solution, the ports in the vessel top plate must be equipped with septa and septum collars. This also applies to the port for the antifoam sensor, variant sensor and dosing needle.

To do so, proceed as follows:

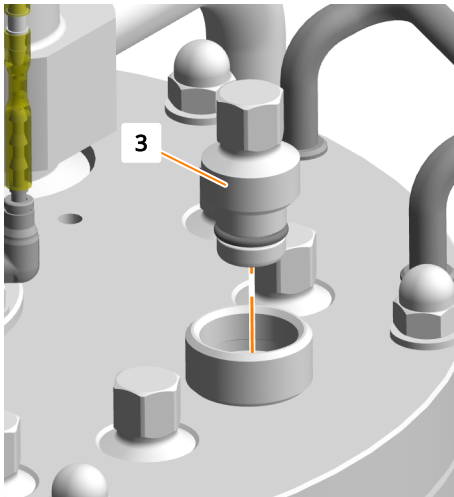
1. Release and remove the blanking plug using a hexagon socket spanner.

Basic Unit



2. → Insert the septum into the port.

3. → Screw the septum collar (1) into the port (2) by hand.



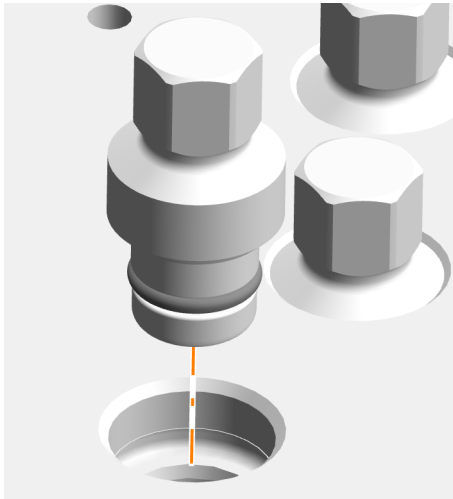
4. → Screw the blanking plug (3) with the O-ring into the septum collar by hand.

5. → Use the hexagon socket spanner to tighten the blanking plug.

2.6.5 Closing Unused Ports and Nozzles

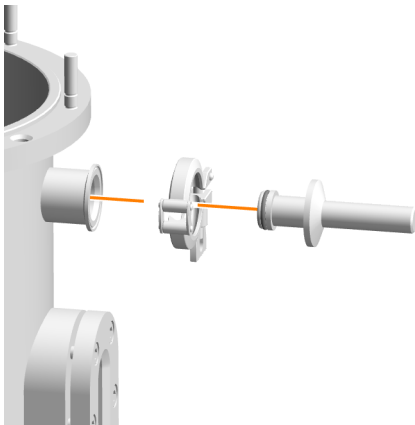
All unused ports and nozzles in the vessel top plate and on the vessel must be sealed with blanking plugs before sterilization. To do so, proceed as follows:

19 mm Port Vessel Top Plate



- 1.** → Screw the blanking plug with the O-ring into the 19 mm port by hand.
- 2.** → Use the hexagon socket spanner to tighten the blanking plug.

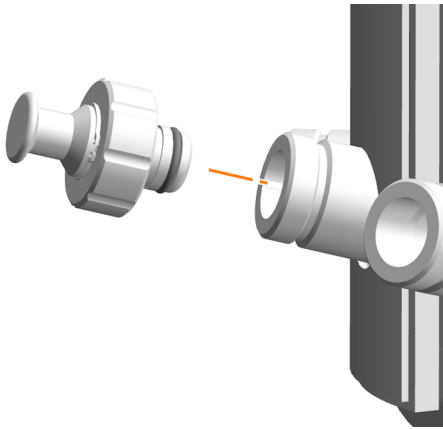
Lateral Tri-Clamp Ports



- 1.** → Insert the blanking plug with O-ring into the Tri-Clamp port as far as it will go.
- 2.** → Secure it with the clamp.

Basic Unit

Ingold Nozzle Blanking Plug



1. ➤ Insert the blanking plug with O-ring into the Ingold nozzle.
2. ➤ Tighten the blanking plug by hand.

2.6.6 Cleaning the Vessel

If the optional TechCIP CIP unit from the device manufacturer is available, the cleaning process runs automatically. This process is described in the separate TechCIP operating instructions.

The following descriptions refer to manual cleaning operations and are of a general nature.

Depending on the degree and kind of contamination, rinsing with water can be sufficient. If remains of foam or protein are adhering to the inside of the vessel, then the following procedure will ensure sufficient cleaning:

1. ➤ Carefully remove sensors from the ports and put aside in order to clean them separately according to the manufacturer's specifications.
2. ➤ Fill the vessel with 0.1 N NaOH.
3. ➤ Close all vessel ports and affix the vessel top plate.
4. ➤ Start the cultivation and stir strongly for 2 hours by using the stirrer function.

Temperatures of e.g. 40 °C up to 60 °C improve the cleaning action, prolong stirring duration as necessary.

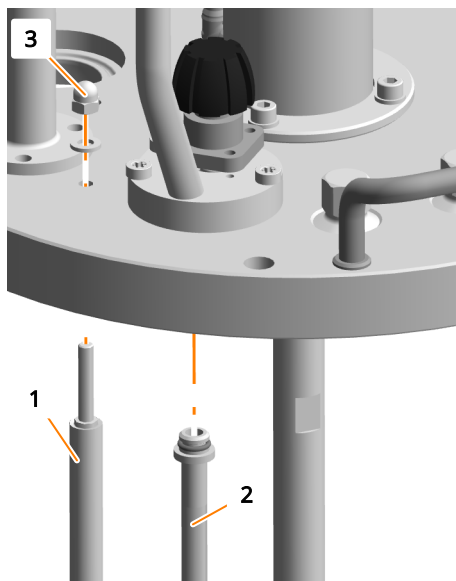
5. ➤ Stop the cultivation, shut down the system and switch off the device at the main switch.
6. ➤ Empty the vessel.
7. ➤ Thoroughly rinse the vessel with water.
8. ➤ Repeat the procedure, if necessary.

If the vessel is not used again for the next cultivation right after, sufficient air circulation in the vessel should be ensured.

2.6.7 Cleaning the Vessel Top Plate

Depending on the application, it might be necessary to separately clean the vessel top plate. To thoroughly clean the vessel top plate, proceed as follows:

1. Lift off the vessel top plate, swing it off, lower it and place it on a suitable surface with the inside of the top plate facing upwards (for details, see ➔ Chapter 2.6.2 'Removing and Mounting the Vessel Top Plate' on page 37).



2. If necessary, remove the sparger holder (1) with sparger (2):

- Loosen the cap nut (3) on the outside of the vessel top plate and remove it together with the washer.
- Remove the sparger holder with sparger from the inside of the vessel top plate.



The sparger is firmly welded to the sparger holder and is therefore automatically removed as well.

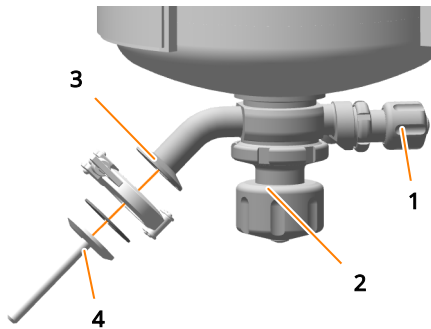
3. Carefully rinse the sparger holder and sparger with water.
If necessary use 0.1 N caustic soda.
4. Carefully rinse the vessel top plate with water or wipe it down with a wet cloth or sponge.
If necessary use 0.1 N caustic soda.
5. Check the top plate seal (O-ring) and O-ring of all built-in-parts for damage and replace if necessary.
6. Let the vessel top plate and all built-in-parts dry or wipe them dry.
7. Mount the clean and dry sparger holder and sparger in the clean and dry vessel top plate.
8. Store the vessel top plate so that it is clean, dry and protected (e.g. from falls or other damage) if it is not used for the next cultivation.

Basic Unit

2.7 Harvest Valve (Bottom Valve)

2.7.1 Setup and Function

Overview



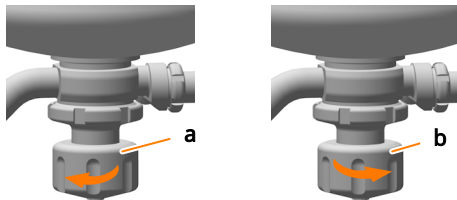
- 1 Clean steam valve 05.16.01
- 2 Harvest valve 05.12.01
- 3 Tri-Clamp connection
- 4 Blind cap

The manual steam-sterilizable harvest valve (bottom valve) (2) is installed ex-factory in the vessel bottom. The manual valve for clean steam (1) is integrated into the harvest valve and connected to the device's clean steam line. The Tri-Clamp connection (3) at the harvest valve outlet is equipped with a blind cap (4), flat gasket and clamp.

Depending on the process phase and the available options, the following is connected here:

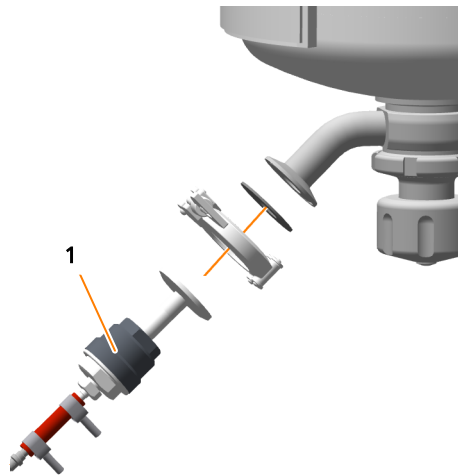
- Condensate line (on the device side)
- Harvest hose line (on the operator's side)
- Resterilizable transfer line (option)
- CIP-return hose line of mobile CIP unit TechCIP (option)
- Sampling set (option)

Opening/Closing the Valve



- OPEN: Turn the valve handle counter-clockwise (a)
- CLOSE: Turn the valve handle clockwise (b)

Sterilization



1 Steam trap 05.20.01

For sterilization, the condensate line with steam trap (1) must be connected to the harvest valve. If available, the optional sampling set is connected here. For details on the sterilization process, see ➔ Chapter 8.9.4 'SIP Harvest Valve – Sterilization Harvest Valve' on page 250.

2.7.2 Using the Harvest Valve (Bottom Valve)

Safety Notes



CAUTION

The harvest valve (bottom valve) gets very hot during sterilization. Depending on the cultivation temperature, it can also get hot during operation. This poses a risk of burns when touching the harvest (bottom) valve.

- After sterilization, let the harvest valve cool down.
- Wear heat-resistant protective gloves when operating the harvest valve.

Harvest/Emptying/Transfer

For harvest/emptying, the hose/pipe line on the provider's side must be affixed or a suitable container be placed under the harvest valve. If the (optional) pressure control is installed, the process is started in the touch screen software; see ➔ Chapter 8.9.10 'Harvest' on page 263.

To transfer the contents of the bioreactor to a tank, vessel, or another bioreactor on the provider's side, the resterilizable transfer line (optional) can be used and connected. For further information, see ➔ Chapter 3.4 'Resterilizable Transfer Line' on page 99 and ➔ Chapter 3.4.2 'Preparing the Resterilizable Transfer Line for Cultivation' on page 100. The transfer process is then controlled via touch screen software, see ➔ Chapter 8.9.11 'Transfer' on page 266.

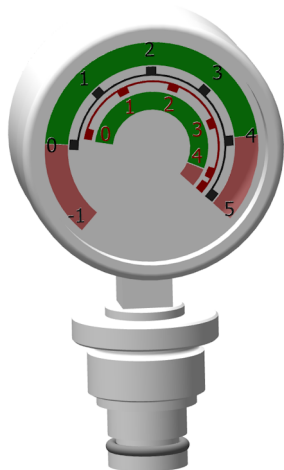
Basic Unit

Sampling

For sampling via the harvest valve, the optional sampling set can be used and connected. For further information, see ➔ Chapter 4.8 'Sampling Set' on page 139 and ➔ Chapter 4.8.2 'Using the Sampling Set' on page 140.

2.8 Vessel Pressure Display (Manometer)

2.8.1 Setup and Function



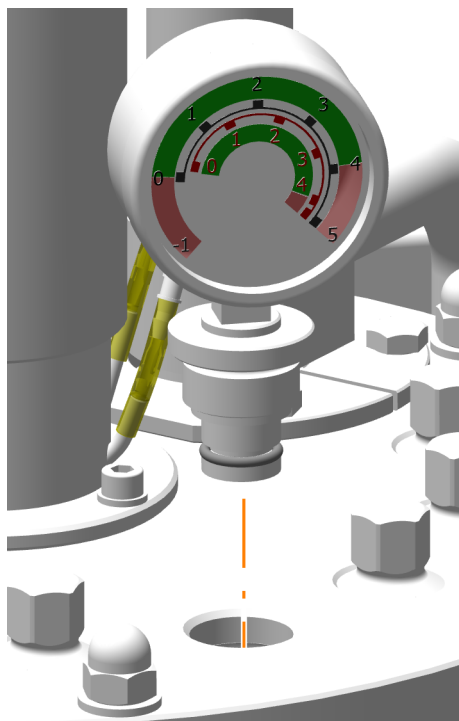
The maximum permissible vessel pressure is 4.0 bar(g). Manometer 08.30.01 indicates the pressure in the vessel in a range from -1 bar(g) to +5.0 bar(g). The manometer has two different measuring scales. The outer scale corresponds to the pressure at a vessel temperature of 25 °C. The inner scale corresponds to the pressure at a vessel temperature of 121 °C. Two red markings indicate the non-permissible pressure range of the vessel.

The manometer is equipped with an O-ring and is mounted in a 19 mm port in the vessel top plate.



For this, vessels with 10 liter working volume are equipped with a lateral 19 mm port, located in the upper part of the vessel.

2.8.2 Mounting the Manometer



To mount the manometer, proceed as follows:

1. Carefully insert the manometer with O-ring into the port.

! NOTICE

The steel membrane of the manometer is very delicate and can be damaged by friction or knocks from hard objects.

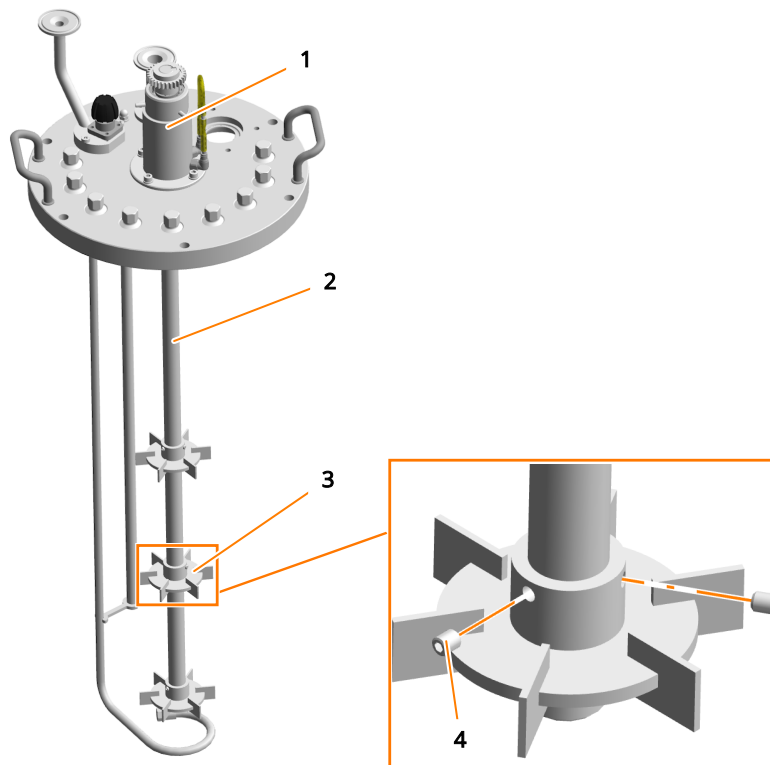
2. Tighten the manometer by hand.
Ensure that the manometer is screwed in straight.

Basic Unit

2.9 Stirrer

2.9.1 Setup and Function

Overview



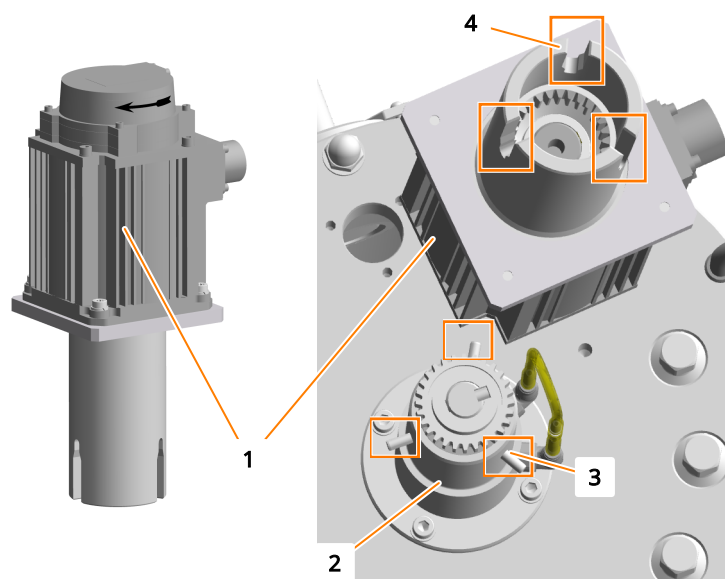
- 1 Drive hub
- 2 Stirrer shaft
- 3 Rushton impeller
- 4 Grub screw (2 x)

The stirrer shaft (2) is driven from above and turns clockwise (right/top view). The stirrer shaft is screwed onto the drive shaft in the drive hub (1) and is sealed by a single mechanical seal.

Depending on the vessel size, two (10 L WV) or three (20 L and 30 L WV) Rushton impellers (3) are affixed to the stirrer shaft using grub screws (4). After loosening the grub screws, the impellers can be moved up or down or removed completely from the stirrer shaft.

Pitched blade impellers with downward or upward flow are also available as an option (➔ Chapter 4.11, page 144).

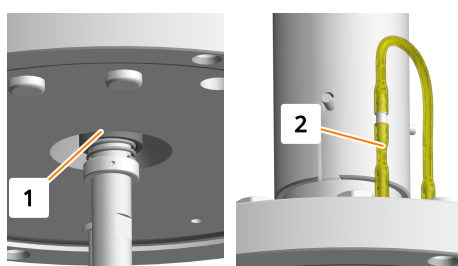
Motor



- 1 Motor
- 2 Drive hub
- 3 Pin (3 x)
- 4 Groove (3 x)

An air-cooled servo motor (1) is used as drive. The motor is coupled by placing it on the drive hub (2) on the vessel top plate. Here, the three grooves (4) on the motor must be aligned with the three pins (3) on the drive hub.

Mechanical Seal



- 1 Mechanical seal
- 2 Silicone hose

The mechanical seal (1) must always be lubricated. For lubrication, glycerine is filled in the silicone hose (2) on the vessel top plate (→ Chapter 2.9.3 'Lubricating the Mechanical Seal' on page 54).

! NOTICE

Manipulations on the mechanical seal can damage it.

Important information on the mechanical seal

Refilling glycerine

During operation, a small amount of glycerine is used for lubricating the mechanical seal. Hence, the chamber should be refilled at regular intervals, e.g. after a number of cultivations or every time the top plate is cleaned. If the mechanical seal is fine, glycerine will ooze out from the overflow even if only a small quantity is refilled.

Basic Unit

Important information on the mechanical seal

Glycerine discoloration	Due to normal abrasion of the mechanical seal, dark discoloration of the glycerine, which is visible in the silicone hose, occurs even after a short period of operation of the stirrer shaft. This discoloration is completely normal and does not indicate advanced wear of the mechanical seal.
Loss of glycerine	If there is a significant loss of glycerine during or between two cultivations, this can indicate that the mechanical seal is not placed correctly or that it is defective. A significant loss of glycerine can be identified by the fact that either significantly more glycerine is consumed when refilling the chamber, and/or the culture solution turns dark due to escaping glycerine that has run along the stirrer shaft into the culture.
Replacing the mechanical seal	If there is a significant loss of glycerine, an INFORS HT service technician must check whether the mechanical seal needs to be replaced.

2.9.2 Uncoupling and Coupling the Motor

Safety Notes



CAUTION

The motor is heavy! Work in pairs when coupling and uncoupling the motor.



CAUTION

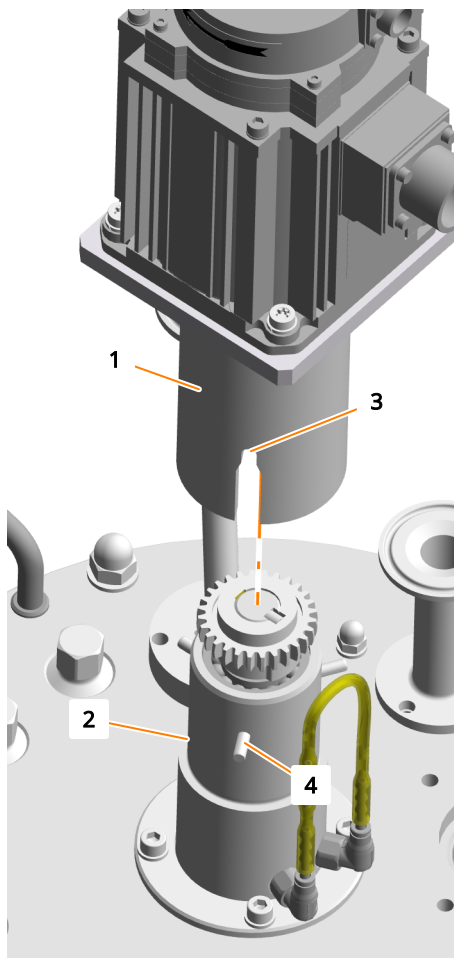
Touching the motor during operation or during the cool-down phase can cause slight burns.

The two cables for power supply and control of the motor are plugged into the motor when the device is installed and then remain connected permanently. In routine operation, the motor merely needs to be coupled and uncoupled.

Uncoupling the Motor

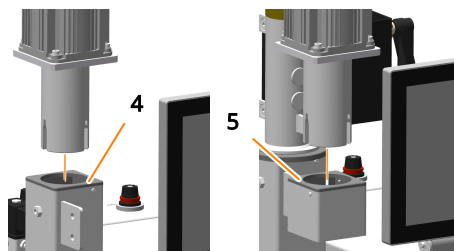
Prior to uncoupling the motor from the drive hub, ensure the following:

- The device is switched off on the main switch.
- The vessel is de-pressurized.
- The motor has cooled down.



1. ➔ With two people, lift the motor (1).

If necessary, loosen the motor cap (2) from the drive hub (3) by lightly shaking it.

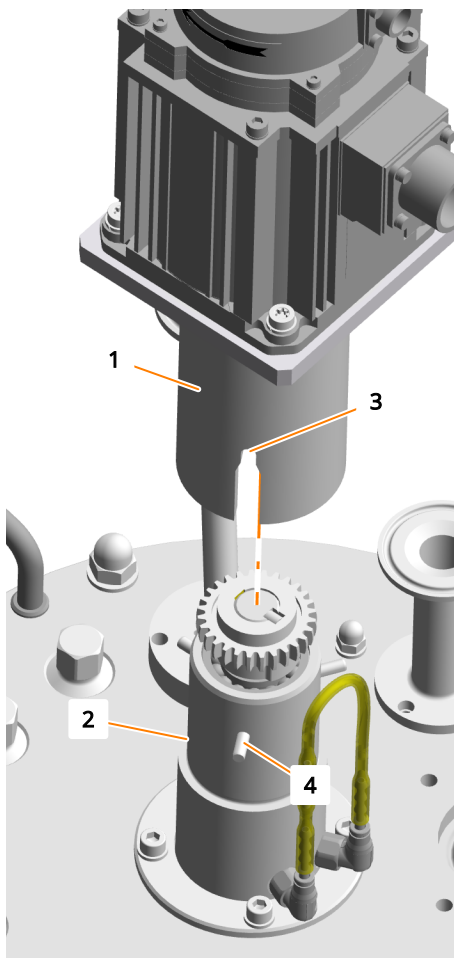


2. ➔ Place the motor in the holder (4) of the central column or, if applicable in the holder (5) of the lifting device for the vessel top plate.

Coupling the Motor

1. ➔ With two people lift the motor out of the holder.

Basic Unit



2. → Place the motor cap (1) onto the drive hub (2) on the vessel top plate.

In doing so, align the three grooves (3) on the motor cap with the three pins (4) on the drive hub. No other position is possible

2.9.3 Lubricating the Mechanical Seal

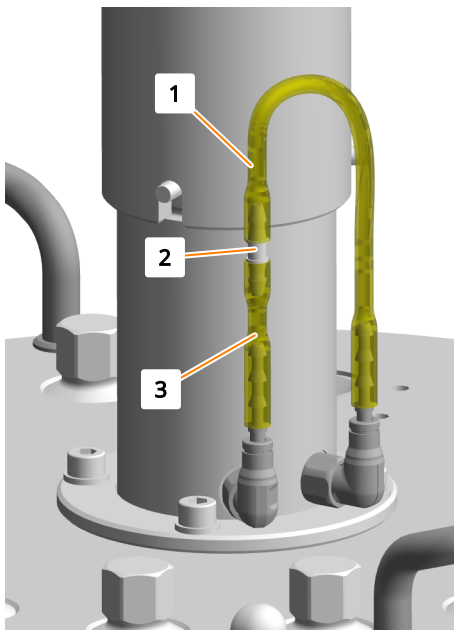
To ensure lubrication of the mechanical seal, the silicone hose at the bottom of the drive hub of the top plate must always be filled with liquid (glycerine).

! NOTICE

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

- Before each cultivation, check the glycerine fill level in the hose.
- Refill glycerine if necessary.

To refill, proceed as follows:



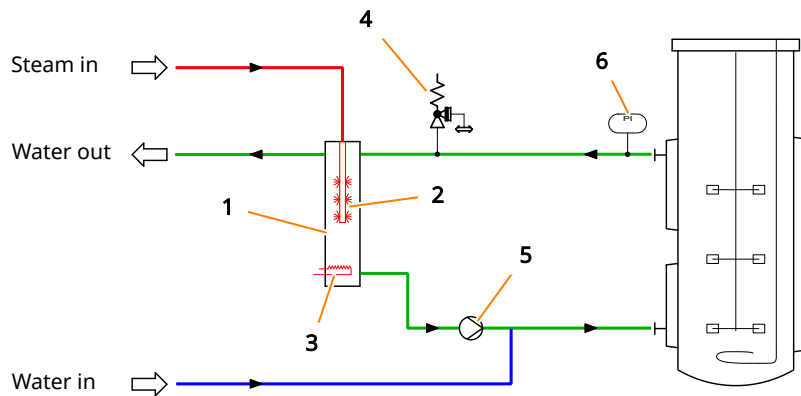
- 1.** ➤ Carefully pull off the long hose section (1) with hose nozzle (2) from the short hose section (3).
- 2.** ➤ Fill a syringe with glycerine.
- 3.** ➤ Insert the syringe into the open end of the short hose piece and fill it with glycerin until the long hose section is full.
- 4.** ➤ Remove the syringe and reinsert the long hose section with hose nozzle into the short hose section.
- 5.** ➤ If glycerine has come out of the hose, wipe it off with a cloth.

Basic Unit

2.10 Temperature Control System and Sterilization

2.10.1 Setup and Function

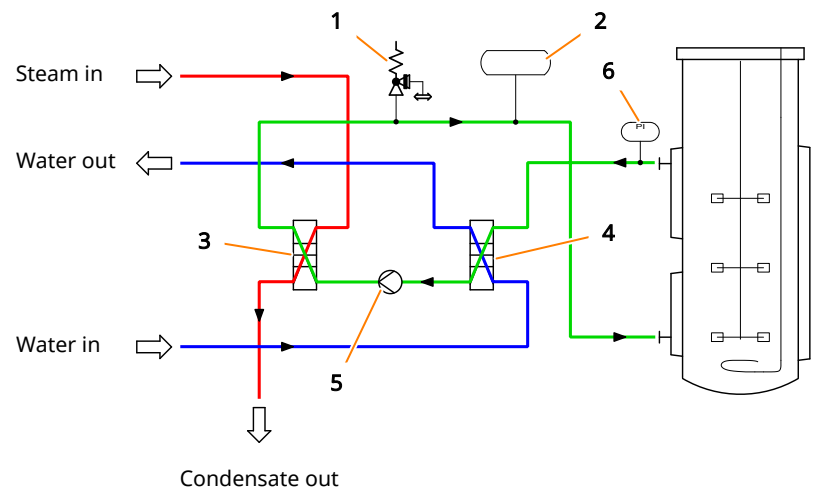
Overview Open Circuit



- 1 Heating element
- 2 Injection nozzle for direct steam injection
- 3 Electric heating cartridge
- 4 Safety valve
- 5 Circulation pump
- 6 Manometer

By default, the device has temperature control system with open circuit. The circuit consists of a heating element and a circulation pump, which ensures the circulation of the heating/cooling liquid within the jacket.

- Heating: Depending on the variant selected, the heating element features either an electric heating cartridge or an injection nozzle for direct steam injection
- Cooling: The water is fed directly into the vessel jacket, or the temperature control circuit.

Overview Closed Circuit


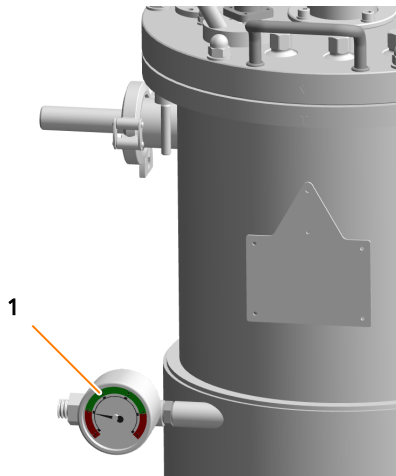
- 1 Safety valve
- 2 Expansion vessel
- 3 Heating heat exchanger
- 4 Cooling heat exchanger
- 5 Circulation pump
- 6 Manometer

A closed temperature control circuit with two heat exchangers is available as an option. Here, the heating / cooling liquid remains constantly in the circuit. The water is circulated by the integrated circulation pump. An expansion vessel compensates for changes in volume within the circuit. In addition to the vessel temperature, the temperature in the circuit is also measured to ensure precise temperature control.

- Heating: Steam is fed into the secondary circuit of the heating heat exchanger.
- Cooling: The water is fed into the secondary circuit of the cooling heat exchanger.

Basic Unit

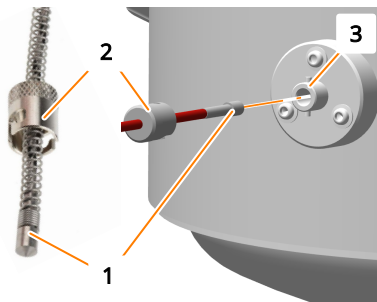
Pressure Safety



1 Manometer 01.30.01

The maximum permissible pressure in the temperature control system is 3.0 bar(g). The manometer (1) installed on the water outlet of the vessel jacket indicates the pressure in a range from -1.0 bar(g) to +4.0 bar(g). A CE-certified safety valve (➔ Chapter 2.16.2 'Safety Valve Temperature Control Circuit' on page 84) is used to protect the vessel jacket from excess overpressure.

Temperature Sensor



- 1 Measuring tip
- 2 Bajonet lock
- 3 Nozzle

The temperature inside the vessel is measured using a plug-in Pt100 sensor with a bayonet lock (2). During commissioning of the device, the sensor is inserted into the nozzle (3) on the rear of the vessel. The pressure spring on the temperature sensor ensures a constant contact pressure of the measuring tip (1). The temperature sensor remains connected during normal operation of the device.

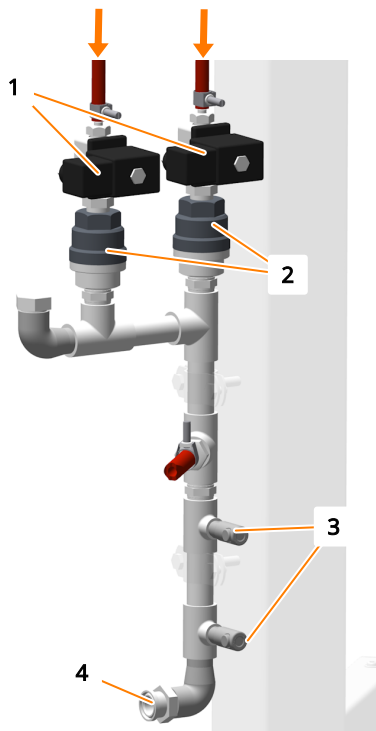
Sterilization

- Open circuit: Steam is fed into the vessel jacket to heat and sterilize the medium inside the vessel.
- Closed circuit: To heat up and maintain the sterilization temperature, steam is fed in the secondary circuit of the heating heat exchanger. The medium to be sterilized in the vessel is heated and sterilized via the vessel jacket.

The steam generated by the liquid in the vessel sterilizes the inlet air and exit gas filters in both systems at the same time. The entire process is automatic and controlled using the touch screen software.

The harvest valve (bottom valve) 05.12.01 is sterilized via a separate line using clean steam from the same steam supply. The same applies to the optional sample valve 17.13.01, the optional resterilizable feed line and the optional resterilizable transfer line.

Condensate



- 1 Solenoid valve
- 2 Steam trap
- 3 Rapid coupling (socket)
- 4 Condensate outlet

The condensate generated during sterilization is collected from all points via solenoid valves (1) and steam traps (2) into a single collection line. Condensate drainage on the laboratory side is thus handled centrally via a single line (4). The hose lines leading to the various peripherals ¹⁾ are connected to the condensate collection line using rapid couplings (3) with automatic shut-off.

¹⁾ Exception: optional resterilizable transfer line

Optional

A separate recirculating chiller is available for supplying cooling water (➔ Chapter 3.7 'Recirculating Chiller' on page 103). 3-way ball valves at the water inlet and outlet allow for manual switching between tap water and chilled water when using the recirculating chiller or a cooling water system on the provider's site (➔ Chapter 3.6 'Switching between Tap Water / Chilled Water' on page 103).

An optional steam generator can be integrated into the system for steam supply (➔ Chapter 3.5 'Steam Generator' on page 102).

Basic Unit

2.11 Gassing System

2.11.1 Setup and Function

Gases and Gas Mixture

Air, oxygen (O_2), nitrogen (N_2) and carbon dioxide (CO_2) can be used for gassing. A gas mixture can consist of air + O_2 , air + N_2 , or air + O_2 + N_2 . The composition of the gas mixture is set and controlled via the touch screen software. CO_2 is separately added.

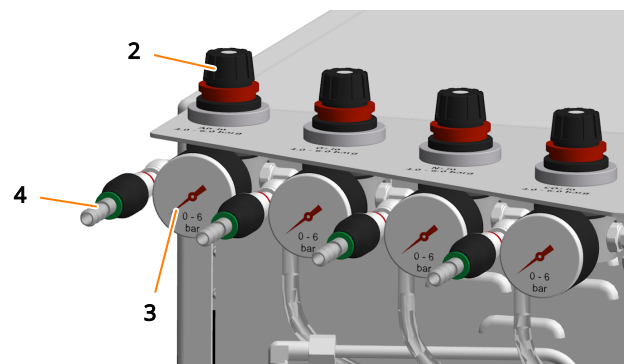
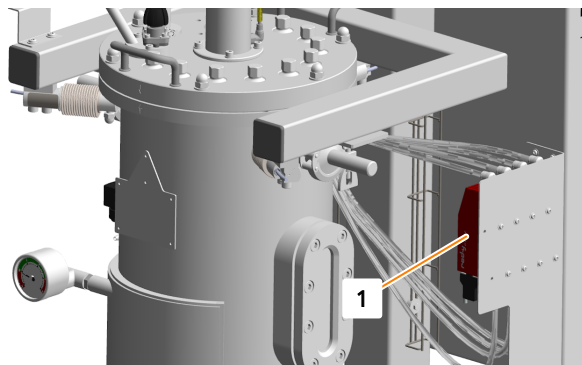
CO_2 can be used, for example, instead of liquid acid for pH control or for pCO_2 control (option).

Gassing Strategy

Two variants can be selected as the gassing strategy:

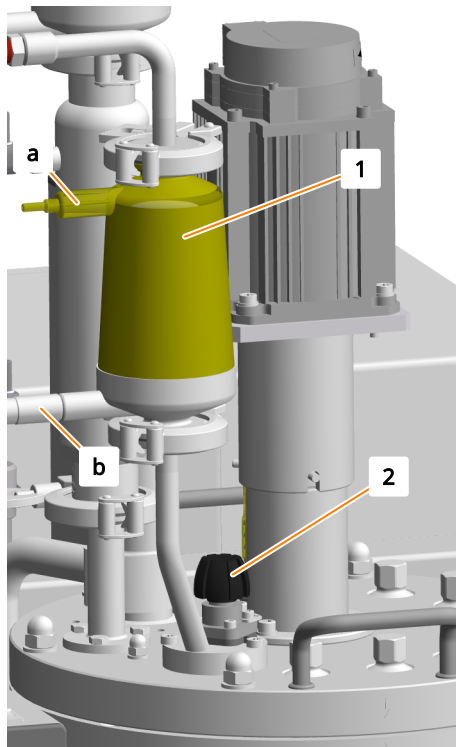
Strategy	Properties
Standard	- Flow control via an electronic mass flow controller - Gasmix via solenoid valves
High End	Flow control and gasmix via electronic mass flow controllers, 1 piece per gas

Gassing Units and Gas Connections



- 1 Mass flow controller
- 2 Pressure reducing valve
- 3 Manometer
- 4 Check valve

Depending on the chosen gassing strategy, the device is fitted and configured with the corresponding gassing units (solenoid valves, mass flow controllers). The figure shows the variant with all gases and four mass flow controllers (1). The gas connections are located on the rear of the device and are labelled with the corresponding gas. Each gas connection has a pressure reducing valve (2), a check valve (4) and a manometer (3).

Inlet Air Filter and Valve 02.16.01

- 1 Inlet air filter (membrane filter)
- 2 Valve 02.16.01
- a Twist valve unused
- b Twist valve condensate

A steam sterilizable membrane filter (1) is placed in the gassing line. The filter has two manual twist valves. The condensate hose is connected to the lower twist valve (b). This valve must be open. The upper twist valve (a) is not used and must be closed.

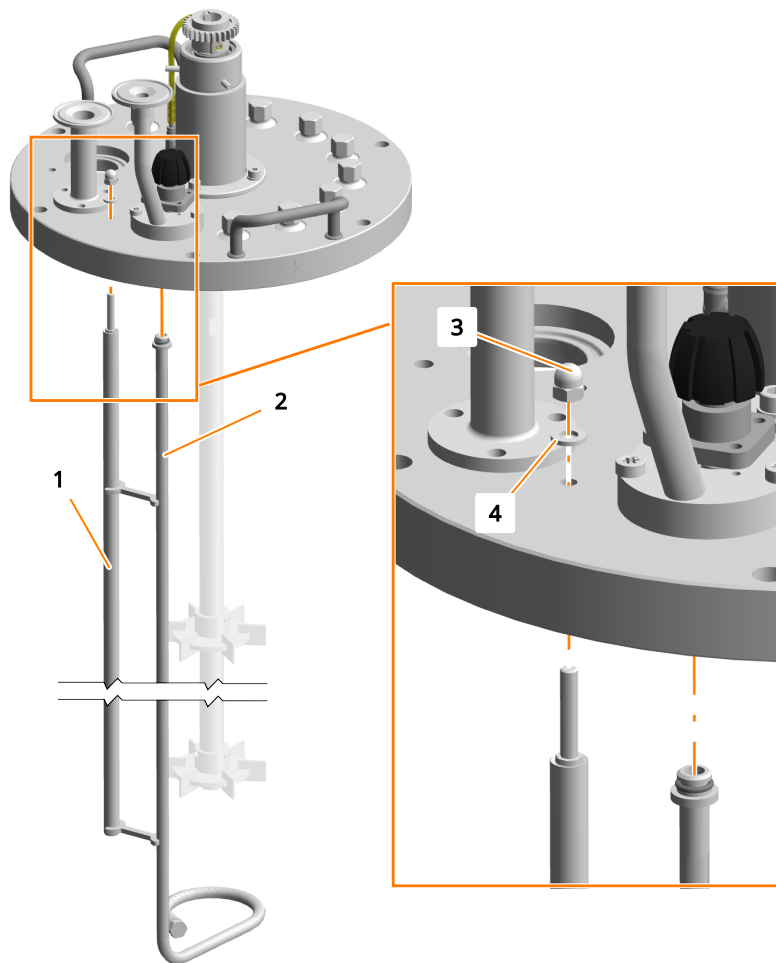
The valve 02.16.01 (2) on the vessel top plate directs the process gas into the sparger during the cultivation, and air into the head space during the cool-down phase of full sterilization. The valve is operated manually:

- Position *STER*: valve position during sterilization.
- Position *OP*: after finishing the sterilization and reaching the pre-selected inoculation temperature for the cultivation, the valve must be returned to position *OP*.

The corresponding instructions are also shown in the respective process sequence in the touch screen software.

Basic Unit

Gas Entry



- 1 Sparger holder
- 2 Ring sparger
- 3 Cap nut M6
- 4 Washer

Gas enters the vessel via a ring sparger (2). The ring sparger is welded to the sparger holder (1). This stabilizes the sparger in the vessel. The sparger with O-ring is mounted in the port with diaphragm valve 02.16.01. The sparger holder is inserted into the bore hole and affixed to the vessel top plate with a washer (4) and cap nut (3).

2.11.2 Removing and Mounting the Inlet Air Filter

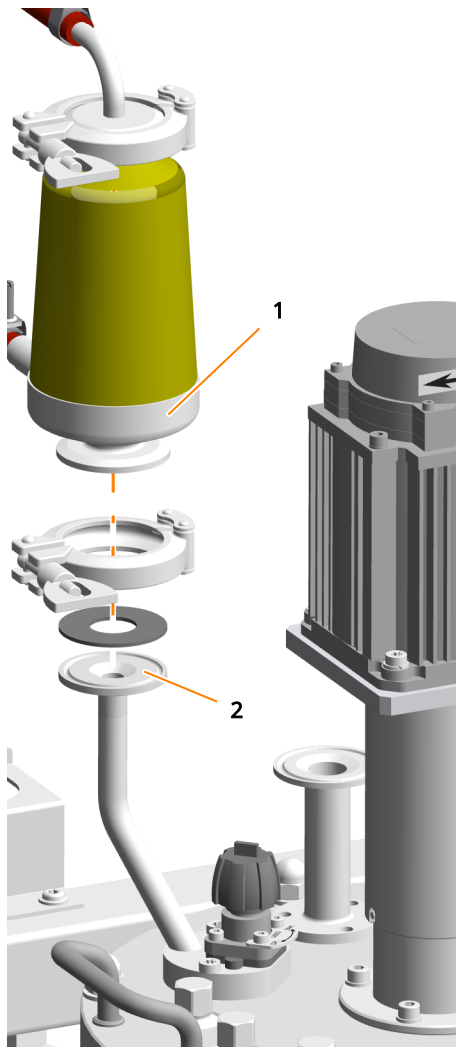
Removing the Inlet Air Filter



The inlet air/gas hose line does not necessarily have to be removed.

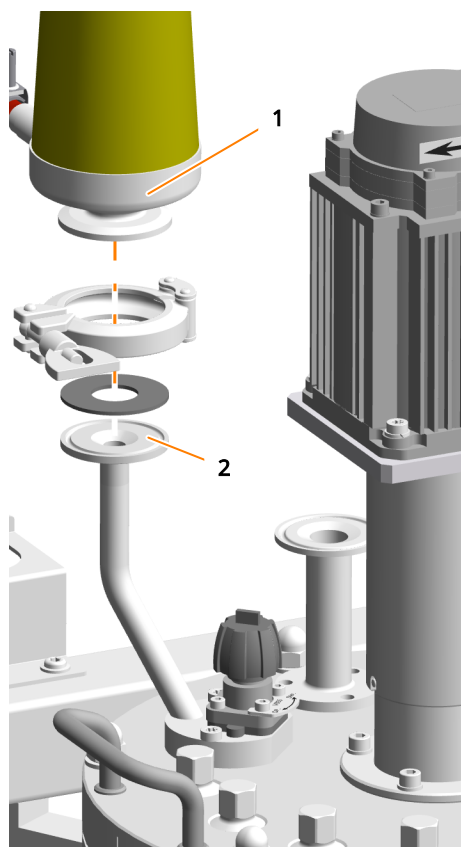
Due to its light weight, the inlet air filter does not require a special holder. It can hang loosely on the hoses.

1. ➔ Open the clamp between the inlet air filter (1) and flange (2) on the vessel top plate and remove it together with the inlet air filter and flat gasket.
2. ➔ Securely store the clamp and flat gasket for mounting.



Basic Unit

Mounting the Inlet Air Filter



1. ➔ Place inlet air filter (1) with the flat gasket flush on the flange (2) of the vessel top plate and secure it with the clamp.
2. ➔ If the inlet air/gas hose line has been removed, mount it in the same way.

2.12 Exit Gas System

2.12.1 Setup and Function

Overview

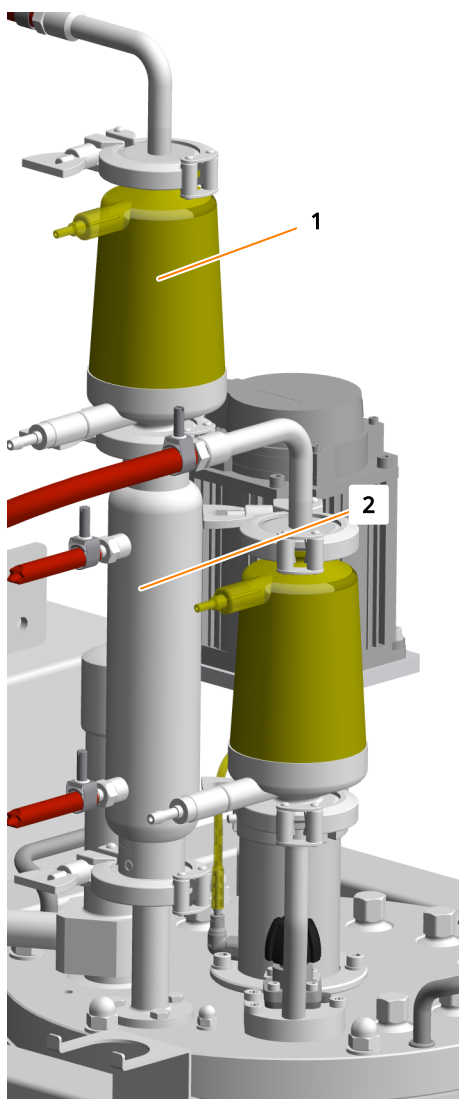
Any cultivation can increase the pressure inside the vessel through heating or gas production, even without active gassing. Hence, an exit gas line must be available for every cultivation in a bioreactor.

- 1 Exit gas filter
- 2 Exit gas cooler

Exit gas streams via the exit gas cooler (2), exit gas filter (1) and a solenoid valve (03.06.02, not pictured) into the atmosphere or into the operator's exit gas line or an appropriate ventilation system.

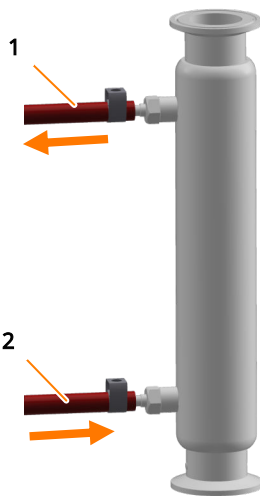
The pressure in the vessel can be controlled optionally via a pressure control valve (03.41.01) in the exit gas line and a pressure sensor on the vessel (→ Chapter 3.11 'Pressure Control' on page 111).

It is also possible to analyze the exit gas while the cultivation is running (→ Chapter 3.14 'Exit Gas Analysis' on page 117).



Basic Unit

Exit Gas Cooler

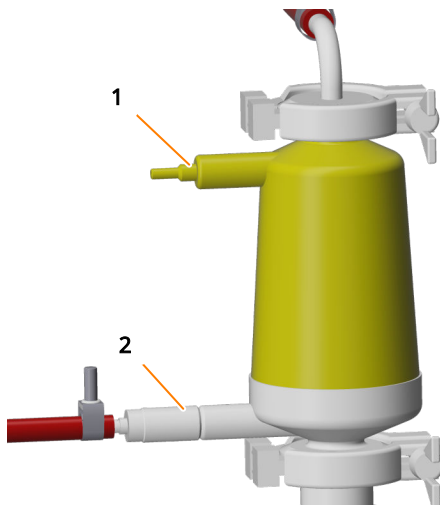


- 1 Return water
- 2 Water supply

The exit gas cooler dries the exit gas through condensation, thus preventing the exit gas filter from becoming clogged with moisture. At the same time, it also prevents water loss in the culture medium.

The exit gas cooler has pressure hoses for the water inlet (2) and outlet (1). Water is fed in from the supply for the temperature control system; this is done automatically during the cultivation and the full sterilization in accordance with the appropriately programmed process sequences.

Exit Gas Filter



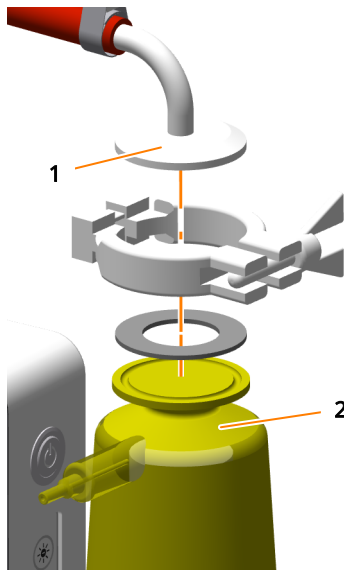
- 1 Twist valve unused
- 2 Twist valve condensate

A steam sterilizable membrane filter is used as the exit gas filter. The filter has two manual twist valves. The condensate hose is connected to the lower twist valve (2). This valve must be open. The upper twist valve (1) is not used and must be closed.

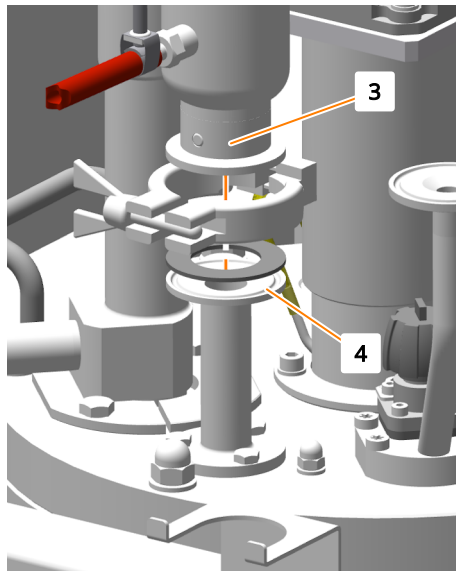
2.12.2 Removing and Mounting the Exit Gas Cooler with Exit Gas Filter

Removing the Exit Gas Cooler with Exit Gas Filter

The exit gas cooler and exit gas filter can be removed as one unit. However, the exit gas hose line must be removed. Proceed as follows:

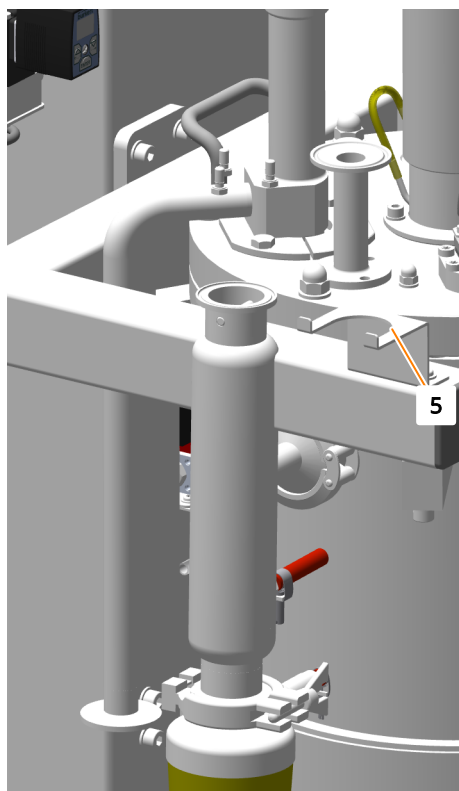


1. → Open the clamp between the exit gas filter (2) and the flange of the exit gas hose (1) and remove it together with the exit gas hose and flat gasket.



2. → Remove the clamp, exit gas cooler (3) and flat gasket between the exit gas cooler and flange (4) on the vessel top plate in the same way.
3. → Securely store the clamps und flat gaskets for mounting.

Basic Unit

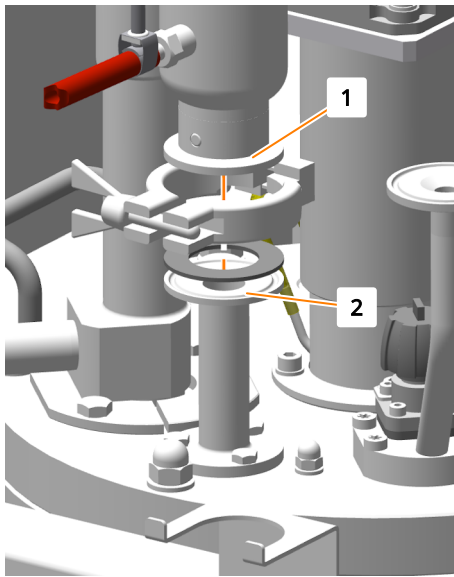


- 4.** → Turn over the exit gas cooler and place it in the holder (5).

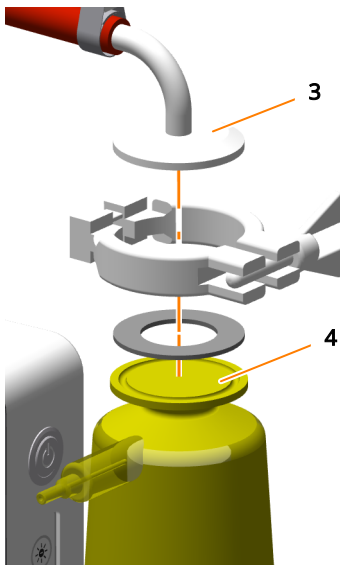
Mounting the Exit Gas Cooler with Exit Gas Filter



- 1.** → Remove the exit gas cooler from the holder and turn it around.



- 2.** → Place the exit gas cooler (1) with flat gasket flush on the flange (2) on the vessel top plate and secure them with the clamp.



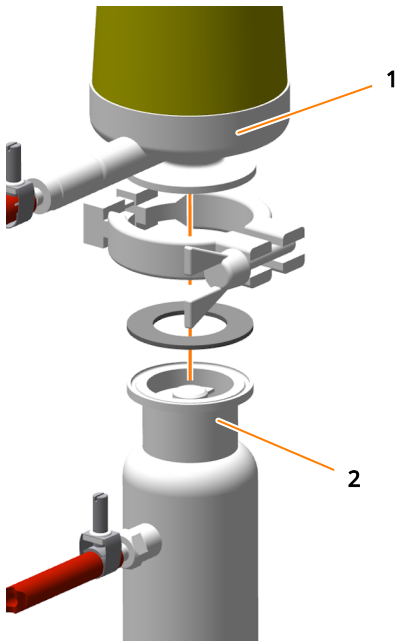
- 3.** → Place the flange of the exit gas hose (3) with flat gasket flush on the flange (4) of the exit gas filter and secure them with the clamp.

2.12.3 Cleaning the Exit Gas Cooler

To thoroughly clean the (removed) exit gas cooler, its baffle body can be removed. Proceed as follows:

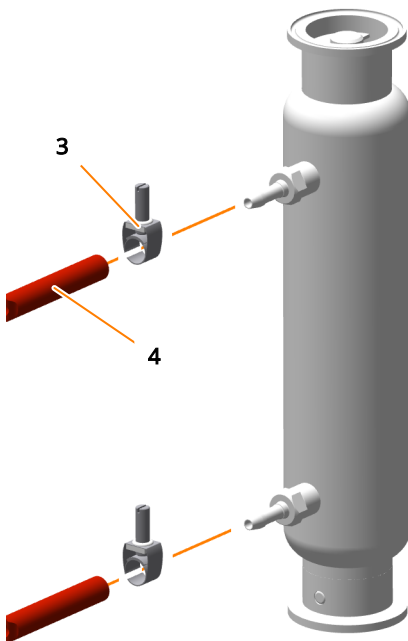
Basic Unit

Removing Inlet Air Filter



1. → Open the clamp between the exit gas filter (1) and the exit gas cooler (2) and put aside together with the exit gas filter and flat gasket for later mounting.

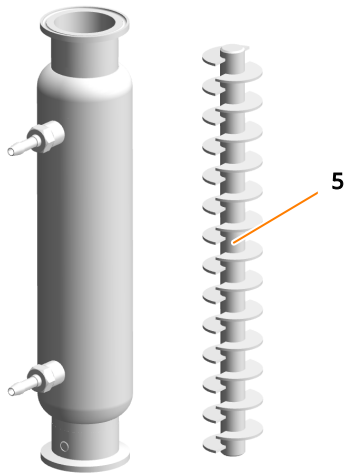
Removing Hoses



2. → Loosen the hose clamps (3) and disconnect the red pressure hoses (4) for water inlet and outlet from the exit gas cooler.

Removing Baffle Body

- 3.** ➤ Carefully remove the baffle body (5) from the exit gas cooler.

**Cleaning**

- 4.** ➤ Place the exit gas cooler and baffle body into 0.1 N NaOH for 4 hours.
- 5.** ➤ Thoroughly rinse both parts with water.
- 6.** ➤ Place both parts into an ultrasonic bath for 2 to 5 minutes.
- 7.** ➤ Thoroughly rinse both parts with distilled water.
- 8.** ➤ Let both parts dry on a clean base and then re-assemble them.

Basic Unit

2.13 pH Control

2.13.1 Setup and Function

Function

The pH value in the culture medium is measured by the pH sensor and controlled by adding reagent (acid, base). Acid and base are added via the two digital peristaltic pumps *Acid* and *Base*.

The reagents are kept in reagent bottles that are connected via hoses, e.g. with a push valve or an inoculation needle in the vessel top plate and the two pumps.

Measurement System

Depending on the variant selected, the measurement system for pH is equipped and configured for analog or digital sensors manufactured by METTLER or digital sensors manufactured by HAMILTON.



The pH sensors of the Easyferm Plus ARC type have been preconfigured by the INFORS HT device manufacturer. Replacement sensors must be configured before use.

Measurement system	Properties
METTLER analog	- Conventional pH sensor (potential measurement against reference) - Type: 405-DPAS-SC-K8S/120
METTLER digital	- Conventional pH sensor (potential measurement against reference) with built-in electronics - Type: InPro 3253i, ISM
HAMILTON digital	- Conventional pH sensor (potential measurement against reference) with built-in electronics - Type: Easyferm Plus ARC

Calibration

Generally speaking, the following applies: the calibration of a pH sensor is always performed BEFORE the sterilization.



The followings only applies to digital pH sensors:
If the pH sensor has already been calibrated externally, the bioreactor will use this data and there is no need for calibration process on the operating panel.

Mounting

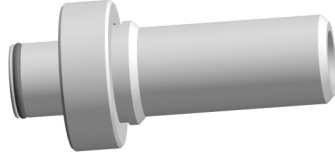
The pH sensor is mounted into an Ingold nozzle in the vessel. The sensor's manufacturer includes suitable insertion housing with the sensors.

2.13.2 Mounting and Connecting the pH Sensor

Insertion Housing

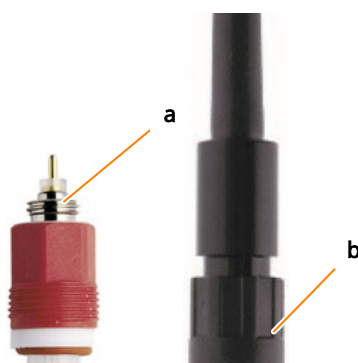
Insertion housings serve as sensor adapter and also protect the sensor from physical damage.

The pH sensors, which vary depending on the pH measurement system used, are supplied with the appropriate insertion housing for mounting in the Ingold nozzles.

	■ METTLER variant: The pH sensor is supplied with the appropriate insertion housing of the type InFit 761 with cable kink protection for mounting in the Ingold nozzle.
	■ HAMILTON variant: The pH sensor is supplied with the appropriate insertion housing of the type Flexifit U Bio for mounting in the Ingold nozzle. The pH sensor is equipped with an electrically conductive O-ring by the device manufacturer INFORS HT. The sensor's original O-rings/support rings have been removed. Replacement sensors must be equipped identically!

Sensor and Cable Connections

The sensor and cable connections of the pH sensors differ depending on the pH measurement system used.



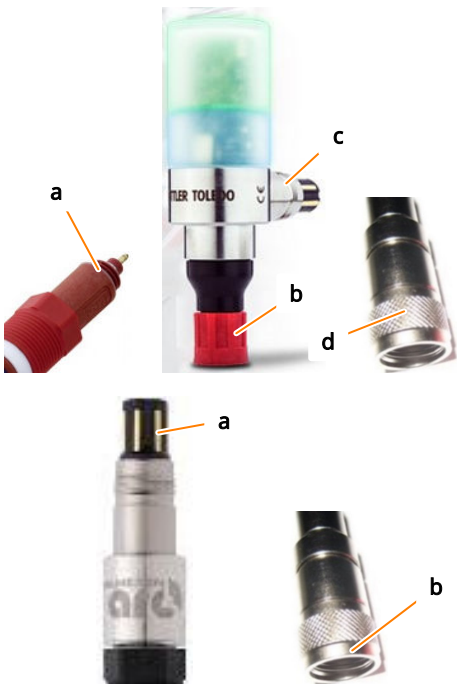
METTLER analog, type 405-DPAS-SCK8S/ 120

Sensor head connection (a)	K8S
Cable socket (b)	AK9

! NOTICE

The screening on the sensor cable may become damaged if it is kinked or twisted. This may lead to faulty measurements.

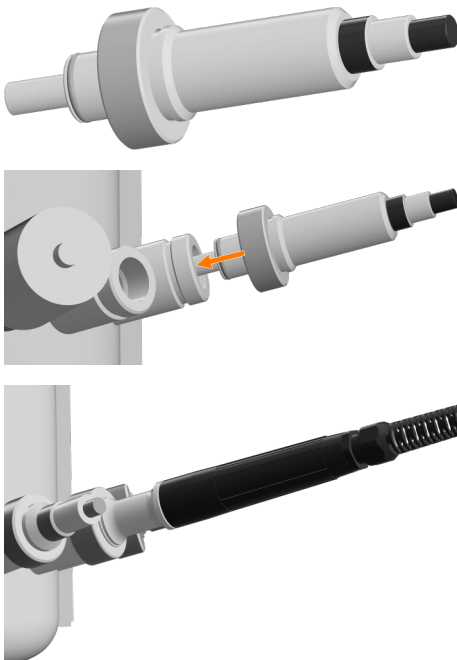
Basic Unit



METTLER digital, type InPro 3253i with head transmitter M100	
Sensor head connection (a)	ISM
Cable socket (d)	VP8
Head transmitter M100: push-in fitting for sensor (b)	
Head transmitter M100: push-in fitting for cable (c)	

HAMILTON digital, type Easyferm Plus ARC	
Sensor head connection (a)	VP8
Cable socket (b)	VP8

Mounting and Connecting the pH Sensor



1. Insert the sensor into the insertion housing according to the sensor manufacturer's guidelines.
2. Insert the sensor into the Ingold nozzle and tighten it manually using the coupling nut.
3. If necessary, mount the cable kink protection according to the manufacturer's specifications prior to connecting the cable.
4. Connect the sensor cable.

2.14 pO₂ Control

2.14.1 Setup and Function

Function

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

pO₂ increase	The concentration of oxygen dissolved in the medium (pO₂) can be increased using the following methods: ■ Increasing the rotation speed of the stirrer ■ Increasing the gas volume flow rate (air and/or oxygen) ■ Increasing the oxygen content in the Gasmix These approaches can also be combined.
pO₂ reduction	In anaerobic processes, the vessel can be gassed using nitrogen. This displaces the oxygen dissolved in the medium.

Measurement System

Depending on the variant selected, the measurement system for pO₂ is equipped and configured for analog or digital sensors manufactured by METTLER or digital sensors manufactured by HAMILTON.



Digital pO₂ sensors have been preconfigured by the INFORS HT device manufacturer. Replacement sensors must be configured before use.

Measurement system	Properties
METTLER analog	■ Traditional amperometric/polarographic pO₂ sensor ■ Type: InPro 6820 Polarographic pO₂ sensors must be polarized for commissioning or after they have been disconnected from the power source.
METTLER digital	■ pO₂ sensor with integrated opto electronics ■ Type: InPro6860i, ISM
HAMILTON digital	■ pO₂ sensor with integrated opto electronics ■ Type: VisiPerm RS485-ECS with ODO-Cap H3, straight Separately available: ODO-Cap H4, convex, more robust, slightly longer response time

Basic Unit

Measurement und Calibration

Generally speaking, the following applies: unlike e.g. pH measurements, which are calibrated to absolute measurements, 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 absolute concentration of dissolved oxygen in mmol/L may therefore vary at 100 % saturation, depending on the process.



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.

Mounting

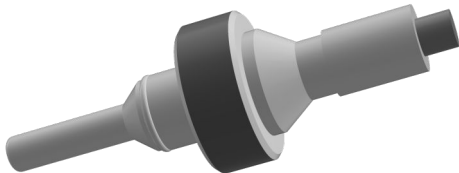
The pO₂ sensor is mounted into an Ingold nozzle in the vessel. Depending on the sensor type, it is mounted directly or with the included appropriate insertion housing from the sensor manufacturer.

2.14.2 Mounting and Connecting the pO₂ Sensor

Insertion Housing

Insertion housings serve as sensor adapter and also protect the sensor from physical damage.

The pO₂ sensors, which vary depending on the pO₂ measurement system used, are supplied with the appropriate insertion housings for mounting in the Ingold nozzles.



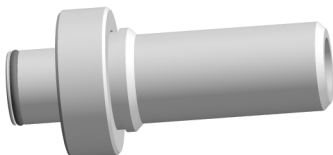
■ METTLER analog variant:

The pO₂ sensor is designed in such a way that it can be mounted directly in the Ingold nozzle, without insertion housing.



■ METTLER digital variant:

The pO₂ sensor is supplied with the appropriate insertion housing of the type InFit 761 with cable kink protection for mounting in the Ingold nozzle.



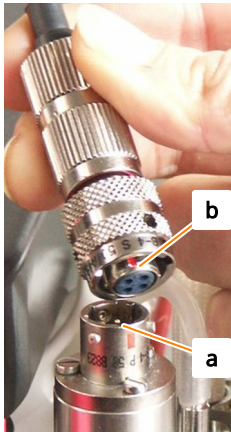
■ HAMILTON variant:

The pO₂ sensor is supplied with the appropriate insertion housing of the type Flexifit U Bio for mounting in the Ingold nozzle.

Basic Unit

Sensor and Cable Connections

The sensor and cable connections of the pO₂ sensors differ depending on the pO₂ measurement system used.



METTLER analog, type InPro 6820/25/080 (amperometric, polarographic)	
Sensor head connection (a)	T-82
Cable socket (b)	T-82

! NOTICE

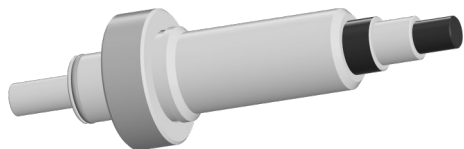
The screening on the sensor cable may become damaged if it is kinked or twisted. This may lead to faulty measurements.

METTLER digital, type InPro6860i	
Sensor head connection (a)	VP8
Cable socket (b)	VP8

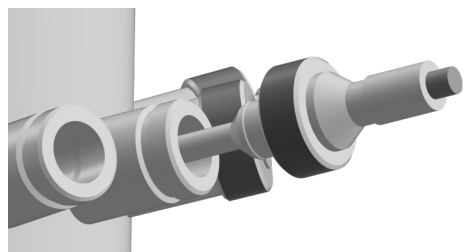
HAMILTON digital, type Visiferm RS485-ECS	
Sensor head connection (a)	VP8
Cable socket (b)	VP8

Basic Unit

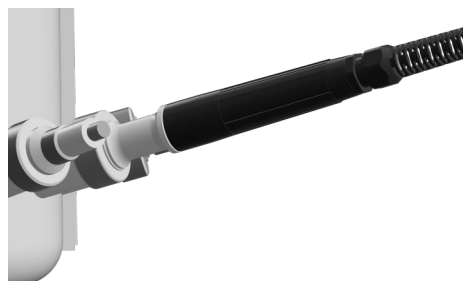
Mounting and Connecting the pO₂ Sensor



1. → If necessary, insert the sensor into the insertion housing according to the sensor manufacturer's guidelines.



2. → Insert the sensor into the Ingold nozzle and tighten it manually using the coupling nut.



3. → If necessary, mount the cable kink protection according to the manufacturer's specifications prior to connecting the cable.

4. → Connect the sensor cable.

2.15 Antifoam Control

2.15.1 Setup and Function

Overview

Two variants of the antifoam sensor (08.38.01) are available for detecting foam in the vessel.

Antifoam sensor with dosing needle (standard)	Antifoam sensor with ceramic tube
- Hose connector - Protective cap (2 x, non-sterilizable!) - Sensor head with cable connector (a) - Sensor shaft with transparent heat-shrink hose - Clamping adapter with hollow screw (a), threaded housing (b) and O-ring (c) - Septum collar with internal thread - Sensor tip (sharp!) For insulation, the sensor shaft is covered with a transparent heat-shrink hose.	- Sleeve with connector cap - Clamping adapter with hollow screw (a), threaded housing (b) and O-ring (c) - Sensor shaft with ceramic tube - O-ring For insulation, the sensor shaft is encased in a ceramic tube.

Basic Unit

The mounting depth of both antifoam sensors can be adjusted when the hollow screw is loosened. The antifoam sensor with a dosing needle cannot be sterilized in situ. It is supplied with a septum collar and must be autoclaved separately. The antifoam sensor with a ceramic tube is sterilized in situ along with the vessel.

Function

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 can cause a pressure build-up in the vessel. Several measures can be taken to prevent this. The most common method is to reduce the foam by adding antifoam agent. The antifoam agent is kept in a reagent bottle that is connected to the antifoam pump via a hose. When the antifoam sensor comes in contact with foam or liquid, the antifoam pump is activated. Depending on the sensor variant, the antifoam agent is added either directly via the antifoam sensor (variant with dosing needle) or separately using an addition utensil such as for example an inoculation needle or a push valve (variant with ceramic tube).

2.15.2 Preparing the Antifoam Sensor for Cultivation

General Information

The antifoam sensor (variant with dosing needle only) is autoclaved separately. Prior to autoclaving, the antifoam sensor should be set to the approximate mounting depth. It should be set too low rather than too high. Pulling out is possible even during cultivation and bears a significantly lower risk of contamination than pushing in.

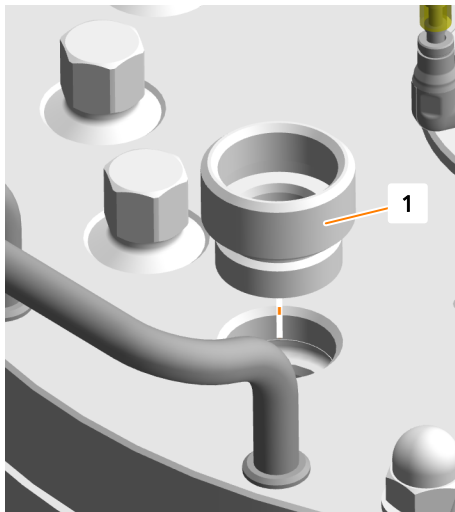
Setting the Mounting Depth

Note the following points before the setting:

! NOTICE

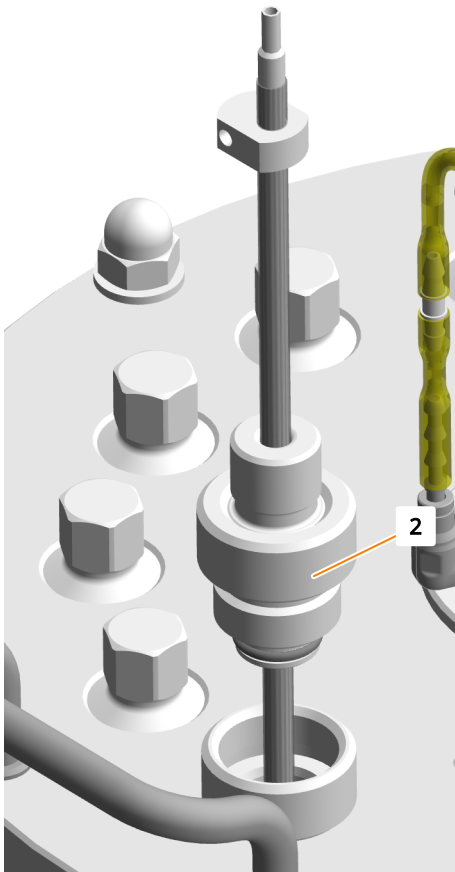
- The transparent insulation (heat-shrink hose) must be intact and the hollow screw of the clamping adapter may not touch the sensor head with connector, otherwise a continuous signal is generated.
- If the antifoam sensor is fixed too tightly in the clamping adapter, or if the mounting depth of the level sensor is changed with a tightened hollow screw, the heat-shrink hose may be damaged.

Proceed as follows:



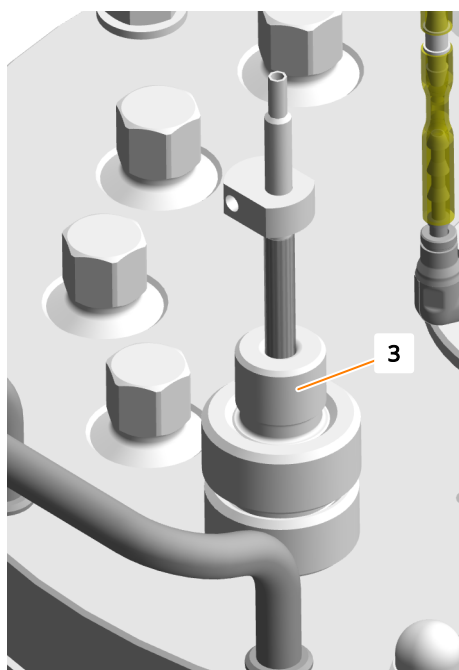
1. → Screw the septum collar (1) into the 19 mm port in the vessel top plate by hand.

2. → Remove the protective caps from the antifoam sensor.



3. → Screw the antifoam sensor on the clamping adapter (2) into the septum collar by hand.

Basic Unit



- 4.** ➤ Carefully loosen the hollow screw (3) by hand.
- 5.** ➤ Set the antifoam sensor to the desired mounting depth.
- 6.** ➤ Carefully tighten the hollow screw by hand.

Autoclaving

Proceed as follows:

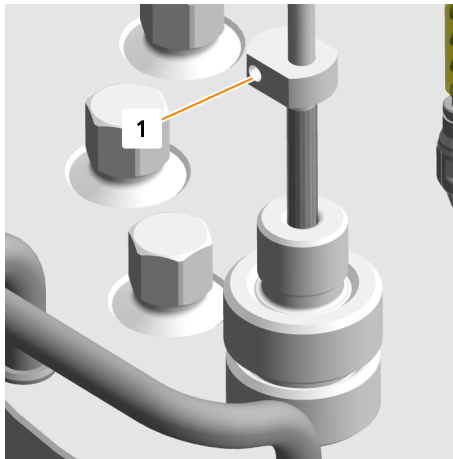
- 1.** ➤ Unscrew the antifoam sensor on the clamping adapter from the septum collar by hand.
- 2.** ➤ Unscrew the septum collar from the port by hand and put it aside for later use.
- 3.** ➤ Connect the hose of the reagent bottle for antifoam agent to the antifoam sensor and pinch it off with a hose clamp.
- 4.** ➤ Secure all hose connections with cable ties.
- 5.** ➤ Autoclave everything together in accordance with internal guidelines.

2.15.3 Mounting and Connecting the Antifoam Sensor

Variant with Dosing Needle

After autoclaving and after in situ sterilization, proceed with mounting the antifoam sensor as with an inoculation needle. For more information on this, see ➔ 'Using Inoculation Needles' on page 135.

Connect the sensor cable as follows:



- ➔ Insert the banana connector of the sensor cable into the connector (1) on the sensor head.

Variant with Ceramic Tube

To mount the antifoam sensor and to connect the sensor cable, follow the same procedure as for the level sensor variant with ceramic tube. For more information on this, see ➔ Chapter 3.9.2 'Mounting and Connecting the Level Sensor' on page 106.

Basic Unit

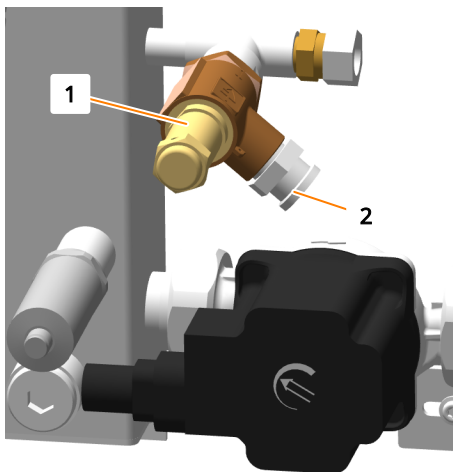
2.16 Safety Valves

2.16.1 General Information

All installed safety valves have been certified by the German Technical Inspection Association (TÜV). As with all safety-related components, they must be included in a maintenance plan; otherwise their operational safety cannot be guaranteed.

The provider must also subject the safety valves to regular checks in accordance with national regulations. For detailed information on the safety valves, refer to the corresponding manufacturer documentation.

2.16.2 Safety Valve Temperature Control Circuit



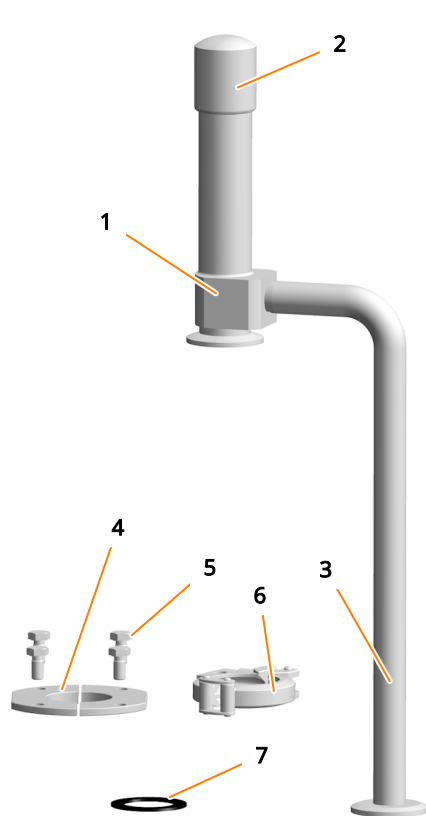
- 1 Safety valve 01.08.01
- 2 Tri-Clamp connection

The safety valve (1) in the temperature control circuit protects the vessel jacket against impermissible excess pressure. It is fitted and set by the device manufacturer. During normal operation of the device, the operator does not have to operate the valve.

The safety valve has a Tri-Clamp connection (2). The (provider's) pipe or hose line must be connected here for the safe discharge of possibly escaping steam or hot water in case of triggering (opening) of the safety valve. For details on discharge, see also ➔ Chapter 6.5 'Safety Valves' on page 151.

2.16.3 Safety Valve Vessel

Overview



- 1 Safety valve 08.08.01
- 2 Lifting device
- 3 Overpressure venting pipe
- 4 NA connect flange (2 x)
- 5 Hexagon head screw M8 (4 x)
- 6 Clamp (1 x)
- 7 Flat gasket (1 x)

The spring-loaded safety valve (1) with lifting device (2) protects the bioreactor vessel (not the vessel jacket!) against inadmissible overpressure. If the response pressure is exceeded, the safety valve opens and, depending on the process phase and vessel contents, allows steam, hot and/or contaminated liquid or gases to escape in a controlled manner via the overpressure venting pipe (3). Once the pressure has normalized, the valve closes automatically and restores the seal.

Safety valves for vessels with 20 L and 30 L working volume are mounted using four hexagon head screws (5) and two NA connect flanges (4). Safety valves for vessels with 10 L working volume are secured using a clamp (6). A flat gasket (7) ensures a tight seal for both variants.

The overpressure venting pipe has a Tri-Clamp connection. The (pro-viders's) pipe or hose line must be connected here to safely discharge any media that may escape. For details on discharge, see also ➔ Chapter 6.5 'Safety Valves' on page 151.

The safety valve must be mounted, intact and functional at all times, see also ➔ Chapter 10.3 'Maintenance Plan' on page 284.

2.16.4 Mounting the Vessel Safety Valve

The safety valve that protects the vessel against impermissible over-pressure must always be mounted.



WARNING

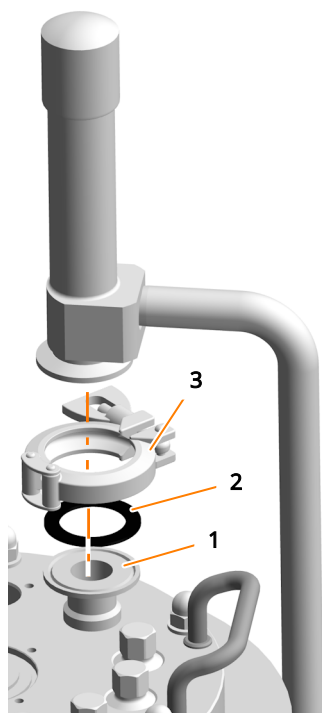
If the safety valve is not mounted, the pressure cannot escape in a controlled manner if the permissible pressure in the vessel is exceeded.

This can lead to pressurized components bursting or flying around.

For detailed information on the safety valve, see the separate documentation provided by the safety valve's manufacturer.

Basic Unit

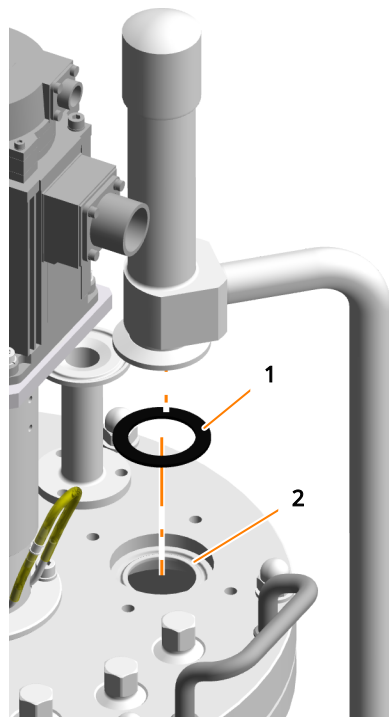
10 Liter WV Vessels



Proceed as follows:

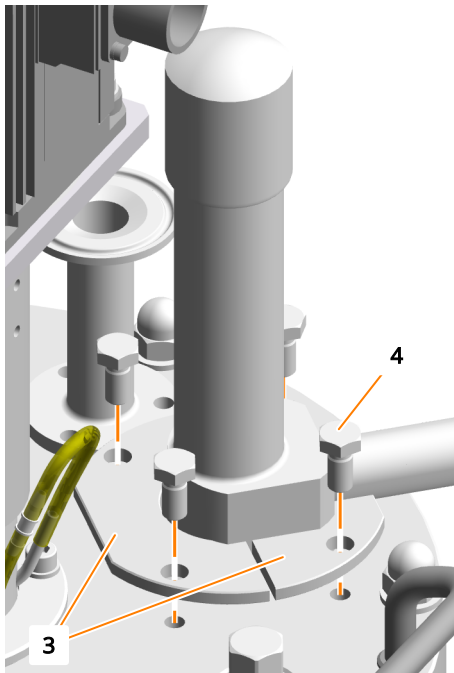
- ➔ Place the flat gasket (2) and safety valve flush on the Tri-Clamp port (1) on the vessel top plate and secure them with the clamp (3)

20 and 30 Liter WV Vessels



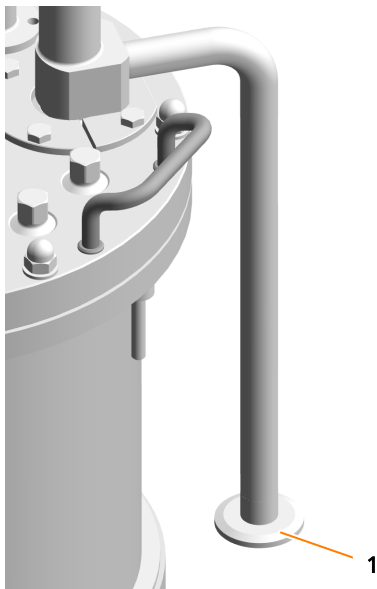
Proceed as follows:

1. ➔ Place the flat gasket (1) and safety valve flush in the Tri-Clamp connection (2) on the vessel top plate.



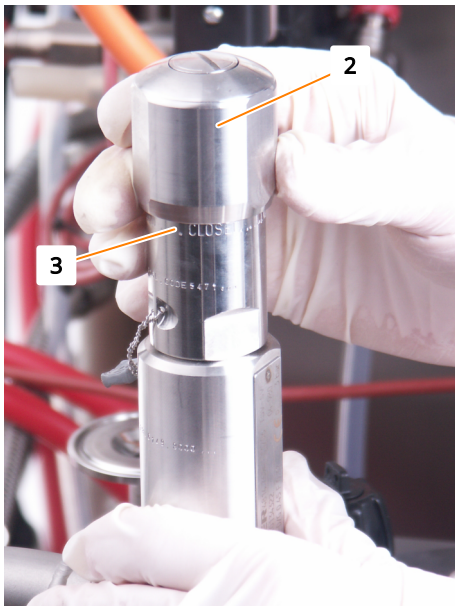
- 2.** → Position the two NA connect flanges (3) so that they fit precisely.
- 3.** → Fit the four hexagon head screws M8 (4) and tighten them crosswise with a wrench.

All Vessel Sizes



- 1.** → Connect the hose or piping (on the provider's side) to the open end of the overpressure venting pipe (1).

Basic Unit



- 2.** → Ensure that the safety valve is closed. If necessary, turn the cap (2) of the lifting device clockwise until the mechanical stop, until the engraving *CLOSED* (3) is visible.

2.17 Identification of the Device

2.17.1 Identification Plate

Position

The identification plate for identifying the device is located on the instrumentation cabinet and on the support.

Content

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

INFORS HT		
Designation:		
Type:		
S/N & Year:		
Mains:	VAC	Hz
Current:	A	
Made in Switzerland		
Infors AG, Rittergasse 27, CH-4103 Bottmingen		
		

- Manufacturer's name
- Designation = category of device
- Type = device type (name)
- S/N = serial number
- Year = year of manufacture
- Mains = nominal voltage and frequency
- Current = power consumption
- Manufacturer's address
- WEEE marking
- CE marking

2.17.2 Plant Identification Plate

The plant identification plate is affixed to the central column and contains the following information:

INFORS HT		
CH-4103 Bottmingen		
		CE 0036
Beschreibung Designation	Pilotbioreactor	
Typ Type	Techfors-S	
Seriennummer Serial number		
Baujahr Year of manufacture		
	Prozessraum Process area	Temperier syst. Temp. syst.
Druckbereich (bar) Pressure range (bar)		
Temperaturbereich (°C) Temperature range (°C)		
Prüfdatum Test date		

- Device manufacturer with address, CE marking
- Type of plant and device type (name), serial number and year of manufacture
- Min./max. pressure (barg) and temperature (°C) in process chamber and in temperature control system, as well as the test date.

Basic Unit

2.17.3 Vessel Identification Plate

The vessel identification plate is welded on the outside of the vessel. Depending on whether the vessel is manufactured in accordance with the Pressure Equipment Directive or the ASME Boiler and Pressure Vessel Code, the information on the vessel identification plate differs.

In any case, it contains the following information:

- Vessel manufacturer and address
- Permitted overpressure during operation
- Permitted operating temperature
- Year of manufacture of the vessel

The exact data can be found on the vessel identification plate and in the accompanying vessel documentation.

3 Options

3.1 Overview of the Options

The following options are available in addition to the standard device.

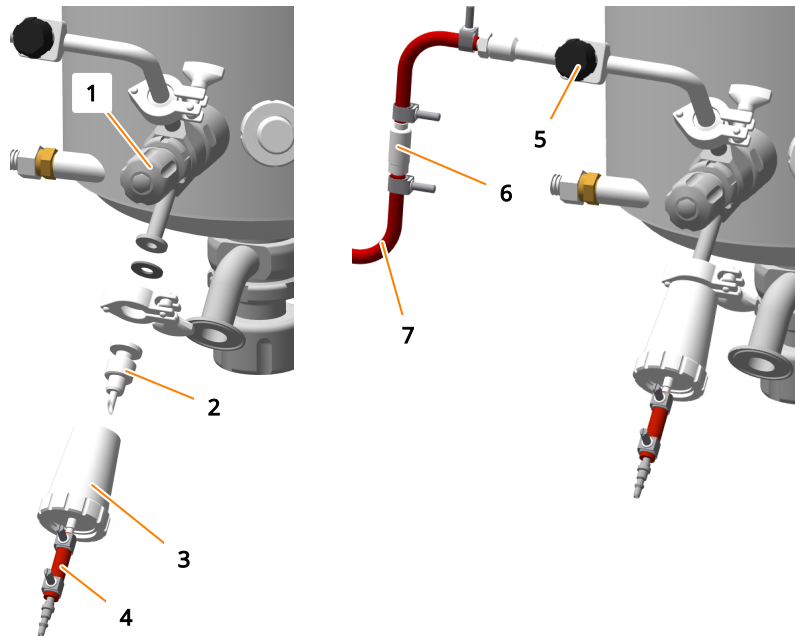
Designation	Additional information
Lateral sample valve	➔ Chapter 3.2, page 92
Resterilizable feed line	➔ Chapter 3.3, page 95
Resterilizable transfer line	➔ Chapter 3.4, page 99
Temperature control system with closed loop	➔ Chapter 12.3.4, page 294
Steam generator	➔ Chapter 3.5, page 102
Switch between tap water / chilled water	➔ Chapter 3.6, page 103
Recirculating chiller	➔ Chapter 3.7, page 103
Vessel top plate lifting device	➔ Chapter 3.8, page 104
Level detection	➔ Chapter 3.9, page 105
Pressure control	➔ Chapter 3.11, page 111
Weight measurement	➔ Chapter 3.12, page 114
Turbidity measurement	➔ Chapter 3.13, page 115
Exit gas analysis	➔ Chapter 3.14, page 117
Foam detection exit gas (High Foam)	➔ Chapter 3.10, page 109
pCO ₂ measurement	➔ Chapter 3.15, page 119
Redox measurement	➔ Chapter 3.16, page 120
Permissive measurement	➔ Chapter 3.17, page 121
Pump(s)	➔ Chapter 3.18, page 121
Mobile CIP unit TechCIP	➔ Chapter 3.21, page 123
Base tray with drain valve	➔ Chapter 3.20, page 122

Options

3.2 Sample Valve

3.2.1 Setup and Function

Overview

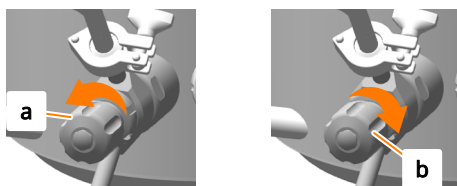


- 1 Sample valve 17.13.01
- 2 Needle
- 3 Steam trap
- 4 Condensate hose

- 5 Valve 17.16.01(clean steam)
- 6 Rapid coupling
- 7 Clean steam hose

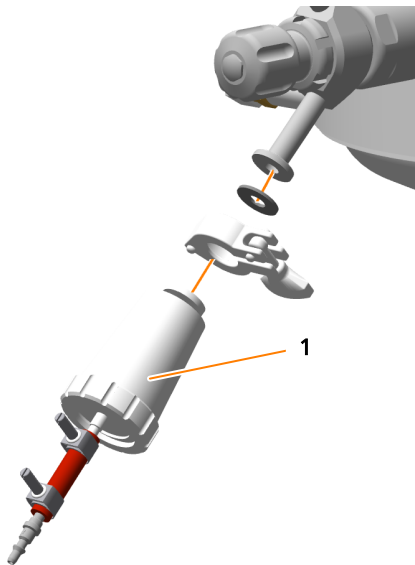
The manual sample valve (1) is screwed into the straight Ingold nozzle on the vessel. The steam supply for sterilization is controlled manually via valve 17.16.01 (5). The valve is connected to the clean steam line (pressure hose, 7) on the device via rapid coupling with automatic shut-off (6). The steam trap (3) with needle (2) is pre-mounted to the condensate outlet of the sample valve with flat gasket and clamp. A pressure hose with a hose nozzle (4) at the outlet of the steam trap is used to connect to the device's condensate collection line.

Opening/Closing the Valve



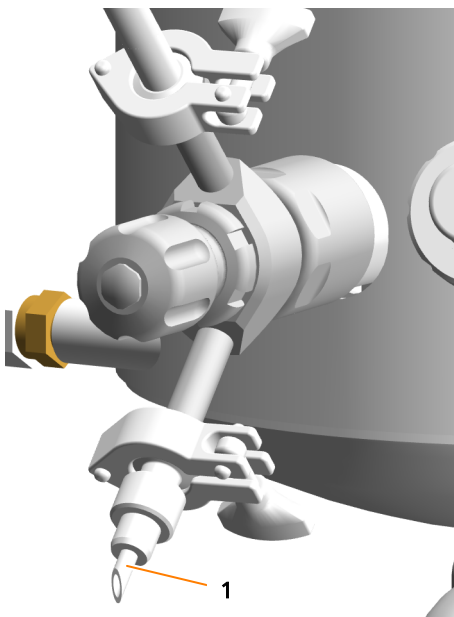
- OPENING: Turn the valve handle counter-clockwise (a)
- CLOSING: Turn the valve handle clockwise (b)

Sterilization



The steam trap (1) with screwed in needle must be connected to the sample valve for sterilization. To drain the condensate, the pressure hose must be connected to the device's condensate collection line. Sterilization is started via the touch screen software, see ➔ Chapter 8.9.5 'SIP Sample Valve – Sterilization Sample Valve' on page 252.

Sampling



For sampling, the steam trap is unscrewed from the needle (1).

Options

3.2.2 Using the Sample Valve



CAUTION

The sample valve gets very hot during sterilization. Depending on the cultivation temperature, it can also get hot during operation. This poses a risk of burns when touching the sample valve.

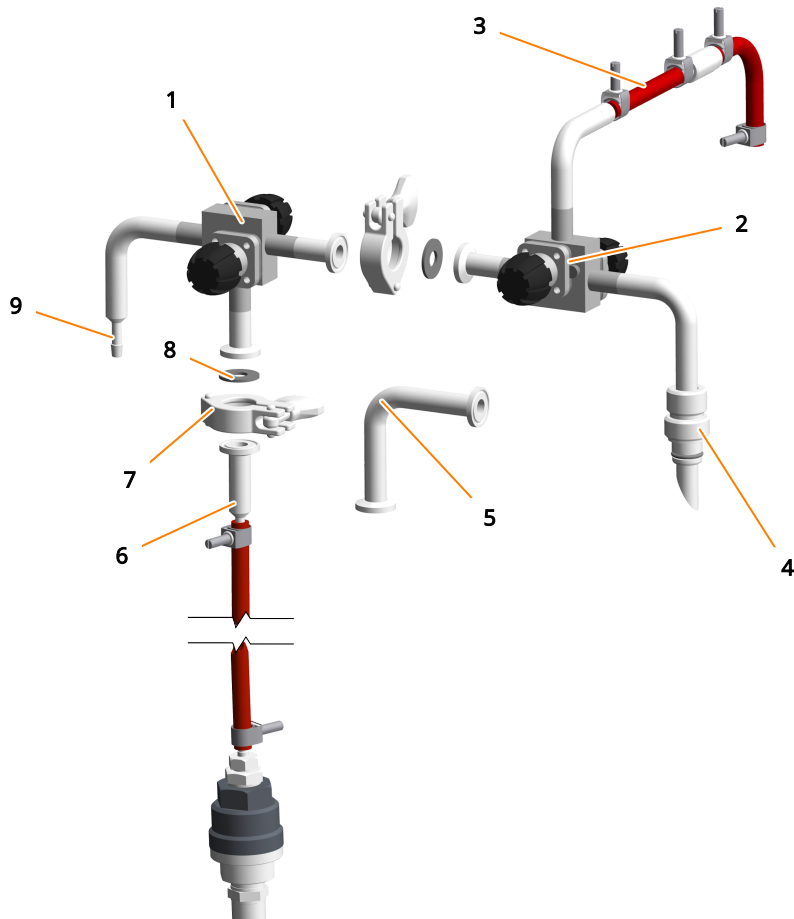
- After sterilization, let the sample valve cool down.
- Wear heat-resistant protective gloves when operating the sample valve.

To take a sample, proceed as follows:

1. Have the sample bottle/container ready.
2. Unscrew the steam trap counter-clockwise from the needle.
 - ➡ The needle is now visible.
3. Place the sample bottle under the needle. Or, if necessary, use the needle to pierce the septum on the sample bottle.
4. Open the sample valve: turn the valve handle counter-clockwise.
5. Fill the sample bottle with the required amount of liquid.
6. Close the sample valve: turn the valve handle clockwise.
7. If necessary, pull the needle out from the septum in the sample bottle.
8. Screw the steam trap clockwise to the needle.

3.3 Resterilizable Feed Line

3.3.1 Setup and Function



- | | | | |
|---|---|---|--|
| 1 | Block valve 13.16.01 / 13.16.03 (vessel/steam) | 5 | Condensate elbow |
| 2 | Block valve 13.16.02 / 13.16.04 (condensate/reagent bottle) | 6 | Condensate line with steam trap |
| 3 | Clean steam line (pressure hose with rapid coupling) | 7 | Clamp (2 x) |
| 4 | Connection nozzle with O-ring for vessel top plate (19 mm port) | 8 | Flat gasket (2 x) |
| | | 9 | Hose nozzle (6 mm) for reagent bottle connection |

The resterilizable feed line enables a sterile connection between the bioreactor and a container, e.g. a reagent bottle for adding sterile liquid, e.g. nutrient solution, etc.

Before sterile liquid can be added to the vessel via the resterilizable feed line, the various components such as block valves (also known as sterile cross) and the container, e.g. the reagent bottle, must be prepared appropriately:

Options

- Sterilization in the autoclave: the block valve *13.16.02* / *13.16.04* and the container/reagent bottle are sterilized separately in the autoclave.
- Full sterilization: the block valve *13.16.01* / *13.16.03* is mounted and sterilized in situ together with the vessel.
- Sterilization of the feed line: the block valve *13.16.02* / *13.16.04* is mounted, and the feed line is sterilized.

3.3.2 Preparing the Resterilizable Feed Line for Cultivation

Safety Notes



CAUTION

The components of the feed line get very hot during sterilization.

- After sterilization, let the feed line cool down.
- Wear heat-resistant protective gloves when working on the hot feed line.

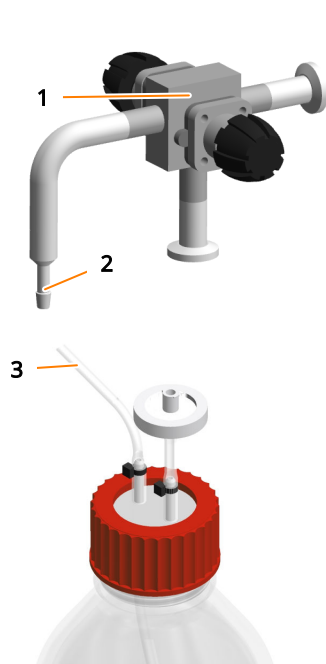
Autoclaving the Block Valve *13.16.02* / *13.16.04* and Reagent Bottle

Proceed as follows:

1. ➞ Prepare/equip the reagent bottle for sterilization in the autoclave (➞ Chapter 4.4.2 'Preparing Reagent Bottles for Cultivation' on page 127).

Choose hose lengths in such a way that the hoses reach from the reagent bottle via the pump to the block valve *13.16.02* / *13.16.04* without tension or kinks when the feed line is mounted.

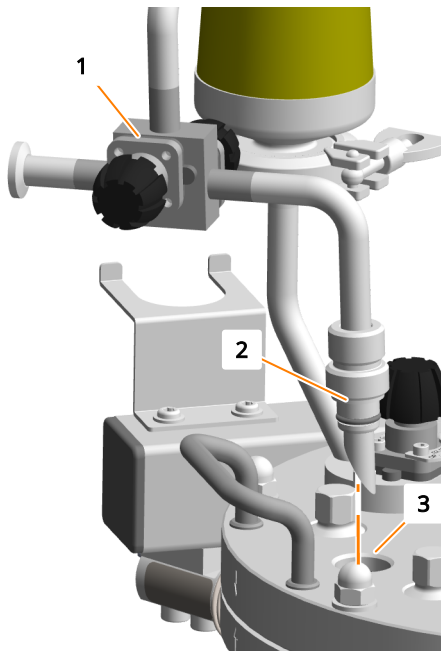
2. ➞ Depending on the application: fill the reagent bottle before autoclaving or fill the reagent bottle under sterile conditions after autoclaving.



3. → Connect the hose line (3) of the reagent bottle to the hose nozzle (2) on block valve 13.16.02 / 13.16.04 (1) and secure it with a cable tie.
4. → Close both valves.
5. → Autoclave everything together in accordance with internal guidelines.

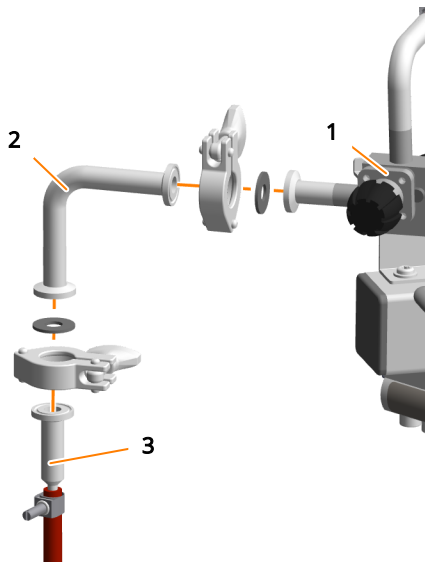
Sterilizing Block Valve 13.16.01 / 13.16.03 in situ

Proceed as follows:



1. → Insert the connection nozzle (2) (with O-ring) of the block valve 13.16.01 / 13.16.03 (1) into a 19 mm port (3) in the vessel top plate and tighten by hand.

Options



2. → Connect the condensate elbow (2) to block valve *13.16.01 / 13.16.03* (1) with flat gasket and clamp.
3. → Connect the condensate line (3) to the condensate elbow with flat gasket and clamp.
4. → Execute a full sterilization.

For a detailed description of the sterilization process, see
→ Chapter 8.9.3 'Full Sterilization' on page 245.

Sterilizing the Feed Line

Once the full sterilization and the sterilization in the autoclave are completed and the components have cooled down:

1. → Remove the condensate elbow from the block valve *13.16.01 / 13.16.03*.

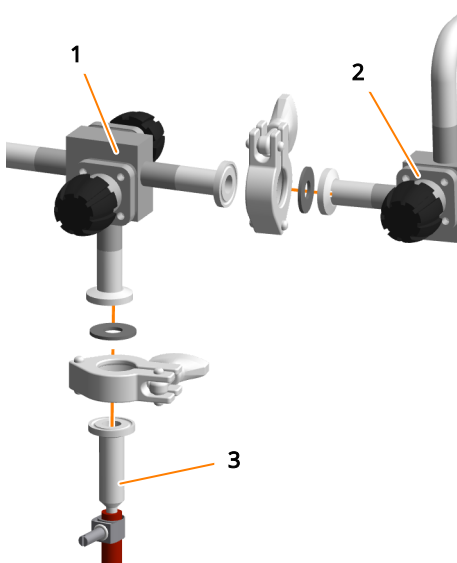


Both valves remain closed and the hose line on the reagent bottle remains disconnected!

2. → Remove the condensate line from the condensate elbow.
3. → Connect the block valve *13.16.02 / 13.16.04* (1) to block valve *13.16.01 / 13.16.03* (2) with flat gasket and clamp.
4. → Connect the condensate line (3) to block valve *13.16.02 / 13.16.04* with flat gasket and clamp.
5. → Connect the reagent bottle to the pump (→ Chapter 2.5.3 'Inserting the Pump Hoses' on page 30).
6. → Sterilize the feed line.

For a detailed description of the sterilization process, see
→ Chapter 8.9.6 'SIP Feed Line – Sterilization Feed Line' on page 253.

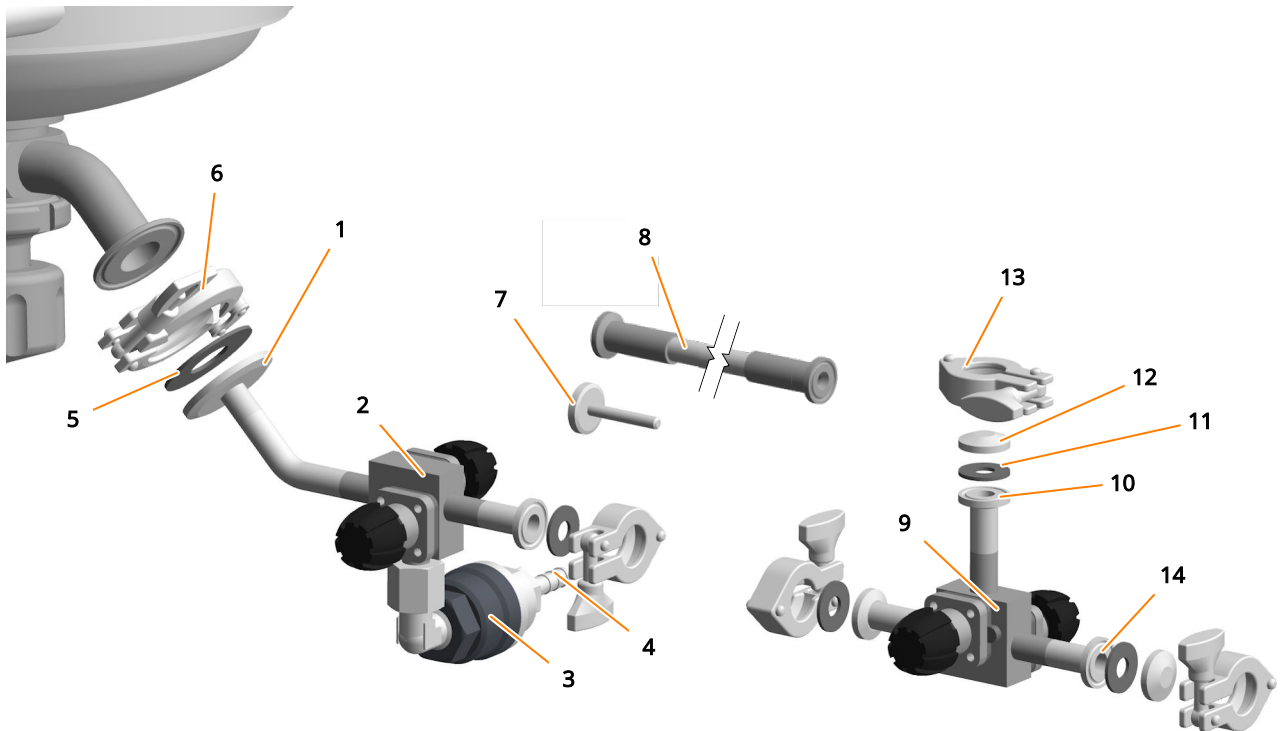
➡ After finishing the sterilization, all components of the resterilizable feed line are sterile and ready for cultivation.



3.4 Resterilizable Transfer Line

3.4.1 Setup and Function

Overview



- | | |
|---|---|
| 1 Harvest valve connection | 9 Block valve 19.16.03 / 19.16.04 (steam/ext. transfer unit) |
| 2 Block valve 19.16.01 / 19.16.02 (vessel/condensate) | 10 Connection DN8 for steam (on provider's side) |
| 3 Steam trap | 11 Flat gasket (2 x) |
| 4 Hose nozzle 9 mm for condensate drain hose (on provider's side) | 12 Blind cap (2 x) |
| 5 Flat gasket DN1" (1 x) | 13 Clamp |
| 6 Clamp DN10 (1 x) | 14 Connection DN8 for external transfer unit (container, tank, etc. on provider's side) |
| 7 Blind cap with handle (1 x) | |
| 8 Transfer hose (length = 5 m) | |

Options

Function

The reterilizable transfer line allows a sterile connection between the bioreactor and a tank, container or other bioreactor on the provider's side. The contents of the bioreactor are transferred sterily to this external transfer unit via the transfer line.

Preparation and use of the reterilizable transfer line involves the following steps:

- Sterilization of the block valve *19.16.01 / 19.16.02*
- Sterilization of the connected transfer line



Whether and how the sterility of the interface between the block valve *19.16.03 / 19.16.04* and the external transfer unit is established is defined by the user and is not described in this operating manual.

- Execution of the transfer process

3.4.2 Preparing the Resterilizable Transfer Line for Cultivation

Safety Notes



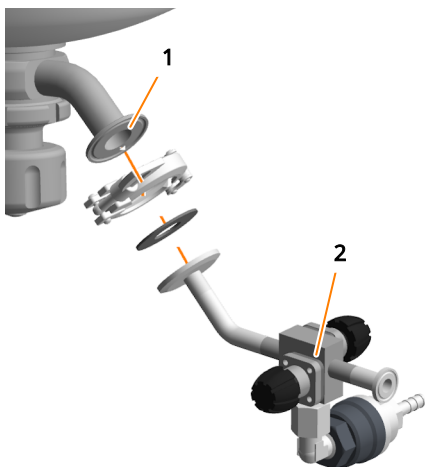
CAUTION

The components of the transfer line get very hot during sterilization.

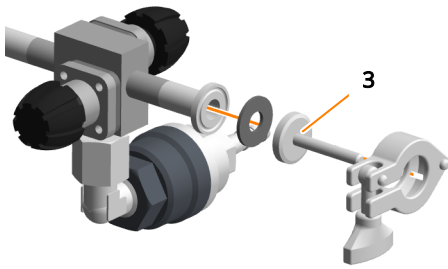
- After sterilization, let the transfer line cool down.
- Wear heat-resistant protective gloves when working on the hot transfer line.

Sterilizing the Block Valve *19.16.01 / 19.16.02*

Proceed as follows:



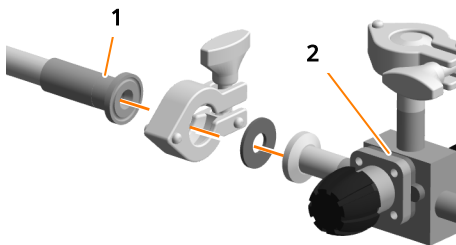
1. → Connect block valve *19.16.01 / 19.16.02* (2) with flat gasket and clamp to the connection flange of the harvest valve *05.12.01* (1).



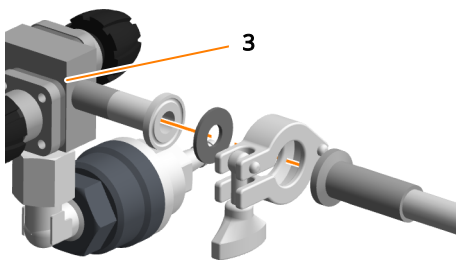
2. → Connect the blind cap (3) with flat gasket and clamp to the block valve.
3. → Sterilize the block valve, see ➔ Chapter 8.9.7 'SIP Transfer Block Valve – Sterilization Transfer Block Valve' on page 256.

Sterilizing the Transfer Line

Proceed as follows:



1. → Connect the transfer hose (1) with flat gasket and clamp to block valve 19.16.03 / 19.16.04 (2) of the external transfer unit.
2. → Remove the blind cap from block valve 19.16.01 / 19.16.02.



3. → Connect the other end of the transfer hose with flat gasket and clamp to block valve 19.16.01 / 19.16.02 (3).
4. → Sterilize the transfer line, see ➔ Chapter 8.9.8 'SIP Transfer Line – Sterilization Transfer Line' on page 258.

Transfer

Once sterilization is complete, all components of the transfer line are sterile and ready for transfer, see ➔ Chapter 8.9.11 'Transfer' on page 266.

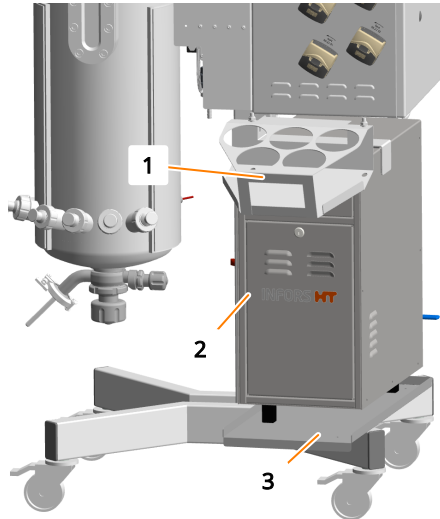


Whether and how the sterility of the interface between the block valve 19.16.03/19.16.04 and the external transfer unit is established is defined by the user and is not described in this operating manual.

Options

3.5 Steam Generator

Overview



- 1 Holder for 5 x 500 mL reagent bottles
- 2 Steam generator
- 3 Tray

The steam generator (2) is integrated into the bioreactor system including a tray (3) and the holder (1) for reagent bottles.

Function

The steam generator is used for the sterilization of the vessel and peripheral devices and is also used for heating, depending on the temperature control system chosen.

The steam generator is available in two variants with different output. The variant used depends on the vessel volume:

- 6 kW: for vessels with 10 L working volume
- 10 kW: for vessels with 20 L und 30 L working volume

Requirements for the Mains Connection

The steam generator has a separate mains connection.

To avoid dangers due to electrical current, the in-house mains connection must meet the following requirements:

- Tri-phase, constant power supply
- In the building, the power supply must be protected using a fault current protection switch (RCD – Residual Current Device).

Refer to the technical data for the electric connection values, ➔ Further information on page 304.



Detailed information about the steam generator can be found in the separate documentation provided by the steam generator manufacturer. Read the manual before commissioning and follow the instructions.

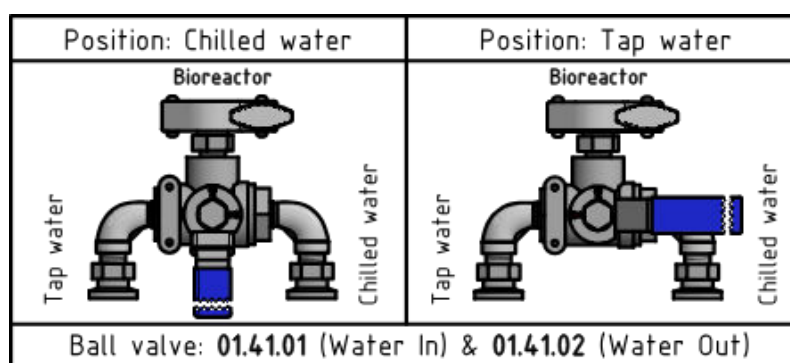
3.6 Switching between Tap Water / Chilled Water

If a cooling water system provided by the operator is available or a recirculating chiller, which is available separately, is used, 3-way ball valves 01.41.01 (water inlet) and 01.41.02 (water outlet) can be used to switch between tap water and chilled water.

! NOTICE

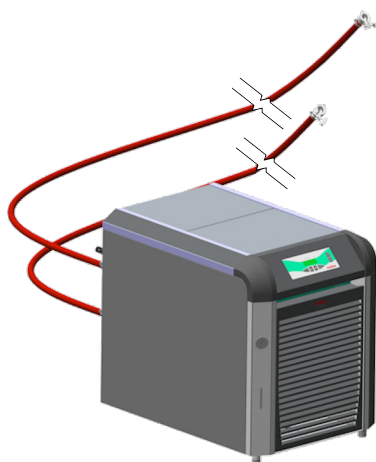
An incorrect position of the ball valves (tap water IN open / chilled water OUT open) for tap water / chilled water can lead to overfilling or overflowing of the cooling circuit!

A sticker that indicates the different valve positions of the 3-way ball valves is placed on the rear of the instrumentation cabinet.



Suitable instructions for the process are also displayed in various dialog boxes in the touch screen software.

3.7 Recirculating Chiller



The device can also be supplied with chilled water via separate recirculating chiller. In this case, as when using a cooling water system on the house side, the optional 3-way ball valves 01.41.01 and 01.41.02 for switching between tap water and chilled water are required and automatically integrated into the device.

Refer to the technical data for the electric connection values, see ➔ Chapter 12.4.2, page 304.



Detailed information about the recirculating chiller can be found in the separate documentation provided by the chiller manufacturer. Read the manual before commissioning and follow the instructions.

Options

3.8 Lifting Device for Vessel Top Plate



A lifting device is available for lifting and lowering the vessel top plate. This device is mounted on the central column of the basic unit and operated using a rope winch. We recommend using a lifting device in particular for vessels with 20 L and 30 L working volume.

All information regarding function, operation, technical data and safety is available in the separate operating manual.

3.9 Level Detection

3.9.1 Setup and Function

Overview

Two variants of the level sensor (08.38.02) are available for detecting liquid in the vessel.

Level sensor with heat-shrink hose	Level sensor with ceramic tube
1 Cable connection sensor head 2 Protective cap (2 x, non-sterilizable!) 3 Clamping adapter with hollow screw (a), threaded housing (b) and O-ring 4 Sensor shaft with transparent heat-shrink hose 5 Septum collar with internal thread 6 Sensor tip (sharp!) For insulation, the sensor shaft is covered with a transparent heat-shrink hose.	1 Sleeve with connector cap 2 Clamping adapter with hollow screw (a), threaded housing (b) and O-ring 3 Sensor shaft with ceramic tube 4 O-ring For insulation, the sensor shaft is encased in a ceramic tube.

The mounting depth of the level sensors can be adjusted when the hollow screw is loosened. The level sensors are sterilized in situ along with the vessel.

Options



The level sensor variant with heat-shrink hose is supplied with a septum collar. This allows the level sensor to be autoclaved separately, if needed. To do this, the port in the vessel top plate must be equipped with a septum and the septum collar, and after in situ sterilization, it must be pierced with the level sensor like with an inoculation needle.

Function

The level sensor detects liquid in the vessel. As soon as this happens, the measurement display shows "100".

This signal can be used as required for level control in the vessel in order to keep the working volume in the vessel constant. This can be done, for example, by using a simple cascade to control the feed pump or an optional pump that pumps liquid either into or out of the vessel. Special configurations are possible on request.

3.9.2 Mounting and Connecting the Level Sensor

General Information

The mounting depth of the level sensor (both variants) should be set neither too high nor too low. To keep it sterile, it must not be pushed deeper into the vessel after sterilization. Pulling out, however, is possible even during cultivation and bears a significantly lower risk of contamination.

Variant with Heat-Shrink Hose

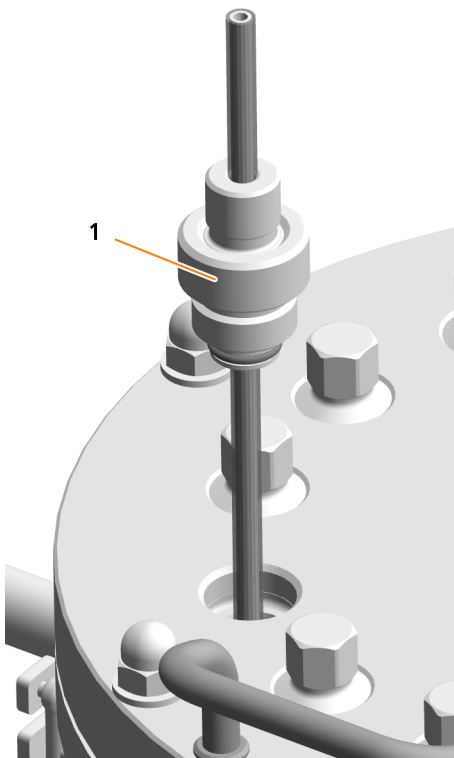
Note the following points before mounting:

! NOTICE

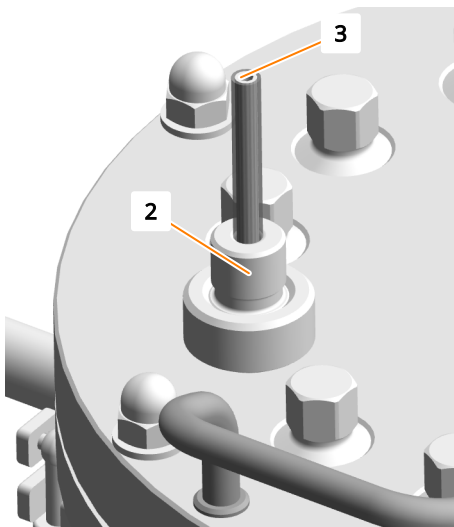
- The transparent insulation (heat-shrink hose) must be intact, otherwise a continuous signal is generated.
- If the level sensor is fixed too tightly in the clamping adapter, or if the mounting depth of the level sensor is changed with a tightened hollow screw, the heat-shrink hose may be damaged.

Proceed as follows:

1. ➔ Remove the protective caps from the level sensor.
2. ➔ Screw the level sensor on the clamping adapter (1) into the 19 mm port in the vessel top plate by hand.



3. ➔ Carefully loosen the hollow screw (2) by hand.
4. ➔ Set the level sensor to the desired mounting depth.
5. ➔ Carefully tighten the hollow screw by hand.
6. ➔ Insert the banana connector of the sensor cable into the connector (3) of the sensor.



Variant with Ceramic Tube

Note the following points before mounting:

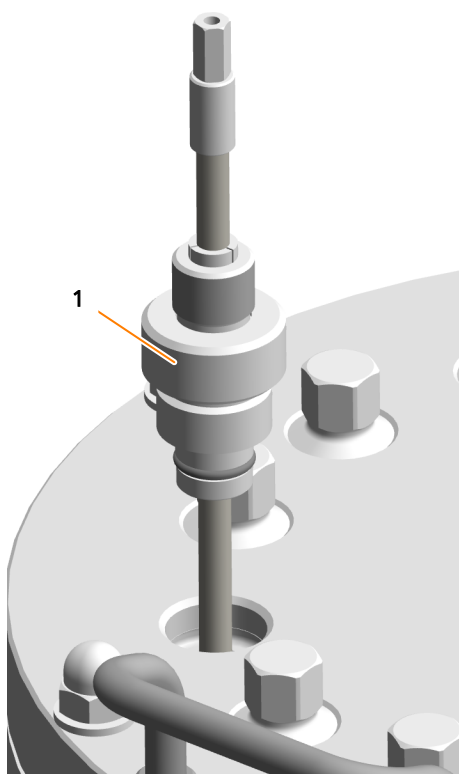
Options

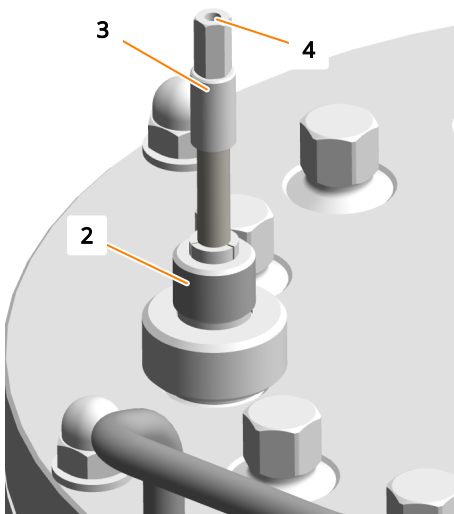
! NOTICE

- If the level sensor is fixed too tightly in the clamping adapter, or if the mounting depth of the level sensor is changed with a tightened hollow screw, the ceramic insulation of the sensor may be damaged.
- Impacts against the ceramic tube or any other use of force as well as dropping the sensor can cause the ceramic tube to break.

Proceed as follows:

1. → Carefully screw the level sensor on the clamping adapter (1) into the 19 mm port in the vessel top plate by hand.



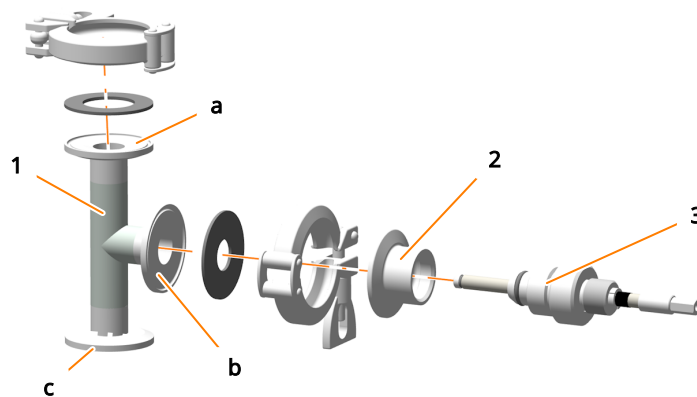


2. Carefully loosen the hollow screw (2) by hand.
3. Adjust the level sensor to the desired mounting depth. Ensure that the sleeve (3) does not touch the hollow screw.
4. Carefully tighten the hollow screw by hand.
5. Insert the banana connector of the sensor cable into the connector cap (4).

3.10 Foam Detection Exit Gas

3.10.1 Setup and Function

Overview



- 1 T-piece with Tri-Clamp connections to (a) exit gas cooler, (b) foam sensor and (c) exit gas flange vessel top plate
- 2 Sensor adapter
- 3 Foam sensor 03.38.01

For bioprocesses that are prone to excessive foaming, conventional antifoam control within the vessel is often insufficient. To prevent foam from rising too high and entering the exit gas stream, a foam sensor can be integrated between the vessel top plate and the exit gas cooler. This is achieved using a sensor adapter with internal thread (2) and a T-piece (1) with Tri-Clamp connections. The foam sensor (3) is screwed into the adapter and inserted into the lateral port of the T-piece. A flat gasket and clamp ensure a tight seal. The foam sensor remains installed during normal operation.

Options

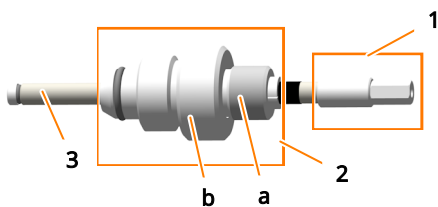


The mounting depth of the foam sensor is set correctly ex-factory and should not be adjusted.

Function

If the foam sensor detects foam during cultivation, a signal is generated. Parameter *High Foam* indicates "100" and at the same time the alarm *High foam detected* is triggered. This switches off gassing. All parameters relevant for gassing remain locked for operation. The operating lock is only released, if no more foam is detected. There is no automatic parameter activation.

Foam Sensor



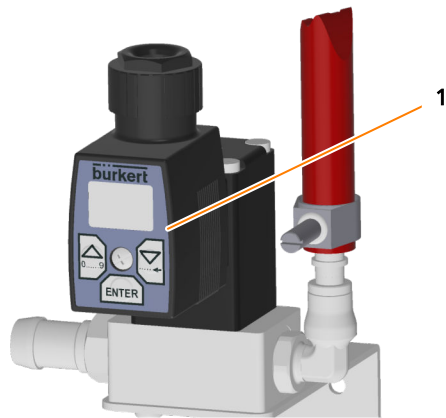
- 1 Sleeve with connector cap
- 2 Clamping adapter with hollow screw (a) and threaded housing (b) with thread
- 3 Sensor shaft with ceramic tube

The foam sensor is equipped with a clamping adapter (2) for mounting in the sensor adapter and cap (1) for cable connection. For insulation, the sensor shaft is encased in a ceramic tube.

3.11 Pressure Control

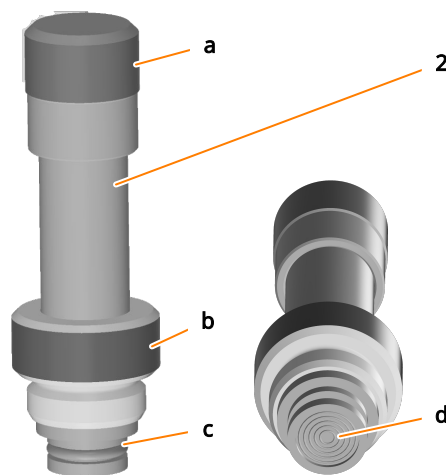
3.11.1 Setup and Function

Overview



- 1 Pressure control valve 03.11.01 (*exit gas*)
- 2 Pressure sensor 08.31.01
- a Steel cap
- b Hollow screw
- c O-ring
- d Steel membrane

The pressure sensor (2) is equipped with an O-ring (c) and a hollow screw (b) for mounting in a 19 mm port in the vessel top plate. The sensor head connection is protected with a steel cap (a). A protective cap (not pictured) protects the sensitive steel membrane (d) of the sensor from damage. The pressure control valve (1) is integrated in the exit gas line.



Function

The pressure in the vessel is measured using a pressure sensor (piezo-resistive pressure transmitter) and regulated with a pressure control valve in the exit gas line. The measurements and the setpoint are displayed in the *Pressure* parameter in the touch screen software.

Maintenance

The pressure sensor is generally maintenance free. The re-calibration cycle depends on the conditions under which it is used. However, we do recommend annual re-calibration by the sensor's manufacturer.

Options

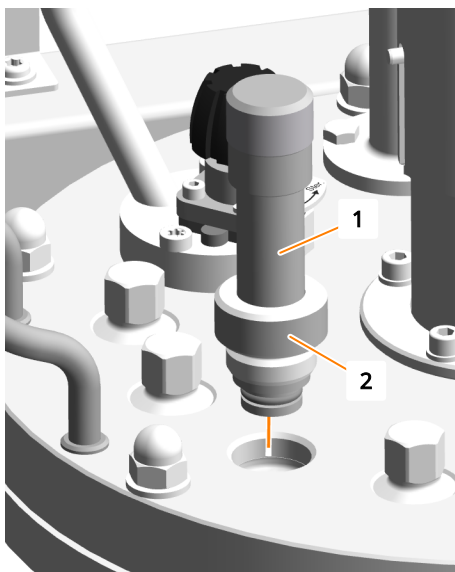
3.11.2 Mounting and Connecting the Pressure Sensor

The pressure sensor must be mounted and connected prior to sterilization. To do so, proceed as follows:

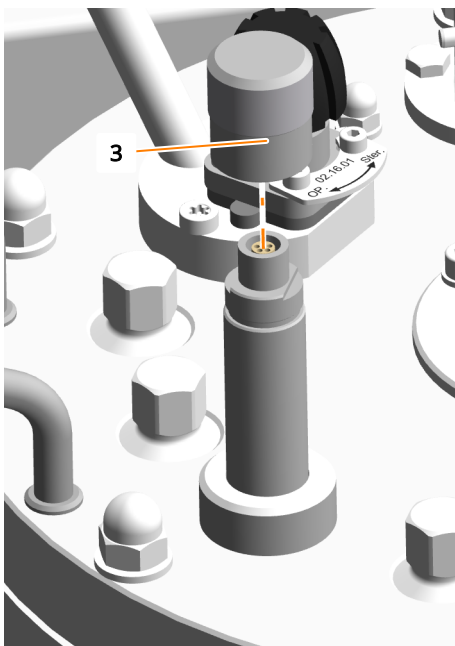
1. → Remove the protective cap from the steel membrane of the pressure sensor.

! NOTICE

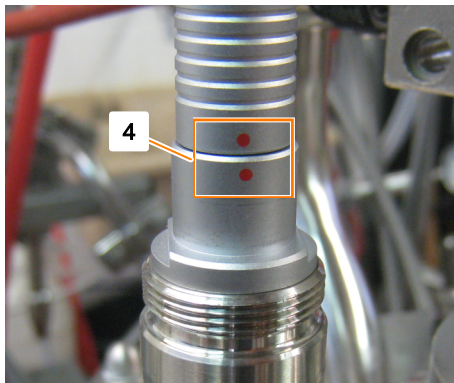
The steel membrane is very delicate and can be damaged by friction or knocks from hard objects.



2. → Carefully insert the pressure sensor (1) with O-ring into the 19 mm port and tighten the hollow screw (2) by hand.



3. → Unscrew the steel cap (3) from the sensor head connection by hand.

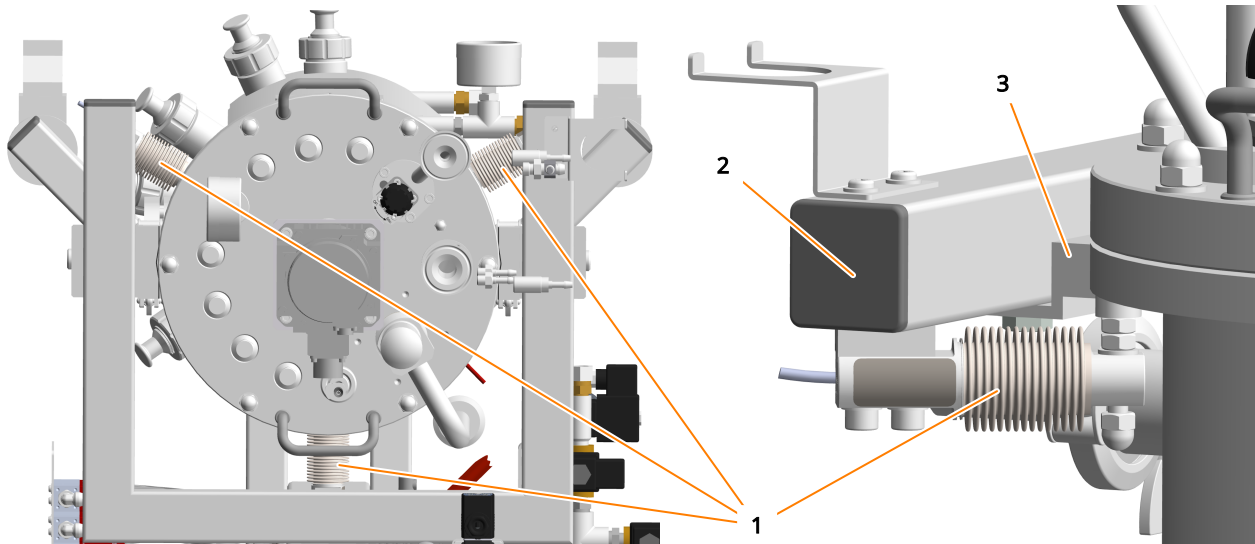


- 4.** → Connect the sensor cable. In doing so, align the red markings (4) on the cable plug and on the sensor head connection.

Options

3.12 Weight Measurement Vessel – Load Cell

Setup and Function



- 1 Load cell (3 x)
- 2 Frame
- 3 Transportation safety device

The weight measurement system of the vessel consists of three load cells (1) integrated in the frame (2) of the vessel stand. The load cells are distributed evenly and placed on the underside of the frame. Bolts on the underside of the vessel flange are used as load application points of the vessel. To protect the load cells from damage during transport, a transportation safety device (3) is installed, see ➔ Chapter 5.2 'Transportation Safety Device' on page 145.

Measurements are output in the *Weight* parameter in the touch screen software. The weight display can also be tared there.

3.13 Turbidity Measurement

3.13.1 Setup and Function

Function

The ASD25-N measurement system from the manufacturer Optek is used to determine the turbidity of the culture. The turbidity can be used to draw conclusions regarding the biomass concentration in the culture.

The system consists of a sensor (single channel light absorption) with an integrated transmitter.

The ASD25-N sensors supply a non-linearized turbidity measurement for the culture. This can be linearized manually using the soft sensor in eve®, for example, in order to determine correlation with factors such as the biomass concentration or optical density.

Depending on the cell density, sensors with different path lengths are available:

- OPL01: for very high cell densities
- OPL05: for higher cell densities
- OPL10: for lower cell densities



If the temperature of the sensor increases to above 65 °C during operation in the medium, an automatic switch off takes place. Once the medium has cooled down, the measurement is continued automatically.

Calibration

The turbidity sensors are pre-calibrated ex-factory. Inserts are available for reference measurement.

Due to the different light absorption of different media, zero point calibration of the turbidity sensor should be performed before each cultivation process. This can be done either before or after in situ sterilization, depending on the application in question.

Mounting

The turbidity sensor is mounted into an Ingold nozzle in the vessel.

Options

3.13.2 Mounting and Connecting the Turbidity Sensor

Due to the position, length and angle of the Ingold nozzle on the vessel, the mounting position of the turbidity sensor is pre-defined. It prevents a gas connection at the port on the top, and medium can drain from sapphire windows. This position also prevents contact with other built-in-parts in the vessel.

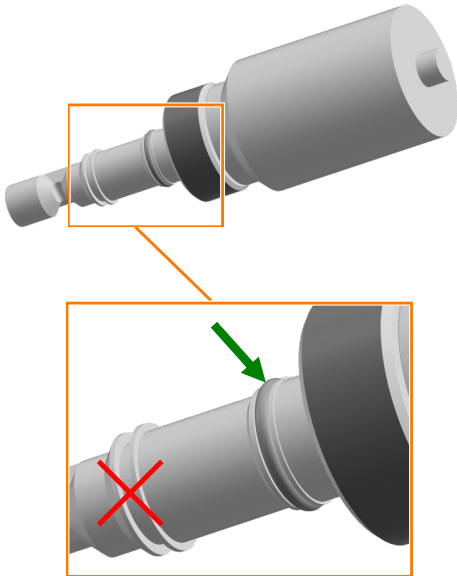
Proceed as follows:

1. → Ensure that there is an intact O-ring in the upper groove of the sensor.



When the sensor is delivered, the O-ring is placed in the correct groove (the green arrow in the figure on the left indicates the position).

2. → Insert the turbidity sensor into the Ingold nozzle.
3. → Manually tighten the coupling nut.
4. → Connect the sensor cable.



3.14 Exit Gas Analysis

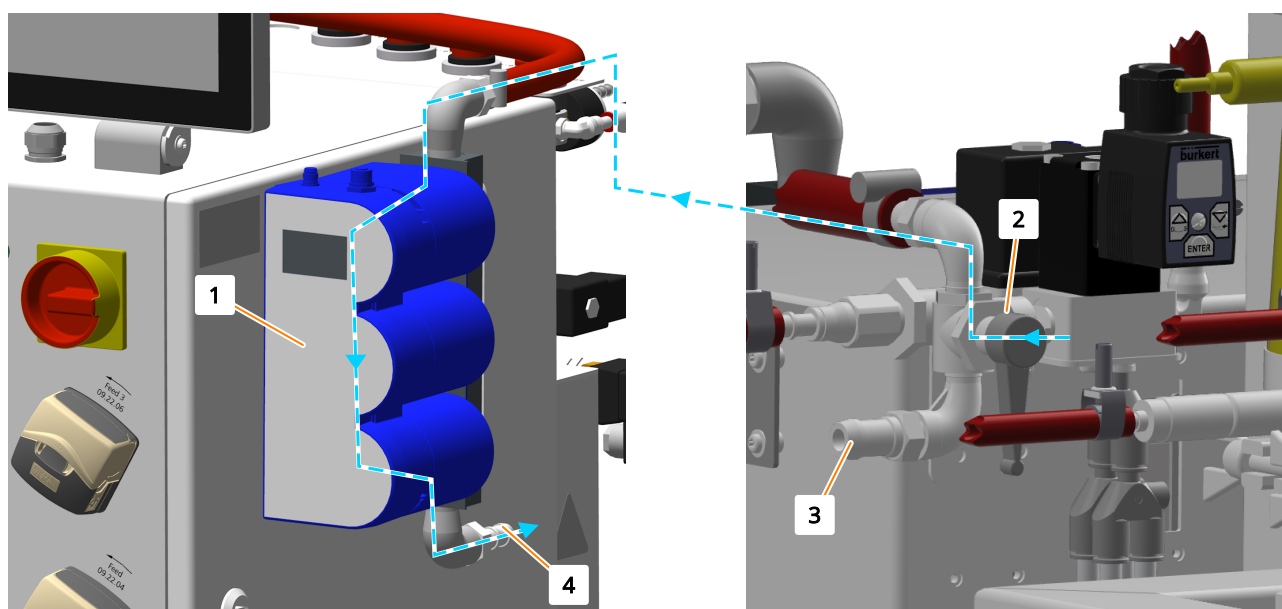
Setup and Function

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 analyzed in the exit gas flow of the bioreactor.

For exit gas analysis, combined CO₂ and O₂ sensors of the type BlueInOne Ferm or Cell as well as BlueVary by the manufacturer BlueSens are available.

Connection and Exit Gas Routing

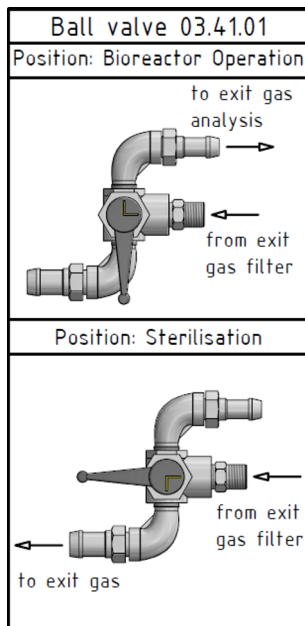
The gas sensors are installed ex-factory. The figure shows the BlueVary type as an example of a gas sensor.



- 1 BlueVary gas sensors
- 2 3-way ball valve 03.41.01 (here: position Bioreactor Operation = exit gas analysis)
- 3 Direct exit gas outlet (without exit gas analysis)
- 4 Outlet of exit gas from exit gas analysis

(both connections for a provider-side exit gas system/hose)

Options



During cultivation, exit gas is routed through the gas sensors. During sterilization, it must be discharged directly into the provider's exit gas line to protect the sensors from moisture. The operator manually makes this switch using the 3-way ball valve *03.41.01*.

! NOTICE

Moisture ingress into gas sensors for exit gas analysis can damage them or falsify the measurement results.

The exit gas line leading through the exit gas analysis must be closed during sterilization.

The flow direction of exit gas as well as the positions of the 3-way ball valve are indicated on the sticker placed on the instrumentation cabinet.

- Position *Bioreactor Operation* = exit gas analysis
- Position *Sterilisation* = direct outlet

Suitable instructions for this process are also displayed in various dialog boxes in the touch screen software.

Calibration

1-point calibration must be carried out once per month and during initial commissioning 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 the manufacturer BlueSens.

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 measurement value output anymore and the display turns red. The gas sensor cartridge must be replaced by the sensor manufacturer.

3.15 pCO₂ Measurement

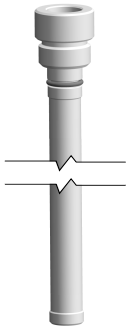
Overview

The saturation of dissolved carbon dioxide (CO₂) in the culture is measured using a digital CO₂ sensor with integrated temperature sensor. Measurements in hPa are displayed on the corresponding transmitter and also in the touch screen software.

The measurement display of the pCO₂ parameter on the touch screen software is set similarly to the measurement display of the transmitter to a range of 0 hPa to 1000 hPa.

Measurement system	Properties
METTLER digital	■ Measurement principle: potentiometric ■ Type: InPro5000i, ISM (digital)

Mounting

	■ Variant for Ingold nozzle The pCO₂ sensor is supplied with the appropriate sensor insertion housing of the type InFit 761 with cable kink protection from the sensor manufacturer. For more details on the sensor insertion housing and sensor mounting, see ➔ Chapter 2.13.2 'Mounting and Connecting the pH Sensor' on page 74 (variant Mettler).
	■ Variant for vessel top plate The pCO₂ sensor is supplied with the appropriate sensor insertion housing from the device manufacturer INFORS HT for mounting into a 19 mm port in the vessel top plate. For more details on the sensor insertion housing and its use, see ➔ Chapter 4.9 'Sensor Insertion Housing' on page 142 and ➔ Chapter 4.10 'Using the Sensor Insertion Housing' on page 142.

Calibration

The sensor is calibrated directly at the transmitter and in accordance with the information provided by the manufacturer of the sensor and transmitter.

Options

3.16 Redox Measurement

Overview

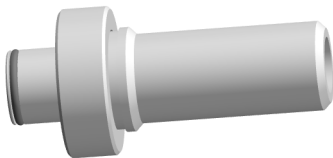
The reduction/oxidation potential (redox) in the medium is measured using the redox sensor.

Measurement system	Properties
HAMILTON digital	- Classic combined sensor (oxidation reduction potential measurement against a reference) with integrated electronics - Type: Easyferm Plus ORP ARC The redox sensor can be connected instead of the pO₂ sensor. If the sensor is configured in addition to the HAMILTON pO₂ sensor, an additional connection cable is required.



The redox sensors of the Easyferm Plus ORP ARC type have been preconfigured by the INFORS HT device manufacturer. Replacement sensors must be configured before use!

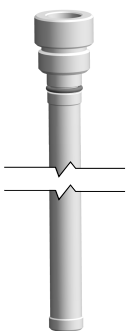
Mounting



- Variant for Ingold nozzle

The redox sensor is supplied with the appropriate sensor insertion housing of the type Flexifit U Bio from the sensor manufacturer.

For more details on the insertion housing and sensor mounting, see ➔ Chapter 2.13.2 'Mounting and Connecting the pH Sensor' on page 74 (variant Hamilton).



- Variant for vessel top plate

The redox sensor is supplied with the appropriate sensor insertion housing from the device manufacturer INFORS HT for mounting into a 19 mm port in the vessel top plate.

For more details on the sensor insertion housing and its use, see ➔ Chapter 4.9 'Sensor Insertion Housing' on page 142 and ➔ Chapter 4.10 'Using the Sensor Insertion Housing' on page 142.



The redox sensor is equipped with an electrically conductive O-ring by the device manufacturer INFORS HT. The sensor's original O-rings/support rings have been removed. Replacement sensors must be equipped identically!

Calibration

Calibration is possible with a corresponding redox buffer solution using a HAMILTON Arc Handheld or a HAMILTON Arc USB cable. Both of these are available separately from the sensor manufacturer.

3.17 Permittivity Measurement**Setup and Function**

Sensors of the ABER Futura system 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.

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

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

3.18 Pumps

In addition to the four standard pumps integrated into the device, additional peristaltic pumps are available. Up to two additional analog pumps can be integrated. The number of possible external pumps depends on the options that already exist.

Specifications	Can be integrated	External, Watson Marlow	External, Masterflex
			
Type	analog (<i>Feed 2</i> and <i>Feed 3</i>)	120 U/DV	L/S Cytoflow, 3-roll pump head
Max. speed	200 min ⁻¹	200 min ⁻¹	600 min ⁻¹
Setting range	0 % to 100 %	0 % to 100 %	0 % to 100 %
Increment	0.1 %	0.1 %	0.1 %

For more information on the external pumps, see the separate documentation from the pump manufacturers.

Options

3.19 Balances

The touch screen software allows the connection of one balance to the bioreactor. If more than one balance is to be connected, the connection via the bioprocess software eve® is required.

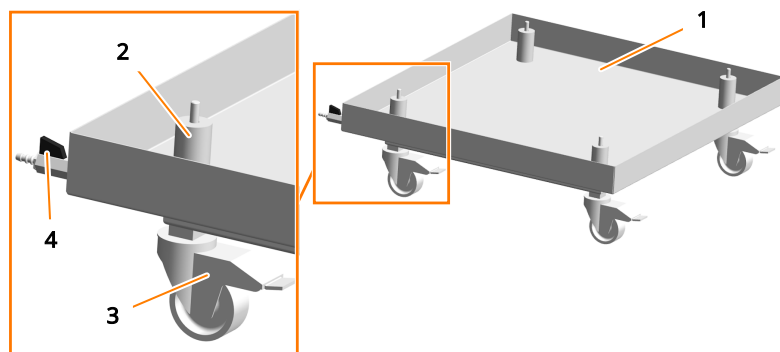
Balances of the following type are available from the device manufacturer:

- Kern DS 30K0.1-A
- Kern FKB 6K0.02-B
- Mettler MA6002
- Mettler MA32001L

In addition to a specific device firmware, these balances also require a suitable configuration, which is carried out by the device manufacturer. This is the only way to ensure smooth functionality.

Non-configured and non-listed models are not supported. If, however, a non-listed balance is to be integrated or several balances of a compatible type are to be used, there is the option of integration into the bioprocess software eve®. Please contact the device manufacturer INFORS HT for further information.

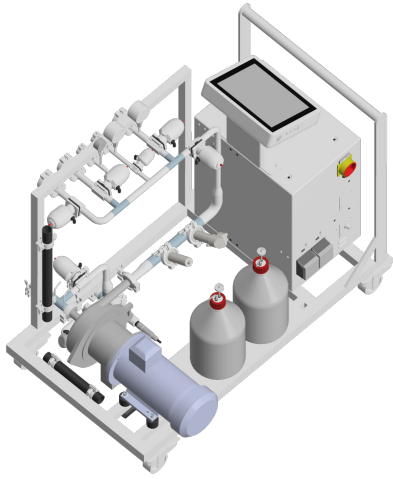
3.20 Base Tray



- 1 Base tray
- 2 Leg (4 x)
- 3 Swivel castor with brake (4 x)
- 4 Ball valve 18.05.01

The device is available with an optional base tray (1). The device is securely anchored in the base tray via four legs (2). The base tray is equipped with a ball valve (4) as a drain valve. The ball valve has a hose connection. A suitable hose is not included in the scope of delivery. The base tray is equipped with four swivel castors with brakes (3). The brakes must be locked at all times.

3.21 Mobile CIP Unit TechCIP



For automatic cleaning of the bioreactor, the mobile CIP unit TechCIP of the device manufacturer is available. The cleaning process using the mobile CIP unit and its operation in general are described in detail in a separate operating manual.

Accessories, Material and Hoses

4 Accessories, Material and Hoses

4.1 Overview of the Accessories

By default (column S), the device is supplied with some accessories and material. Additional accessories are optionally available (column O).

Designation	S	O	Additional Information
Starter set	x		↪ Chapter 4.2, page 125
Reagent bottles	x	x	↪ Chapter 4.2, page 125 ↪ Chapter 4.4, page 126
Connection set		x	↪ Chapter 4.3, page 125
Push valves		x	↪ Chapter 4.5, page 130
Inoculation needles		x	↪ Chapter 4.6, page 134
Vessel light		x	↪ Chapter 4.7, page 137
Sampling set for harvest valve (bottom valve)		x ¹⁾	↪ Chapter 4.8, page 139
Pitched blade impeller (downward and upward flow available)		x	↪ Chapter 4.11, page 144
Sensor insertion housing (for sensor mounting in 19 mm port)		x ²⁾	↪ Chapter 4.9, page 142

¹⁾ Standard accessory for devices without (optional) sample valve

²⁾ Standard accessory for (optional) Redox and pCO₂ sensors, variant for vessel top plate connection.

Accessories, Material and Hoses

4.2 Starter Set

The starter set contains the same material for all three available vessel sizes.

Designation	Use
Reagent bottle, 500 mL	Addition of reagent and nutrient solution
Hexagon socket spanner SW17	Blanking plugs in 19 mm ports
Septum, D = 19 mm, MVQ silicone, transparent	For inoculation in 19 mm ports
Cable tie, polyamide 2.4 x 85 mm, black	Attachment for silicone hoses and pump hoses
Hose connector, 1/8" x 1/8", PVDF	Connection with pump hose ID = 2.5 mm

4.3 Connection Set

The optional connection set contains the same hose and attachment material for all vessel sizes. Depending on the device configuration, more or less Tri-Clamp hose connectors are included.

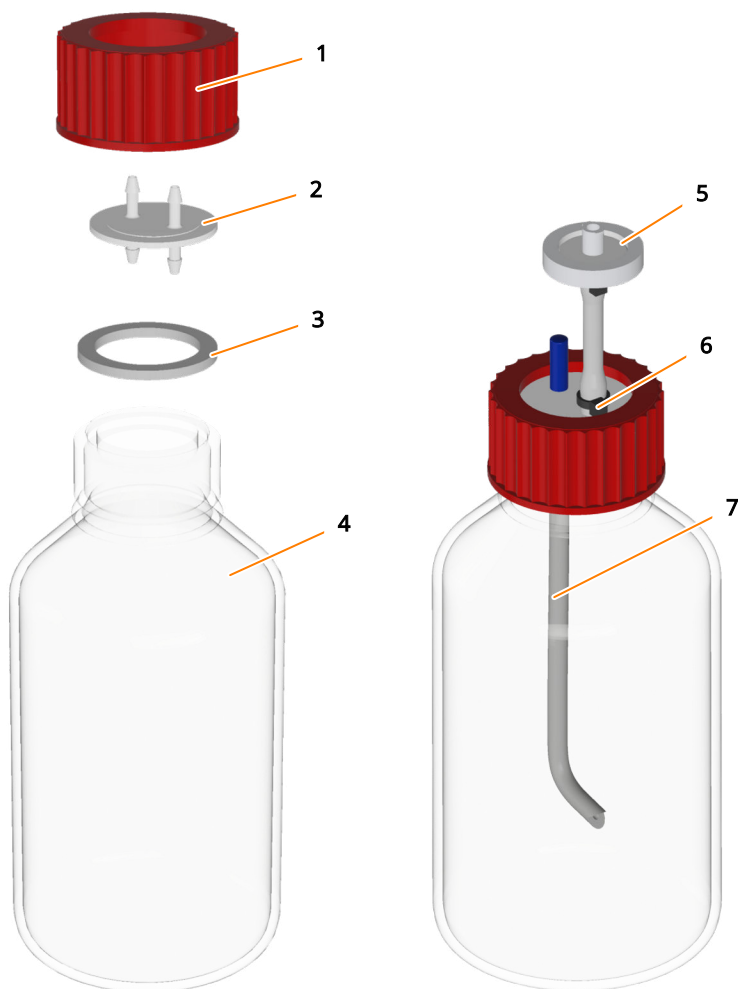
Designation	Use
Pump hose (Marprene/Bioprene), 3.2 x 6.4 mm	Peristaltic pumps
Pressure hose, 12.5 x 21 mm	Water, steam, condensate
Tri-Clamp hose connector 25 mm, D = 12.7 mm	Water, steam, condensate
Clamp 4301 PN 10, D = 25 mm	Closure of Tri-Clamp connection
Flat gasket DN3/4" EPDM	Gasket for Tri-Clamp connection
Hose clamp, 12 – 22 mm	Hose attachment

Accessories, Material and Hoses

4.4 Reagent Bottles

4.4.1 Setup and Function

Overview



- 1 Screw cap
- 2 Hose connector plate
- 3 Flat gasket
- 4 Laboratory bottle

- 5 Filter
- 6 Cable tie
- 7 Silicone hose

Accessories, Material and Hoses

Function

Reagent bottles are used as containers for reagent and nutrient solution. Connected to the appropriate peristaltic pump and an addition utensil, e.g. an inoculation needle, the liquid is pumped into the vessel. Different sizes of reagent bottle are available. They are delivered equipped with hoses and filters.



Silicone hoses or, depending on on-site specifications, weldable hoses for sterile hose connections are not included in the scope of delivery. Pump hoses are included in the optional connection set.

4.4.2 Preparing Reagent Bottles for Cultivation

Reagent bottles are autoclaved together separately with the addition utensils (e.g. inoculation needles). The same goes for the bottle that is filled aseptically with the stock culture (inoculum) shortly before inoculation.

! NOTICE

Damaged hoses and/or clogged filters can lead to undesirable pressure ratios in the reagent bottles.

- Equip each reagent bottle with an open pressure equalization line and a clean and dry filter.
- Use only clean and intact hoses and affix these properly.

To equip a reagent bottle for use, proceed as follows:

1. ➤ Unscrew the screw cap together with the hose connector plate.
2. ➤ Fit a piece of silicone hose onto one of the two hose connectors on the inside of the plate.

Choose the length so that the hose end 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.



Alternatively, the hose end can be cut at an angle. In this case, the hose end can touch the bottom of the bottle.

3. ➤ Secure the hose connections with a cable tie.

Accessories, Material and Hoses

- 4.** ➤ Place a long piece of silicone hose on the equilateral connection on the outside of the hose connector plate.

Choose the length of the hose so that it reaches from the reagent bottle to the pump on the instrumentation cabinet without tension or sharp kinks.

- 5.** ➤ Place a short piece of silicone hose on the second connection on the outside of the hose connector plate.

- 6.** ➤ Fit the filter on the short hose piece.

- 7.** ➤ Secure the hose connections with cable ties.

- 8.** ➤ Before autoclaving, thoroughly rinse the hose of the reagent bottle with distilled water.

- 9.** ➤ Depending on the application: fill, close and label the reagent bottle or fill the reagent bottle under sterile conditions after autoclaving, if necessary.

! NOTICE

Use of highly corrosive reagents, such as hydrochloric acid HCl, can cause damage to components that come into contact with it.



Fill reagent bottles with heat-resistant reagents only. Sterilize non-heat-resistant nutrient solution separately and only transfer it in a sterile manner to the reagent bottle after autoclaving.

- 10.** ➤ Connect a suitable piece of pump hose (Marprene/Bioprene recommended) to the silicone hose of the reagent bottle using a hose connector.
- 11.** ➤ Connect a fitting piece of silicone hose with a hose connector to the open end of the pump hose.
- 12.** ➤ Connect the silicone hose to the addition utensil (e.g. inoculation needle).
- 13.** ➤ Secure all hose connections with cable ties.
- 14.** ➤ Autoclave the reagent bottle with the addition utensil in accordance with internal guidelines.

Accessories, Material and Hoses

4.4.3 Specifications

Volumes/Hoses

Size/volume	Silicone hose diameter
500 mL	2 x 6 mm
1000 mL	3 x 5 mm
2000 mL	3 x 5 mm
5000 mL	3 x 5 mm
10000 mL	3 x 5 mm

Filter

Data	Value	Unit
Filter diameter (hydrophobe)	25	mm
Filter retention rate	0.45	µm

Materials

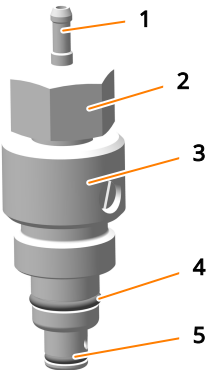
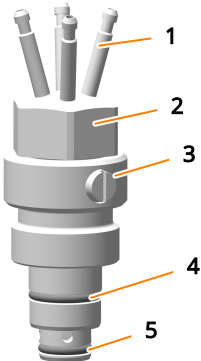
Data	Value
Laboratory bottle	Borosilicate
Flat gasket	Silicone
Filter membrane	PTFE
Hose connector plate	PDVE

Accessories, Material and Hoses

4.5 Push Valves

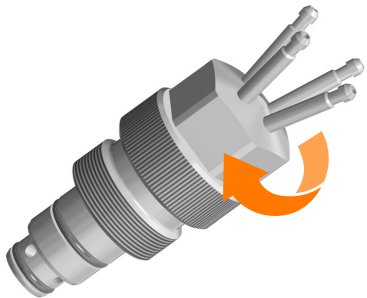
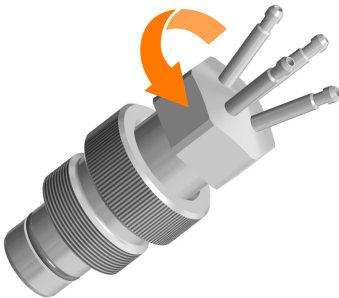
4.5.1 Setup and Function

Overview Two push valve designs are available. The two figures show the push valves in open state.

Single push valve	4 inlet push valve
 1 Hose connector, 1 x 2 Rotary piston 3 Valve body 4 O-ring valve body 5 O-ring rotary piston	 1 Hose connector, 4 x 2 Rotary piston 3 Valve body 4 O-ring valve body 5 O-ring rotary piston

Function Push valves are used for the sterile addition of liquids such as reagents or nutrient solution into the vessel. Push valves are autoclaved separately and then sterilized in situ with the vessel while in the closed position.

Opening/Closing Push Valves

	
→ To open, turn the rotary piston clockwise. ➡ The lower part of the rotary piston is pushed out. The distance between the valve body and rotary piston is reduced.	→ To close, turn the rotary piston counter-clockwise. ➡ The lower part of the rotary piston is retracted. The upper part protrudes from the valve body.

Mounting

A thread is used for mounting it in the 19 mm port.

Hose connector single push valve	ID = 4 mm
	OD = 6 mm
Hose connectors 4 inlet push valve	ID = 2 mm
	OD = 4 mm

4.5.2 Preparing Push Valves for Cultivation

Preparation and Use

Preparation and use of a push valve mainly comprise the following three steps:

- Sterilization in an autoclave: sterilize the closed push valve together with a prepared reagent bottle/laboratory bottle separately in the autoclave.
- In situ sterilization: connect the reagent bottle to the (calibrated) pump and sterilize the closed push valve together with the vessel in situ.
- Cultivation: open the push valve.

For more information, see the following chapters:

- ➡ Chapter 4.4.2 'Preparing Reagent Bottles for Cultivation' on page 127
- ➡ Chapter 8.8.2 'Calibrating the Pumps' on page 239

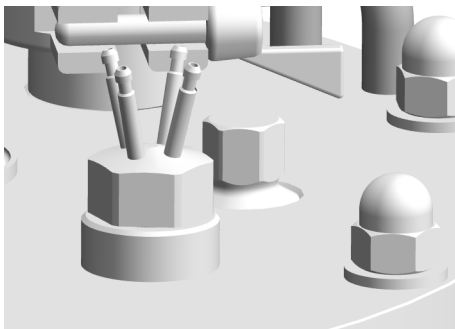
Accessories, Material and Hoses

Autoclaving a Push Valve

Proceed as follows:

1. ➤ Connect the hose of the reagent bottle to the push valve.
When using a 4 inlet push valve, up to four reagent bottles can be connected.
2. ➤ Close any unused connection on the 4 inlet push valve.
3. ➤ Ensure that the push valve is closed, and close it if necessary.
4. ➤ Secure all hose connections with cable ties and pinch off the hoses with hose clamps.
5. ➤ Autoclave everything together in accordance with internal guidelines.

Sterilizing Push Valves in Situ



After autoclaving and sufficient cooling down time, proceed as follows:

1. ➤ Manually screw the closed push valve into a 19 mm port in the vessel top plate.
The figure on the left is an example showing a mounted 4 inlet push valve without hoses.
2. ➤ Connect the reagent bottle(s) to the pump(s) (➔ Chapter 2.5.3, page 30).
3. ➤ Sterilize the push valve together with the vessel in situ.
➡ The part of the push valve that is exposed after autoclaving is now sterile again as well.

Using Push Valves

Proceed as follows:

1. ➤ Open the push valve on the rotary piston clockwise.
2. ➤ Open the clamp.
3. ➤ Fill the hose with the liquid to be pumped via the corresponding pump up to the visible inlet in the push valve (➔ Chapter 8.8.4, page 241).
4. ➤ Start the cultivation (➔ Chapter 8.9.9, page 260).

4.5.3 Specifications

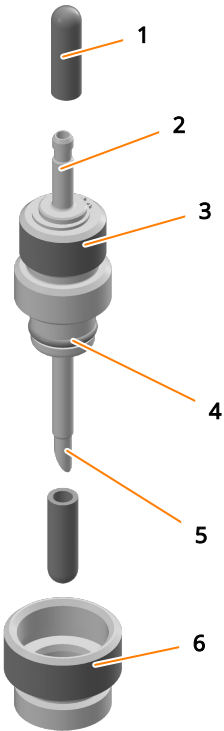
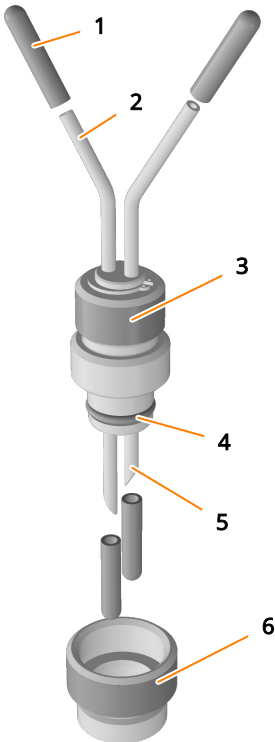
Data	Value
Material in contact with medium	316L
Surface in contact with medium	Ra 0.8 µm, electropolished
Material O-rings	EPDM

Accessories, Material and Hoses

4.6 Inoculation Needles

4.6.1 Setup and Function

Overview Two inoculation needle designs are available.

Single inoculation needle	Double inoculation needle
	
1 Protective cap (cannot be sterilized!), 2 x 2 Hose connector, 1 x 3 Hollow screw 4 O-ring 5 Needle, 1 x 6 Septum collar	1 Protective cap (cannot be sterilized!), 4 x 2 Hose connector, 2 x 3 Hollow screw 4 O-ring 5 Needle, 2 x 6 Septum collar

Function

Inoculation needles are used to add liquids such as reagent, nutrient solution or the inoculation culture (inoculum) to the vessel. For this purpose, a septum, which is fixed with a septum collar in the port in the vessel top plate, is pierced with the inoculation needle.

The inoculation needles are supplied with a septum collar. Their tip is cut on a bias to enable easy piercing. The hose connector and the very sharp(!) tip are provided with non-autoclavable protective caps.

Accessories, Material and Hoses

Mounting

A thread is used for mounting it in the 19 mm port or the septum collar.

Hose connector (1 x or 2 x)	ID = 4 mm
	OD = 6 mm

4.6.2 Preparing Inoculation Needles for Cultivation

Preparation and Use

Preparation and use of an inoculation needle mainly comprise the following three steps:

- Sterilization in an autoclave: sterilize the inoculation needle together with a prepared reagent bottle/laboratory bottle separately in the autoclave.
- Prior to in situ sterilization: equip the port in the vessel top plate with the septum and septum collar.
- After in situ sterilization: connect the reagent bottle with the (calibrated) pump and use the inoculation needle to pierce the septum and screw the needle into the septum collar.

For more information, see the following chapters:

- ➔ Chapter 4.4.2 'Preparing Reagent Bottles for Cultivation' on page 127
- ➔ Chapter 8.8.2 'Calibrating the Pumps' on page 239
- ➔ Chapter 2.6.4 'Equipping the Ports with the Septum and Septum Collar' on page 41

Autoclaving Inoculation Needles

Proceed as follows:

1. ➔ Remove the protective caps from the inoculation needle.
2. ➔ Get the septum collar ready for equipping the port in the vessel top plate.
3. ➔ Connect the hose of the reagent bottle to the inoculation needle.
4. ➔ Secure all hose connections with cable ties and pinch off the hose with a hose clamp.
5. ➔ Autoclave everything together in accordance with internal guidelines.

Using Inoculation Needles

After in situ sterilization, proceed as follows:

Accessories, Material and Hoses

1. ➔ Loosen the blanking plug and unscrew it from the septum collar in the port.



Add a few drops of (70 %) ethanol to the septum to provide additional protection against contamination.

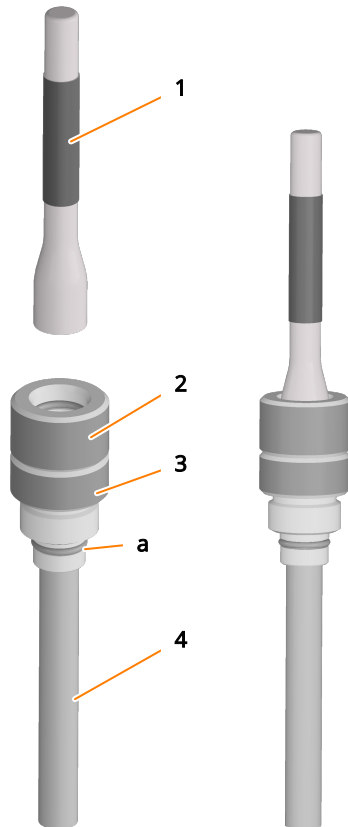
2. ➔ Immediately pierce the septum with the inoculation needle and screw the inoculation needle into the septum collar.
3. ➔ Open the clamp.
4. ➔ Fill the hose with the liquid to be pumped via the corresponding pump up to the visible inlet in the inoculation needle (➔ Chapter 8.8.4, page 241).
5. ➔ Start the cultivation (➔ Chapter 8.9.9, page 260).

4.6.3 Specifications

Data	Value
Material in contact with medium	316L
Surface in contact with medium	Ra 0.8 µm, electropolished
Material O-ring	EPDM

4.7 Vessel Light

4.7.1 Setup and Function

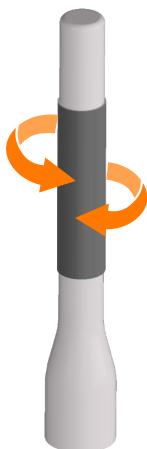


- 1 Torch
- 2 Hollow screw
- 3 Threaded housing with O-ring (a)
- 4 Glass lens

The vessel light consists of a torch (1) and threaded housing (3) with thread and O-ring with integrated glass lens (4) for screwing into a 19 mm port in the vessel top plate. A hollow screw (2) is screwed into the threaded housing and is thus used to affix the torch.

Switching the Vessel Light On and Off

The torch can be switched on or off by turning it clockwise/counter-clockwise.

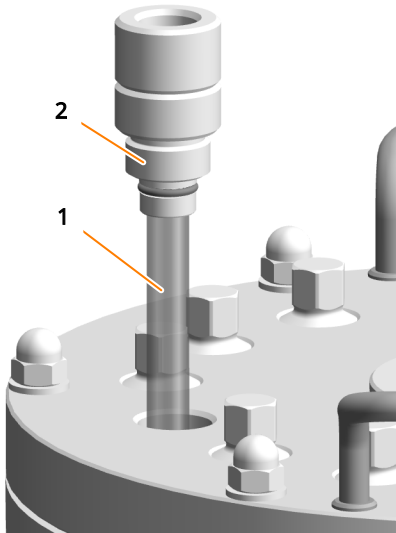


Accessories, Material and Hoses

4.7.2 Mounting the Vessel Light

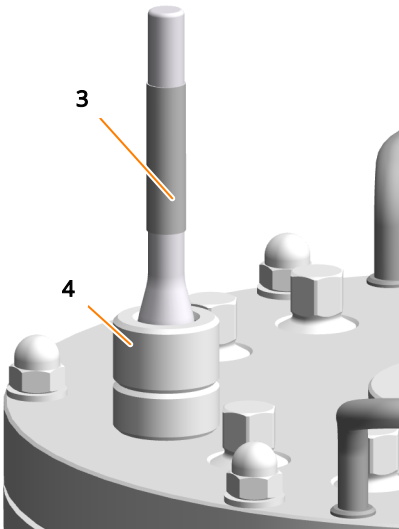
The vessel light is mounted in a 19 mm port in the vessel top plate. To do so, proceed as follows:

1. → Insert the glass lens (1) in the threaded housing (2) with O-ring into the 19 mm port and tighten it by hand.



2. → Place the torch (3) in the hollow screw (4).

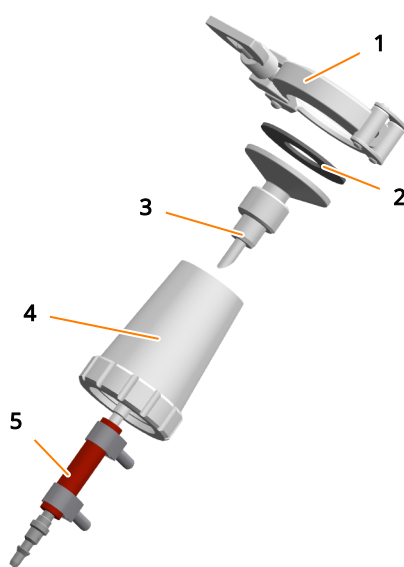
➡ The vessel light is ready for use.



4.8 Sampling Set

4.8.1 Setup and Function

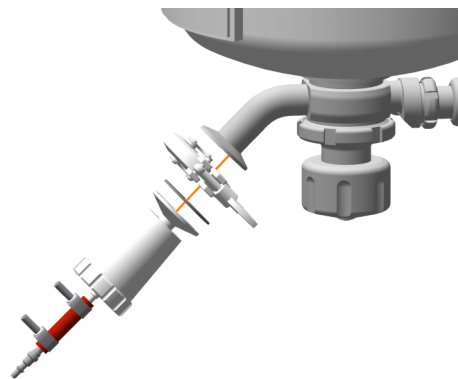
Overview



- 1 Clamp
- 2 Flat gasket
- 3 Needle
- 4 Steam trap 05.20.01
- 5 Pressure hose

A sampling set is available so that the harvest valve (bottom valve) can be used for sampling. It consists of a needle (3) with Tri-Clamp connection with clamp (1) and flat gasket (2) for affixing to the harvest valve. A steam trap (4) with hose nozzle is screwed onto the needle. A pressure hose (5) with rapid coupling (plug) is attached to the hose nozzle for connection to the device's condensate collection line.

Sterilization

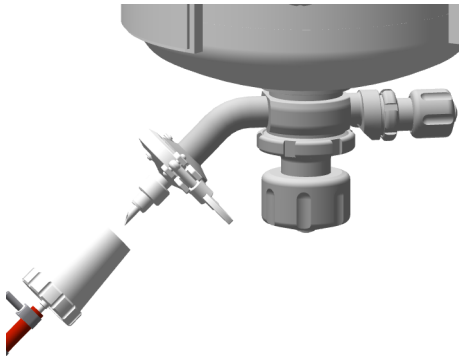


For sterilization, the sampling set with steam trap must be connected to the Tri-Clamp connection on the harvest valve. To drain the condensate, the pressure hose is connected to the device's condensate collection line via rapid coupling. For details on the sterilization process, see ➔ Chapter 8.9.4 'SIP Harvest Valve – Sterilization Harvest Valve' on page 250.

Accessories, Material and Hoses

Sampling

For sampling, the steam trap is unscrewed from the needle.



4.8.2 Using the Sampling Set



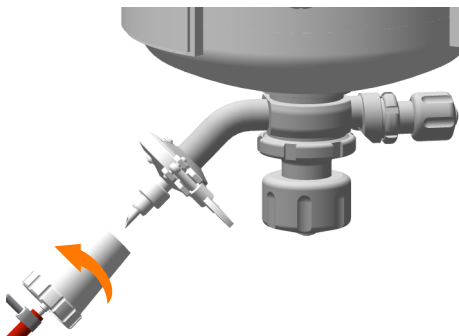
CAUTION

The harvest valve (bottom valve) gets very hot during sterilization. Depending on the cultivation temperature, it can also get hot during operation. This poses a risk of burns when touching the harvest (bottom) valve.

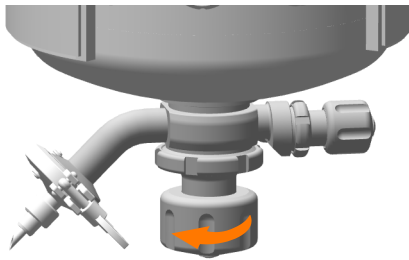
- After sterilization, let the harvest valve cool down.
- Wear heat-resistant protective gloves when operating the harvest valve.

To take a sample, proceed as follows:

1. Have the sample bottle/container ready.
2. Unscrew the steam trap counter-clockwise from the needle.
 - ➡ The needle is now visible.
3. Place the sample bottle under the needle or, if necessary, use the needle to pierce the septum on the sample bottle.

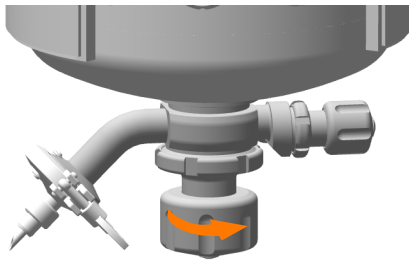


Accessories, Material and Hoses



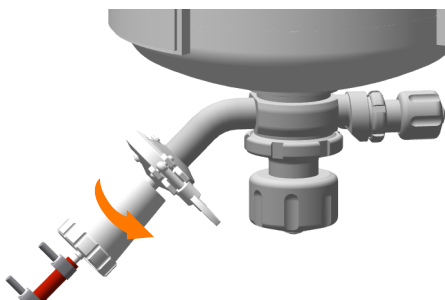
4. → Open the harvest valve 05.12.01: turn the valve handle counter-clockwise.

5. → Fill the sample bottle with the required amount of liquid.



6. → Close the harvest valve 05.12.01: turn the valve handle clockwise.

7. → If necessary, pull the needle out from the septum in the sample bottle.

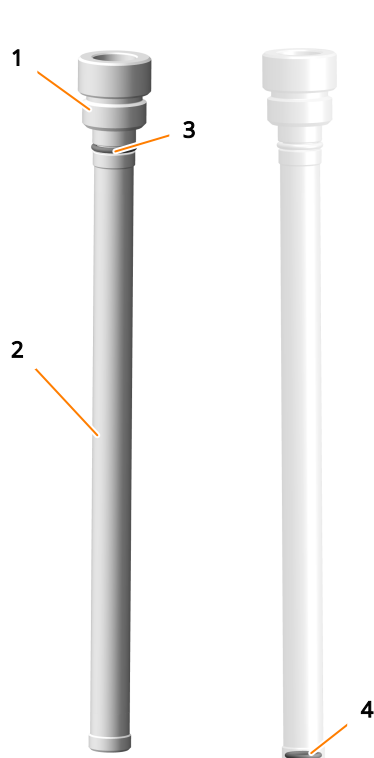


8. → Screw the steam trap clockwise to the needle.

Accessories, Material and Hoses

4.9 Sensor Insertion Housing

4.9.1 Setup and Function



- 1 Nozzle Rd28x1/8" / Pg13.5
- 2 Protection tube
- 3 O-ring outside (2.5 x 15 mm)
- 4 O-ring inside (2 x 12 mm)

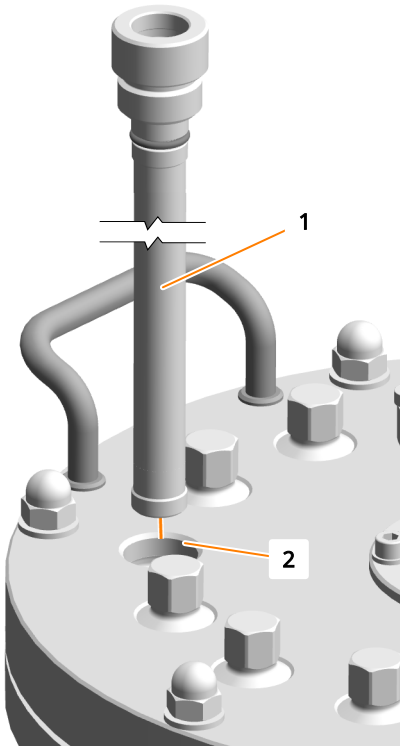
The sensor insertion housing provided by the device manufacturer INFORS HT serves as a sensor adapter for mounting a sensor into a 19 mm port in the vessel top plate. The nozzle (1) has both internal and external threads. The protective tube (2) protects the sensor from mechanical damage. Two O-rings (3 and 4) provide a seal between the port, the sensor insertion housing, and the sensor.

4.10 Using the Sensor Insertion Housing

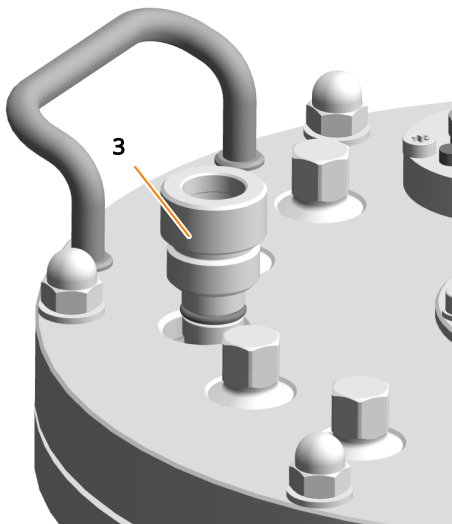
Before use of the sensor insertion housing, ensure that it is equipped with the inner and outer O-ring. To use the sensor insertion housing, proceed as follows:

Accessories, Material and Hoses

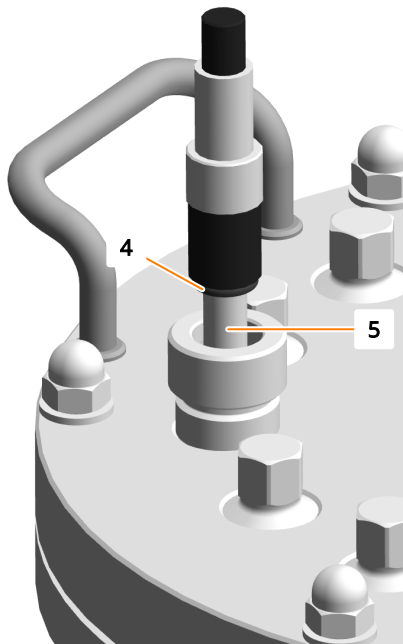
1. → Insert the protection tube (1) of the sensor insertion housing into the 19 mm Port (2).



2. → Tighten the nozzle (3) of the sensor insertion housing by hand in the port.



Accessories, Material and Hoses



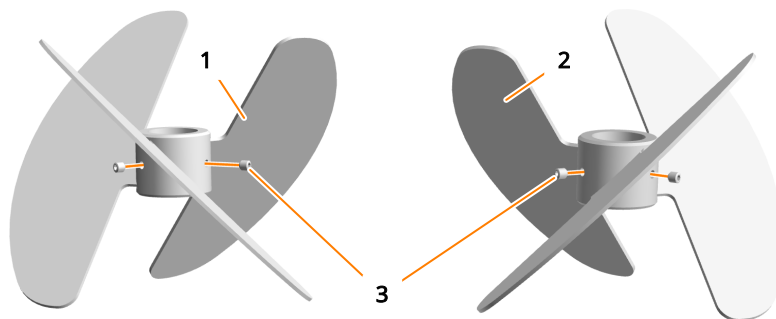
3. → Carefully insert the sensor (5), which is equipped with an O-ring (4), into the sensor insertion housing until it stops.



The redox sensors and pH sensors of the Easy-ferm Plus (ORP) ARC type are equipped with an electrically conductive O-ring by the device manufacturer INFORS HT. The sensor's original O-rings/support rings have been removed. Replacement sensors must be equipped identically!

4. → Screw the sensor into the nozzle of the sensor insertion housing by hand.

4.11 Pitched Blade Impeller



- 1 Pitched blade impeller, downward flow
- 2 Pitched blade impeller, upward flow
- 3 Grub screw (2 x)

The stirrer shaft is equipped with Rushton impellers by default (→ Chapter 2.9, page 50). In addition, pitched blade impellers with a downward (1) or upward (2) flow direction are also available. The impellers are affixed to the stirrer shaft by means of two grub screws (3).

5 Transport and Storage

Inbound delivery and transport to the assembly location are performed only by INFORS HT employees or by persons authorized by INFORS HT. Nonetheless it is possible that the provider's personnel is entrusted with transport tasks in the context of on-site transport. In this case, observe the following notes.

5.1 Transport



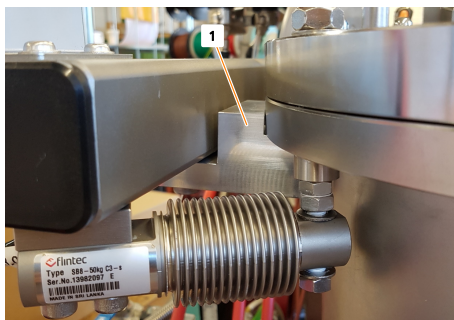
WARNING

Improper transport, use of incorrect auxiliary tools and careless handling of the device may lead to injuries and significant damage to property.

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

- Before moving a device, all provided transportation safety devices must first be affixed to protect the device from damage.
- Always work at least in pairs and use suitable auxiliary equipment when transporting the device.
- Especially when using auxiliary tools, keep in mind that the device's center of gravity is not in the middle.

5.2 Transportation Safety Device



1 Transportation safety device (2 x)

To protect the load cells (optional weight measurement vessel) from damage during transport, a transportation safety device (1) is fitted to the frame of the device stand. This means that two plates are screwed to the right and left on the underside of the frame. The plates prevent the load from being applied to the load cells by the vessel.

The transportation safety device is removed by qualified personnel prior to initial commissioning of the the device and handed over for safekeeping. The transportation safety device must be mounted prior to any transport of the device.

Transport and Storage

5.3 Storage

- Decontaminate, thoroughly clean and dry the vessel and all accessories every time before placing them in storage.
- Maintain and store sensors produced by other manufacturers in accordance with their instructions.
- Store the device and its components clean, dry and protected against dust, dirt and liquids.
- Store the device and its components in a cool place with low humidity but protected against frost.
 - Storage temperature: 5 °C to 55 °C
 - Relative humidity, non-condensing: 10 % to 95 %
- Protect the device from aggressive media, direct sunlight and vibrations.

6 Installation and Commissioning

Only the manufacturer's qualified expert personnel or persons authorized by the manufacturer may install and initially commission the device.

After installation of the device, the temperature control circuit must be filled first. This then remains filled and is emptied only when repair or service work is performed. After connecting the motor cable, the basic functions of the bioreactor are tested briefly in a test run. Since these tasks must not be performed by the operator, they are not covered in this operating manual. Hence, the following section only lists the connection requirements and energies to be provided by the provider.



WARNING

Installation and initial commissioning require trained expert personnel with sufficient experience. Errors during installation may lead to dangerous situations or significant damage to property.

- Only the manufacturer's expert personnel or persons authorized by the manufacturer may install and initially commission the device.
- Contact the manufacturer if the device is to be placed in a different location.

6.1 Operating Conditions at the Installation Location

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

- The figures and ranges specified in the technical data must be observed (➔ Chapter 12.2 'Connections and Connection Values' on page 289 and ➔ Chapter 12.5 'Operating Conditions' on page 308).
- The device must only be installed inside a laboratory or a laboratory-like environment.
- The installation surface must be level, sufficiently stable and load-bearing.
- There must not be any sources of electrical interference in the vicinity.
- The working environment is equipped with a sufficient ventilation system, depending on the application.

Installation and Commissioning

6.2 Minimum Distances to the Device

The device must be positioned at least 150 mm away from walls, ceilings and other devices.

Furthermore, make sure that the vessel top plate with its built-in-parts can be easily lifted off and removed from the vessel. When calculating the distance between the device and the ceiling, this must be taken into account.

6.3 Requirements for the Mains Connection

To avoid dangers due to electrical current, the in-house mains connection must meet the following requirements:

- Constant power supply
- The power supply of the device must be secured on-site by means of an fault current protection switch (RCD – Residual Current Device) of RCCB type B.

In addition to that, ensure the following:

- The building's mains connection can be accessed at all times.
- The voltage values of the device match those of the local mains voltage. Note the information on the identification plate.

Refer to the technical data for the electric connection values.

6.4 Requirements for Connections and Interfaces

To ensure trouble-free operation of the device, certain conditions must be met by the provider. In addition to compliance with the connection pressures, these include further requirements for the supply and discharge of the various energies as well as for process gas and steam. These are listed in the following sections.

For further information on connection pressures and connection sizes, see ➔ Chapter 12.2 'Connections and Connection Values' on page 289.

Process Gas

- Process gases must be dry, clean, and free of oil and dust.
- Recommended compressed air quality as per DIN ISO 8573-1: Class 1.2.1 for process air

! NOTICE

Compressed air containing water or oil can lead to damage to the mass flow controllers.

Installation and Commissioning**Exit Gas**

- The exit gas must be dissipated securely by means of a suitable, gas-tight hose.
- The exit gas line must be higher than the exit gas filter.

Water for Temperature Control Circuit

Water for the temperature control circuit must be of the following quality: CaCO_3 -concentration 0 mmol L⁻¹ to 1.5 mmol L⁻¹

! NOTICE

Cooling water additive containing alcohol can damage the components of the temperature control system.

On site, the water supply of the device comes from tap water. The additional connection of an internal cooling water system or an optional, separate recirculating chiller is also possible.

If a cooling water system is available, the 3-way ball valves 01.41.01 (inlet) and 01.41.02 (outlet) mounted on the device can be used to manually switch between cooling water and tap water.

! NOTICE

An incorrect position of the ball valves (tap water IN open / chilled water OUT open) for tap water / chilled water can lead to overfilling or overflowing of the cooling circuit!

Steam

The device's steam is supplied by the building or via an optional integrated steam generator.

The steam must be of clean steam quality and can be guided through a 5 µm filter.

Required Amount of Steam for each Vessel Size

Vessel	Vessel & filters for inlet air und exit gas	Periphery
10 L WV	≈ 8 kg/h	≈ 1 kg/h
20 L + 30 L WV	≈ 14 kg/h	≈ 1 kg/h

Installation and Commissioning

Water Requirements for Integrated Steam Generator (if Available)

Water for the integrated steam generator must be of the following quality: CaCO_3 concentration 0 mmol L⁻¹ up to a max. of 0.53497mmol L⁻¹

For detailed information on the connection requirements as well as technical data, usage and maintenance of the steam generator, see the separate documentation provided by the manufacturer. Read the manual before initial commissioning of the device and following the instructions therein.

Outlets

- All drains must be heat resistant (max. 100 °C).
- For safety reasons the drains must not be in the immediate vicinity of the operator.
- Contaminated liquids must be drained safely and disposed of in an environmentally friendly manner.

Hoses

Conditions for all hoses used:

- Use pressure-resistant and intact hoses.
- Use hoses with an appropriate diameter; an adapter may be used, if necessary.
- Secure hoses using appropriate hose clamps.

6.5 Safety Valves



CAUTION

If the safety valve of the vessel is triggered, steam, depending on the process phase and vessel contents of the bioreactor, hot and/or contaminated liquid or dangerous gases may escape from the overpressure venting pipe.

When the safety valve of the temperature control system is triggered, steam or hot water can escape, depending on the process phase of the bioreactor.

To ensure that, if the safety valve of the vessel or the temperature control system is triggered, escaping medium is discharged safely, the following must be ensured in the building:

- The outlet of the overpressure venting pipe of the safety valves are equipped with suitable gas-tight, heat-resistant and pressure-resistant hoses or piping. The inner diameters of the hoses/piping must not be smaller than the inner diameters of the overpressure venting pipes.
- The hoses/piping are routed in such a way that the content is discharged safely .
- The safety valve lines have no, or at most the following, backpressures:
 - Vessel safety valve: 15 % of the set pressure
 - Temperature control system safety valve: 10 % of the set pressure

Cultivation

7 Cultivation

This chapter describes the work necessary for preparing, performing and finalizing a cultivation. It also describes how the vessel is sterilized again, cleaned and prepared for a new cultivation.

7.1 Preparing the Bioreactor



CAUTION

Uncontrolled rolling away of the device poses a risk of injury and damage to property.

- Always block the swivel castors.
- Before you start work, ensure that the device stands securely and cannot roll away.



NOTICE

Using tools when mounting/removing built-in-parts including blanking plugs on the vessel and top plate can damage these and result in screw connections that can no longer be removed.

- Mount/remove built-in-parts by hand.
- Insert (hand-tight) and remove the 19 mm blanking plug with the hexagon socket wrench provided.

The following checklist contains all activities for preparing the vessel for cultivation. The order of the activities corresponds to the typical procedure for preparing the bioreactor.



The checklist serves only as an example. The company's internal specifications regarding the activities to be carried out and their sequence must always be observed!

1. Checking and Filling the Vessel

In order to check the seat of the seal (O-ring) and the sparger in the vessel top plate, the position of the baffles in the vessel and the impellers on the stirrer shaft, and to correct them if necessary, the vessel top plate must be lifted. Depending on the application, this is also required for filling the vessel. To do this, the motor must be uncoupled, and the exit gas cooler with exit gas filter and inlet air filter must be removed. The safety valve on the vessel top plate does not necessarily have to be removed. However, the provider-side hose/pipe line on the safety valve's overpressure venting pipe must be removed.

Cultivation

No.	Activity	Additional Information	☒
1.1	Uncouple the motor.	➔ Chapter 2.9.2, page 52	☐
1.2	Remove the exit gas cooler with filter.	➔ Chapter 2.12.2, page 66	☐
1.3	Remove the inlet air filter.	➔ Chapter 2.11.2, page 63	☐
1.4	Remove the vessel top plate.	➔ Chapter 2.6.2, page 38	☐
1.5	Check the top plate seal, the sparger, the impellers and the baffles.	➔ Chapter 2.6.3, page 40	☐
1.6	Mount the vessel top plate.	➔ Chapter 2.6.2, page 39	☐
1.7	Check the lubrication of the mechanical seal, lubricate if necessary.	➔ Chapter 2.9.3, page 54	☐
1.8	Mount the exit gas cooler and filter. Check the twist valves on the exit gas filter: ■ Twist valve with connected hose is open. ■ Unused twist valve is closed.	➔ Chapter 2.12.2, page 68	☐
1.9	Mount the inlet air filter. Check the twist valves on the inlet air filter: ■ Twist valve with connected hose is open. ■ Unused twist valve is closed.	➔ Chapter 2.11.2, page 64	☐
1.10	Couple the motor.	➔ Chapter 2.9.2, page 53	☐

2. Preparing and Mounting Built-in-Parts

After the vessel has been checked and closed again, all required built-in-parts must be mounted and accessories such as inoculation needles, reagent bottles, etc. prepared.

No.	Activity	Additional Information	☒
2.1	Mount the manometer.	➔ Chapter 2.8.2, page 49	☐
2.2	Mount the safety valve.	➔ Chapter 2.16.4, page 85	☐
2.3	If available: mount the vessel light.	➔ Chapter 4.7.2, page 138	☐
2.4	If necessary, calibrate the pumps. This makes it possible to display the actual volume pumped in mL or g. The calibration of the pumps must be performed before autoclaving the reagent bottles.	➔ Chapter 8.8.2, page 239	☐
2.5	Equip the reagent bottles and autoclave them with the addition utensils (inoculation needle, push valve, antifoam sensor).	➔ Chapter 4.4.2, page 127	☐
2.6	If available: prepare inoculation needles for use and autoclave them together with the reagent bottles.	➔ Chapter 4.6.2, page 135	☐

Cultivation

No.	Activity	Additional Information	☒
2.7	If available: autoclave the push valves together with the reagent bottles and mount them.	➔ Chapter 4.5.2, page 131	☐
2.8	If available: prepare the resterilizable feed line for use: - Autoclave the block valve <i>13.16.02</i> / <i>13.16.04</i> with the reagent bottle - Mount the block valve <i>13.16.01</i> / <i>13.16.03</i> in situ.	➔ Chapter 3.3.2, page 96	☐
2.9	If available: prepare the resterilizable transfer line for use: - Sterilize block valve <i>19.16.01</i> / <i>19.16.02</i> - Sterilize the transfer line	➔ Chapter 3.4.2, page 100	☐
2.10	Connect pumps to reagent bottles and fill the hoses of the reagent bottles.	➔ Chapter 2.5.3, page 30	☐
2.11	If required: equip the ports with the septum and septum collar.	➔ Chapter 2.6.4, page 41	☐
2.12	Close unused ports and nozzles.	➔ Chapter 2.6.5, page 43	☐

3. Preparing the Sensors

Before in situ sterilization, all necessary sensors must be prepared, calibrated if necessary, and mounted.

No.	Activity	Additional Information	☒
3.1	Prepare the antifoam sensor for use. The antifoam sensor (variant dosing needle) cannot be sterilized in situ and therefore has to be autoclaved separately with the corresponding reagent bottle.	➔ Chapter 2.15.2, page 80	☐
3.2	Check connection of temperature sensor.	➔ Chapter 2.10.1, page 58	☐
3.3	Calibrate the pH sensor.	➔ Chapter 8.6.3.5, page 220 ➔ Chapter 8.6.3.3, page 215	☐
3.4	Mount and connect the pH sensor.	➔ Chapter 2.13.2, page 74	☐
3.5	Calibrate the pO ₂ sensor.	➔ Chapter 8.6.3.8, page 226 ➔ Chapter 8.6.3.7, page 224	☐
3.6	Mount and connect the pO ₂ sensor.	➔ Chapter 2.14.2, page 76	☐
3.7	Prepare all additional (optional) sensors (e.g. level, pressure, turbidity, redox, pCO ₂ , permittivity or O ₂ / CO ₂ in the exit gas). This is described in the chapter of the respective sensor in the main chapter "Options".		☐

7.2 In Situ Sterilization

For in situ vessel sterilization, there must be enough liquid in the vessel for sufficient steam to form. The exact evaporation loss during a vessel sterilization cannot be determined precisely. A part of the liquid evaporates via the inlet air or exit gas line. A part of the shortfall is compensated for by the inoculum (inoculation culture). Further shortfalls can be compensated for by adding more water before sterilization or by adding separately sterilized medium or sterile water after sterilization.

In principle, there are various possible sterilization methods, but sterilization is always carried out according to the operator's specifications. The following two strategies are commonly used and listed as general examples:

Sterilizing the Vessel with Culture Medium Method

- Fill culture medium into the vessel.
- Sterilize the vessel.
- Fill sterile water into the vessel in a sterile manner to compensate for evaporation losses. Add any non heat-stable components in a sterile manner.

Sterilizing the Vessel without Culture Medium Method

- Fill the vessel with water, add basal salts if needed.
- Sterilize the vessel.
Either drain the water that remains after sterilization or take it into account when adding the culture medium.
- Add the culture medium and inoculum under sterile conditions.
All heat-labile components are usually sterile filtrated and added by injection or with the inoculum afterwards.

For detailed information on the programmed sterilization processes, see ➔ Chapter 8.9 'Processes' on page 244.

7.3 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, set the pO₂ concentration and the pH. The time required for this depends on the working volume.



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.

Cultivation

7.4 Sampling

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

A sample can be taken after sufficient cool-down time after sterilization of the sample valve.

The sampling takes place either via the optional sample valve in the Ingold nozzle or via the harvest valve (bottom valve) with optional sampling set.

- For details on the function and use of harvest/sample valves; see ➔ Chapter 4.8 'Sampling Set' on page 139 and ➔ Chapter 4.8.2 'Using the Sampling Set' on page 140.
- For details on the function and use of the optional sample valve; see ➔ Chapter 3.2 'Sample Valve' on page 92 and ➔ Chapter 3.2.2 'Using the Sample Valve' on page 94.

7.5 Inoculation

Requirements

Check and ensure the following before inoculation:

- Medium has been filled.
- Heat-labile, separately sterilized substances have been added.
- The reagent bottles are connected with the pumps and the vessel, and are filled with a sufficient amount of reagent and nutrient solution for the duration of the cultivation.
- The hoses of the reagent bottles are filled.
- 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 activated).
- Utensils for the inoculation and vessels with inoculum are ready.

Methods

There are different methods for adding inoculum. The exact method depends on the internal guidelines and on the system used and is defined by the operator.

7.6 Harvest

The culture can be harvested at the end of the cultivation. For example, get a suitable vessel ready or connect a hose to the harvest valve.

There are generally two methods for doing this:

- using gravity (0 bar(g))
- overpressure (1.0 bar(g)) – if optional pressure control is available

If the optional pressure control is installed, the harvest process is controlled via touch screen software, see ➔ Chapter 8.9.10 'Harvest' on page 263. For information on the function and use of the harvest valve (bottom valve); see ➔ Chapter 2.7 'Harvest Valve (Bottom Valve)' on page 46 and ➔ Chapter 2.7.2 'Using the Harvest Valve (Bottom Valve)' on page 47.

If the optional resterilizable transfer line is installed, the culture can be transferred to another tank, vessel, or bioreactor at the end of the process. The transfer process is controlled via the touch screen software, see ➔ Chapter 8.9.11 'Transfer' on page 266. For information on the function and preparation of the transfer line, see ➔ Chapter 3.4 'Resterilizable Transfer Line' on page 99 and ➔ Chapter 3.4.2 'Preparing the Resterilizable Transfer Line for Cultivation' on page 100.

7.7 Emptying the Vessel

Depending on the user specifications, the vessel can be emptied either before or after repeated sterilization. A vessel that has been emptied beforehand and only filled with water for sterilizing facilitates its subsequent cleaning.

For emptying the vessel, the same options as for harvesting are available, see ➔ Chapter 7.6 'Harvest' on page 156.

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

7.8 Sterilization after Cultivation

Depending on internal regulations, after completion of cultivation, some accessories such as reagent bottles, hoses, inoculation needles, etc. are then autoclaved separately before subsequent cleaning. The vessel is also once again sterilized in situ. This is particularly necessary as it is relevant to safety when processes are carried out with potentially dangerous, pathogenic or genetically modified microorganisms.



In any case, the exact procedure depends on the operator's requirements and can therefore differ from the one described here.

Proceed as follows:

Cultivation

1. ➤ Use pumps to completely empty all hoses of the reagent bottles.
2. ➤ Disconnect the hoses and remove them from the pumps.
3. ➤ If in use: remove the inoculation needles from the ports in the vessel top plate under sterile conditions and close the ports with blanking plugs before in situ sterilization.
4. ➤ If in use: close the push valves and then sterilize them in situ together with the vessel and then autoclave separately.

5. ➤



We recommend thoroughly rinsing the reagent bottles with water after emptying and before autoclaving. Depending on the operator's specifications, the hoses are disposed of in an environmentally friendly manner and new ones are used for the next cultivation.

If necessary, dispose of residual liquid from the reagent bottle in an environmentally friendly manner.

6. ➤ Autoclave all components together (reagent bottle, hoses and inoculation needle).
 - After the sterilization process is completed successfully, these components will be sterile and no longer carry a risk of microbial contamination.
7. ➤ Repeat in situ sterilization.

8 Operation

This chapter describes all touch screen software functions accessible to the operator in detail. It also describes the emergency shut-off and restarting after an emergency shut-off.

! NOTICE

Changes to settings in the touch screen software by unqualified or untrained personnel can lead to malfunctions.

Most of the illustrations of the various menus, dialog boxes and tab pages of the touch screen software in this manual correspond to the view of a user of the *Technicians* user group and serve as examples. For more information on user groups and access rights, see ➔ Chapter 8.3.2.2 'User Groups' on page 178 and chapter ➔ Chapter 8.3.2.3 'Access Rights' on page 179.



Due to differences in the operating panel's screen format and resolution, the appearance of individual menus, dialog boxes, buttons etc. may differ slightly from the illustrations used in this manual. The functions remain unchanged.

Operation

8.1 Overview Screen, Menu Navigation and Control Elements

Techfors-S Logged in as **Technician** 09:42:25

Sterilisation harvest valve: aborted at 28 Jul 2026 09:36:47

Bioreactor operation: in progress since 00:02:18

Preparation

Calibrate pO₂

Calibrate pH

Fill / Empty Pumps

Calibrate Pumps

Acid Pump	Stop	
Base Pump	Stop	
Antifoam Pump	Stop	unavailable during run
Feed Pump	Stop	unavailable during run

Additional

Tare Weight

Bioreactor Operation

Start

Stop

in progress since 00:02:18

Transfer	Stop
Harvest	Stop

Full Sterilisation	Stop	aborted at 28 Jul 2026 09:36:47
SIP Harvest Valve	Stop	
SIP Sample Valve	Stop	
SIP Feed Line	Stop	
SIP Transfer Line	Stop	
SIP Transfer Block Valve	Stop	

Recipes

Load / Start Recipe

Save Recipe

Delete Recipe

Main

Batch

Controller

Cascades

Trends

System

Alarms

Operation

Techfors-S

Logged in as **Technician**
15:10:38

Sterilisation sample valve: sterilisation, time left: 00:09:14
Bioreactor operation: in progress since 00:03:39

Preparation

Calibrate pO₂

Calibrate pH

Fill / Empty Pumps

Bioreactor Operation

Start

Stop

in progress since 00:03:39

Calibrate Pumps

Acid Pump

Stop

unavailable during run

Base Pump

Stop

unavailable during run

Antifoam Pump

Stop

unavailable during run

Feed Pump

Stop

unavailable during run

Feed 2 Pump

Stop

unavailable during run

Full Sterilisation

Stop

SIP Harvest / Sample Valve

Stop

SIP Sample Valve

Stop

in progress since 00:00:45

SIP Feed Line

Stop

Additional

Tare Weight

Recipes

Load / Start Recipe

Save Recipe

Delete Recipe

Main

Batch

Controller

Cascades

Trends

System

Alarms

INFORS HT

Sections

Title bar	Shows the device name, operating states, warning messages, login status and time. If an external software like eve® accesses the OPC XML DA server of the touch screen software, this is indicated by two vertically opposed arrows in the title bar. These flash while data is being transmitted.
Main section	Shows the main menus and submenus. Inputs are only made in the main section.
Footer	The footer consists of 7 tabs that provide access to the 7 main menus. The tab of a selected main menu is displayed with a light grey background.

Operation

Main Menus

The following main menus are available (from left to right):

- *Main*: shows parameters and their values, pumps or individual valves of the bioreactor.
- *Batch*: this is where the cultivation and all sterilization processes are started and stopped, and sensors and pumps are calibrated.
- *Controller*: lists the process parameters and makes it possible to change values.
- *Cascade*: allows serial, parallel or parallel serial (mixed) cascaded control of one or more parameters.
- *Trends*: shows trend lines of the parameters, time spread between 15 min and 2 days.
- *System*: provides access to the submenus *Valves*, *Security*, *Settings*, *Wipe Screen* and *Shutdown*.
- *Alarms*: shows parameter and system alarms.

Buttons

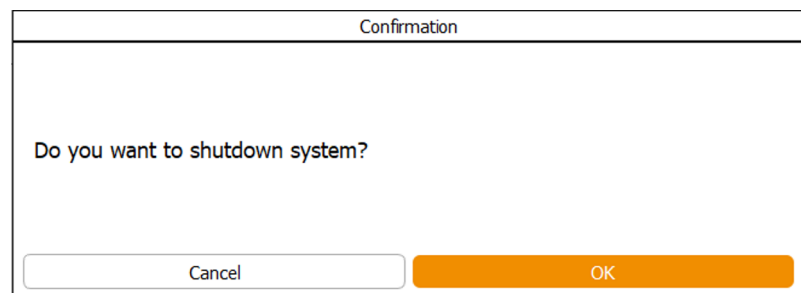


Different buttons are displayed depending on the selected main menu or submenu and access rights. Pressing buttons opens submenus, dialog boxes or tab pages. Available buttons have a white background, buttons that are not available appear grey.

Buttons that are intended to be the next logical step are highlighted in orange color, see figure in next section.

Dialog Boxes and Tab Pages

A dialog box can contain instructions, notes, warnings and general information.



A dialog box can also contain additional buttons, input fields or view boxes as well as tab pages. Example: dialog box *pH properties* with tab pages that lead to the parameter options.

pH properties

Setpoint

Calibrate

PID

Property	Value	Bar
Setpoint	7.00	
Value	2.00	
Output	OFF	
Lower Critical	2.00	
Lower Alarm	2.00	
Upper Alarm	12.00	
Upper Critical	12.00	

Controller:

Auto

OFF

pH temperature comp.

Cancel

OK

Input Fields and View Boxes

Input fields and view boxes are included in various menus, dialog boxes and tab pages. They require numeric or alphanumeric values to be entered or display these.

Numeric Keypad and Alphanumeric Keyboard

Numeric values are entered using a numeric keypad and alphanumeric values are entered using an alphanumeric keyboard. After pressing an input field, the corresponding block for the input appears, depending on the type of field.

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?123

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ON/OFF Switch

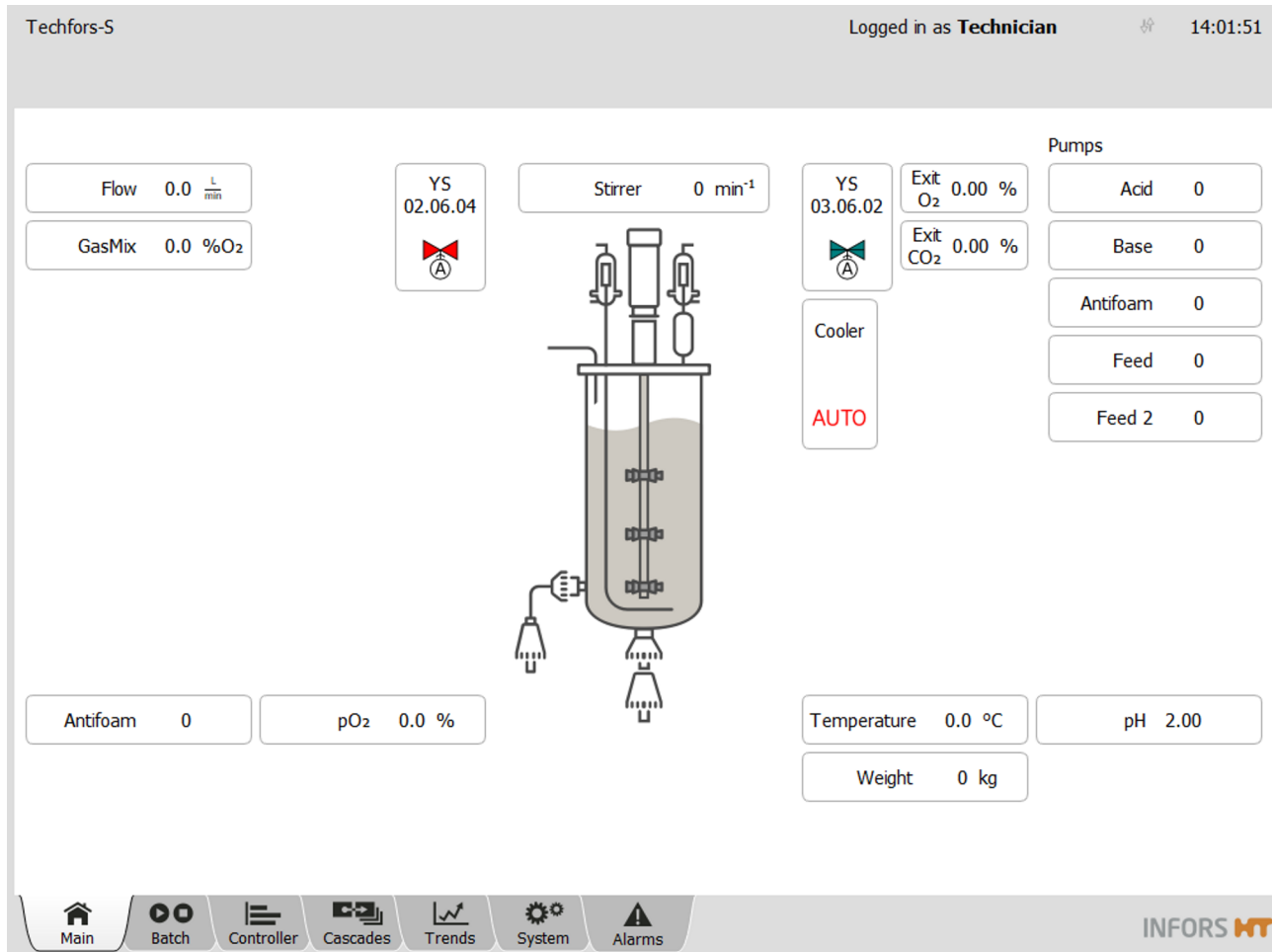


The **ON/OFF** switch is used for activating or deactivating a function.
ON: the switch is orange.
OFF: the switch is white.

Operation

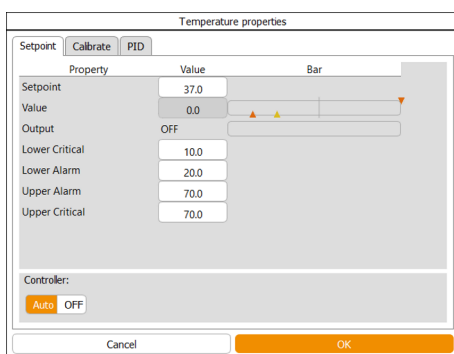
8.2 Main Menus

8.2.1 Main – Overview



The *Main* menu depicts the bioreactor and some of its valves graphically and provides an overview of the process parameters and pumps, which vary depending on the device configuration.

Parameter



Controlled process parameters and their actual values are displayed in the form of buttons. Pressing the button of a parameter leads to the parameter options. Example on the left: *Temperature* parameter, *Setpoint* option.

Pumps

Acid	0
Base	0
Antifoam	0
Feed	0
Feed	593.102

The right part of the screen depicts all integrated peristaltic pumps of the bioreactor in the form of buttons. By default, four pumps are available.

- *Acid*
- *Base*
- *Antifoam*
- *Feed*

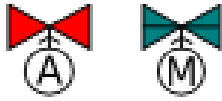
The quantity conveyed (in mL) of the calibrated pump is continuously displayed during a cultivation. This number is visible on the button of the corresponding pump. For non-calibrated pumps the number of rotations is displayed.

Acid pump properties	
Pump factor:	0.277778
Duration:	61
Value:	16.9444
Reset:	☐
Manual control	
FILL	EMPTY
Cancel	OK

Pressing one of the pump buttons opens the *pump properties* dialog box of the selected pump in which the number of revolutions can be reset to zero. The pump factor calculated during a pump calibration is also shown here and can be changed manually. In addition, the **FILL** / **EMPTY** buttons enable manual filling or draining of the pump hose.

Operation

Valves



- The red color indicates a closed valve.
- The green color indicates an open valve.
- The letter *A* indicates that the valve is in automatic mode.
- The letter *M* indicates that the valve is in manual mode, i.e. in a "forced" state.

Valve properties

Auto

On

Off

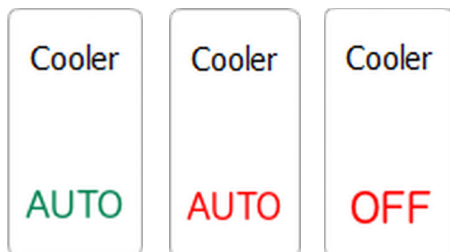
Cancel

Pressing a valve button opens a dialog box where you can use **On**, **Off**, or **Auto** to change the valve status for diagnostic purposes.

! NOTICE

Ex-factory, all valves are switched to automatic mode (*Auto*). These settings must not be changed.

Exit Gas Cooler



The **Cooler** button signals the *01.06.06* valve for the water feed to the exit gas cooler. In automatic mode, the valve opens during an running cultivation and during full sterilization it opens in the cool down phase. For a manually switched valve, no water can be fed in, the valve remains closed. This is signalized with *OFF* in a red font.

8.2.2 Batch – Start Menu

Techfors-S
Sterilisation harvest valve: aborted at 28 Jul 2026 09:36:47

Logged in as **Technician** 09:38:19

Preparation

Calibrate pO₂

Calibrate pH

Fill / Empty Pumps

Calibrate Pumps

Acid Pump Stop

Base Pump Stop

Antifoam Pump Stop

Feed Pump Stop

Additional

Tare Weight

Bioreactor Operation

Start Stop

Transfer Stop

Harvest Stop

Full Sterilisation Stop

SIP Harvest Valve Stop

SIP Sample Valve Stop

SIP Feed Line Stop

SIP Transfer Line Stop

SIP Transfer Block Valve Stop

Recipes

Load / Start Recipe Save Recipe

Delete Recipe

aborted at
28 Jul 2026 09:36:47

Main Batch Controller Cascades Trends System Alarms

INFORS HT

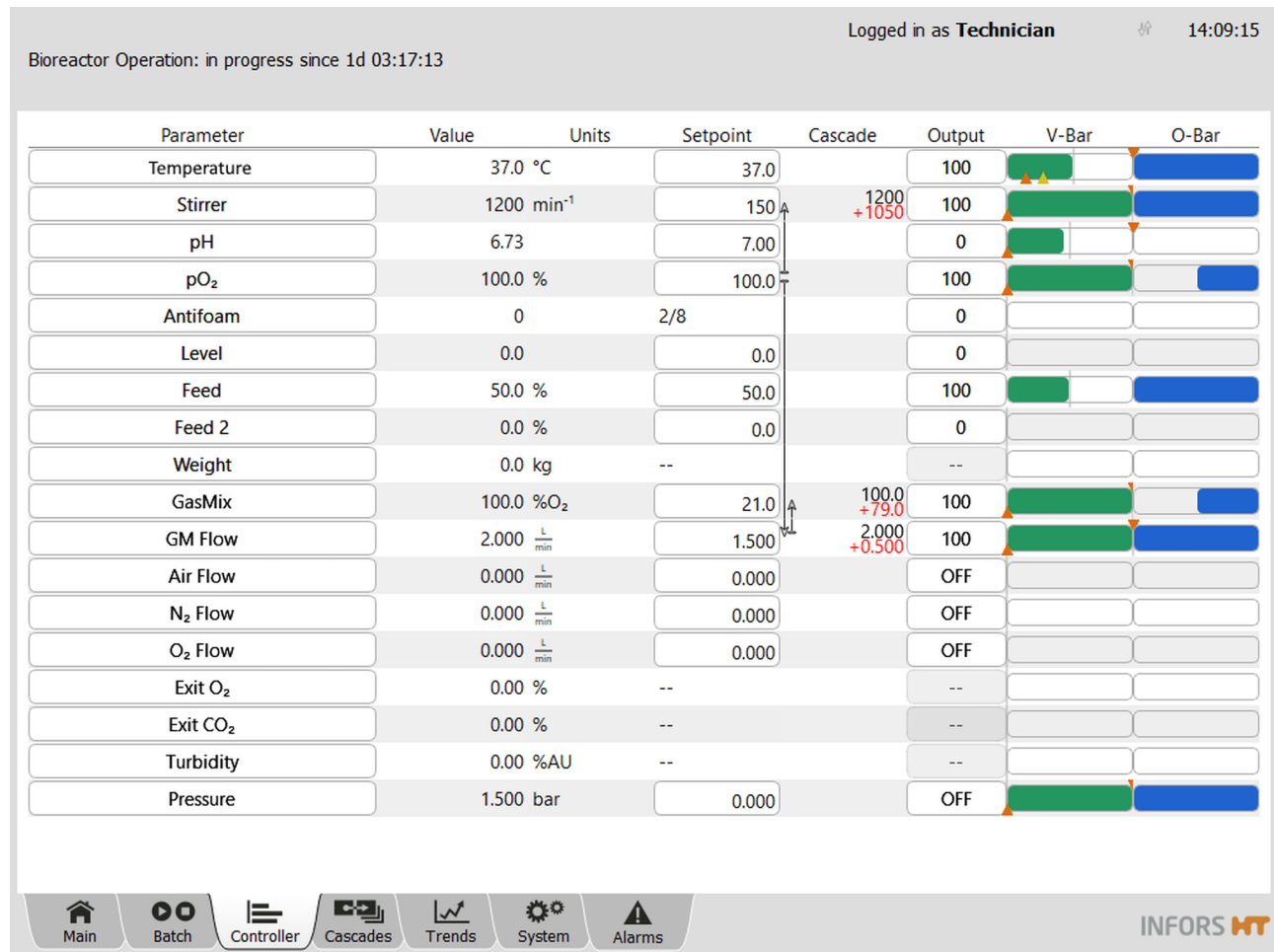
In the *Batch* main menu, the following activities can be performed.

- Starting and stopping the processes.
- Calibrating the pH und pO₂ sensors and pumps.
- Filling/emptying the pump hoses.
- Saving, loading and deleting recipes.
- Taring the weight display (only if the optional vessel weighing system is available).

Depending on the device configuration, the access rights of the operator and the operating status of the bioreactor, more or fewer functions are available and executable. Detailed descriptions of the various functions and processes are available in the corresponding chapters in this manual.

Operation

8.2.3 Controller – Value Display



The *Controller* main menu shows the actual values, setpoints and control outputs of the parameters of the bioreactor. Parameter settings can be adjusted here.

Menu Overview

Designation	Description
<i>Parameter</i>	Lists the parameters. Pressing a parameter button calls up its setting menu (→ Chapter 8.6, page 209).
<i>Value</i>	Shows the actual value of the parameters.
<i>Units</i>	Shows the unit of the parameters.
<i>Setpoint</i>	Enter/change parameter setpoints (→ Chapter 8.6.2.2, page 211).

Designation	Description
<i>Cascade</i>	Shows whether and which cascade control is active and which process parameters are used. Settings for cascade control are made in the <i>Cascade</i> main menu (→ chapter 8.7, page 233).
<i>Output</i>	Displays the controller output of a parameter in %. A deactivated parameter is indicated with the word <i>OFF</i> . If no process is running, all parameters are automatically deactivated. While a cultivation is running, parameters can be activated or deactivated by pressing the controller output button (.. %) or OFF provided automatic mode is set in the <i>Setpoint</i> parameter option (→ Chapter 8.6.2.2, page 211).
V-Bar (value bar)	Graphically displays the comparison between the actual value, setpoint and alarm limit: ■ Grey continuous marking: set setpoint ■ Yellow marking: set alarm limits (<i>lower alarm / upper alarm</i>) ■ Red marking: set critical values (<i>lower critical / upper critical</i>) ■ Green bar: actual value is within alarm limits. ■ Yellow bar: actual value has exceeded the upper alarm limit or fallen below the lower alarm limit. ■ Red bar: actual value has exceeded the critical upper value or fallen below the critical lower value.
O-bar (controller output bar)	Graphically displays the current controller output in %. Two-sided controlled parameters (e.g. pH and temperature) are displayed as two-part bars.



Changed settings in the *Controller* main menu only apply to the running cultivation. A cultivation is always started with the settings in the configuration dialog.

Operation

8.2.4 Cascades

Logged in as **Technician** 17:19:23

Edit ☒

Clear

Advanced ☐

Stirrer, [1/min]

Setp.Max 1200

Setpoint 500

Setp.Min 0

Negative ☐

Output ☐

Antifoam
Feed
Feed 2
Air Flow
GM Flow
GasMix
N₂ Flow
O₂ Flow

Pressure
Temperature
pH

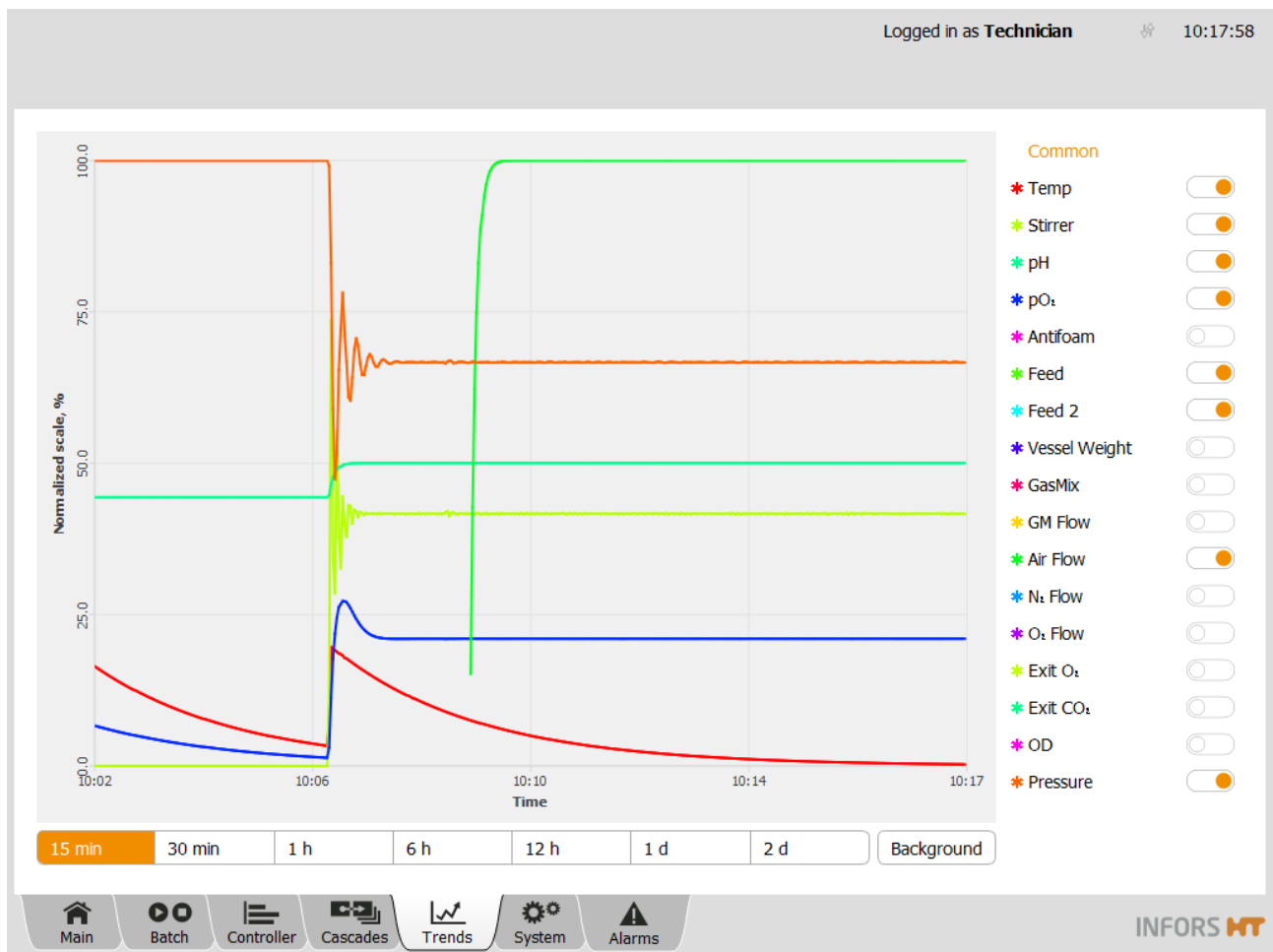
pO₂
↓
Stirrer

Main
Batch
Controller
Cascades
Trends
System
Alarms

INFORS HT

The *Cascades* main menu provides the option of setting up a serial, parallel or mixed cascade control of a parameter. This function is mainly used for pO₂ control. The cascade settings are made in the left-hand section of the screen and the main section presents these schematically. The individual process parameters can be added to a cascade by dragging & dropping them (➔ Chapter 8.7, page 233).

8.2.5 Trends – Trend Lines



The touch screen operating panel keeps the actual values of the parameters in a buffer memory and displays them continuously as a diagram in the *Trends* main menu. This data cannot be archived, edited or exported. However, this data can be transferred to a computer connected via a network, for example, by using eve®, and then be archived there.

The parameters are displayed on the right side of the screen. The trend lines can be shown or hidden by using the **ON/OFF** switches.

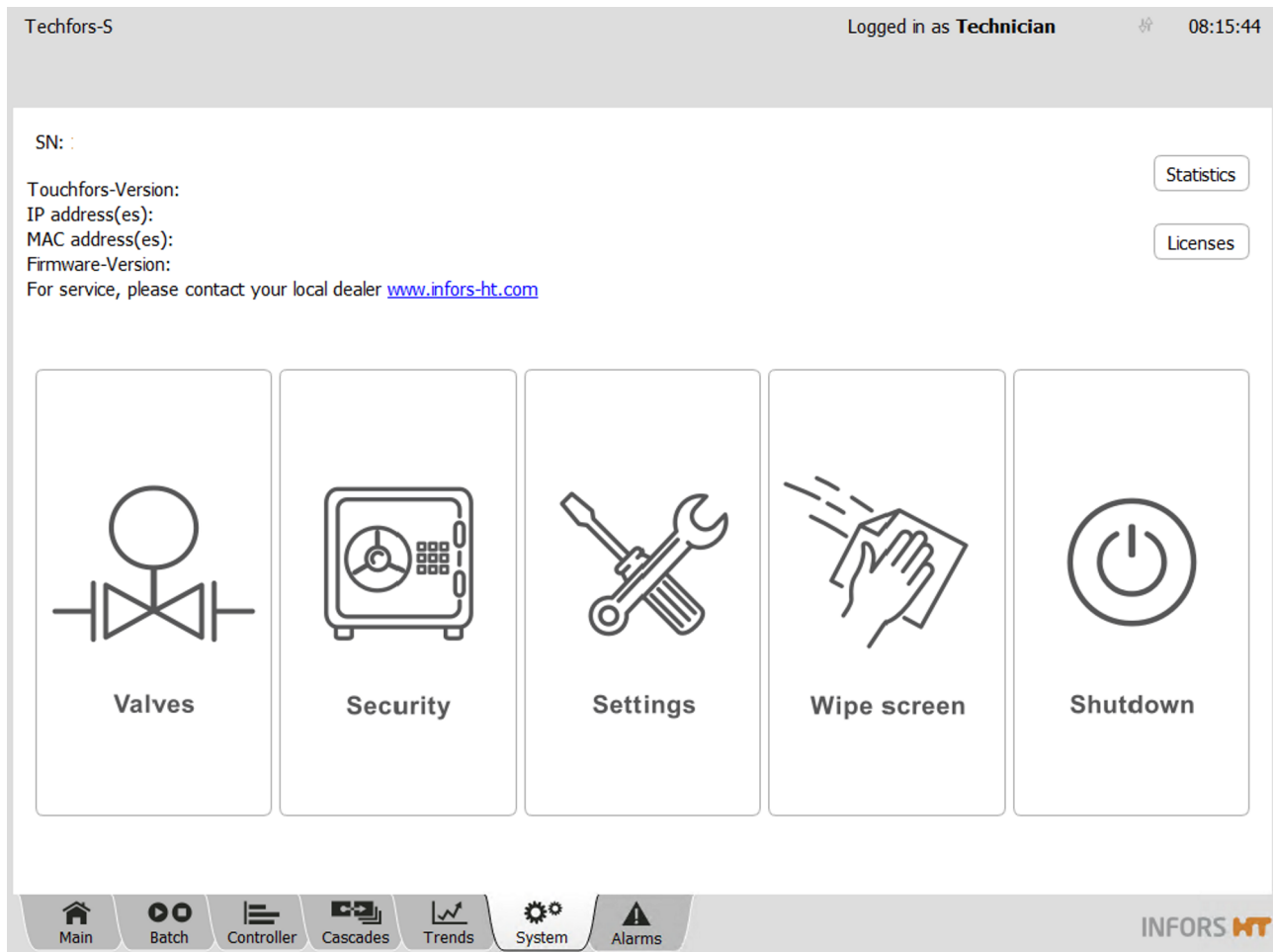
- Y-axis: if the *Common* view is selected (press *Common* above the parameter list), all trend lines of the parameters are displayed on a normalized scale. This means that minimum and maximum permissible values are displayed as 0 % and 100 %.

If a parameter is selected in the list (press the parameter name), the Y-axis label changes to the value range in the parameter's unit.

- X-axis: the time spread of the diagram display can be set from 15 min to 2 days using the buttons below the diagram.
- **Background:** to set the background color in white, grey or black.

Operation

8.2.6 System – System Settings



Device Information

The *System* main menu shows the following information on the device:

- Serial number
- Software version
- IP address(es) of the system
- Device address (*MAC address*)
- Firmware version
- Internet address (domain) of the manufacturer

Buttons

The top right of the screen has two buttons:

- **Statistics:** makes it possible to view some statistics of the software communication with the control board, or hardware. The only purpose of this function is to assist the manufacturer's technical support with troubleshooting.
- **Licenses:** opens a menu with licenses of the software libraries used.

Submenus

The menu has 5 buttons, which lead to different submenus:

- *Valves:* shows the status of the digital outputs
- *Security:* for system login and logout, passwords and user management
- *Settings:* for system and basic settings of the device.
- *Wipe Screen:* lock the screen for 20 seconds e.g. to clean the screen
- *Shutdown:* for shutting down the system.

Operation

8.2.7 Alarms – Alarm Display

8.2.7.1 Menu Overview

Techfors-S Logged in as **Technician** 16:52:37

Bioreactor operation: in progress since 00:39:51

No water

Description	Start	End	Confirmed
No water detected in temperature control system, refill failed	14 Okt 2021 16:15:15		Confirm

Main Batch Controller Cascades Trends System **Alarms**

INFORS HT

The Alarms main menu lists all process parameter alarms by time of occurrence. All system alarms are also displayed here.

Alarm Display



An alarm is indicated by the alternately light red-dark red flashing *Alarms* tab.

The screen has the following columns:

- *Description*: describes the alarm.
- *Start* and *End*: shows the start and end of the alarm with date and time.
- *Confirmed*: uses **Confirm** to display alarms with date, time and user.

8.2.7.2 Parameter Alarms

A parameter alarm occurs as soon as the actual value of a parameter is outside the set alarm limits or critical values.

Example

- Displayed alarm: *pO₂: lower (14.3 < 15)*
- Meaning: the actual value of the parameter pO₂ (= 14.3 %) has fallen below the lower alarm limit (= 15 %).



The values in brackets always refer to the actual value compared to the set alarm limit or critical value.

8.2.7.3 Overview System Alarms

The following system alarms can occur.

System Alarm	Short Description	Additional Information
<i>Password Expiry</i>	The password expires. The alarm for password expiry appears during the 10-day period leading up to the expiry. The password validity period is set when a new user login is created.	➔ Chapter 8.3.2.10, page 188
<i>Difference in board configuration</i>	Different control board configuration(s) detected.	➔ Chapter 8.2.7.3, page 176
<i>Invalid modbus map for Parameter xy</i>	Invalid modbus setting for parameter xy.	This alarm can only appear if changes have been made in the modbus settings. Modbus settings can only be changed by the <i>Service</i> user group.
<i>Requested specialized configuration not installed</i>	An error occurred while restoring backed up data via Restore or installing software updates via Update .	➔ Chapter 8.2.7.3, page 176
<i>No communication</i>	No communication between the control board and the operating panel.	➔ Chapter 9.1.1, page 271
<i>System restarted after power failure</i>	System restart after power failure.	➔ Chapter 9.1.10, page 280
<i>No water detected in temperature control system, refill failed</i>	No water detected in temperature control system.	➔ Chapter 9.1.3, page 273

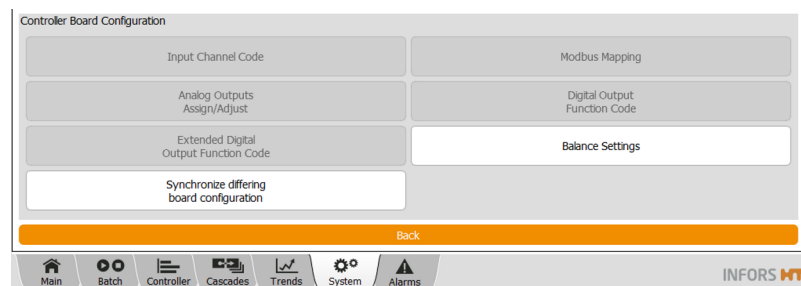
Operation

System Alarm	Short Description	Additional Information
<i>Circulation pressure too low</i>	Only with option temperature control system with closed circuit: insufficient pressure in the temperature control circuit.	➔ Chapter 9.1.3, page 273
<i>Max. heating up time exceeded</i>	Max. heating up time exceeded during full sterilization.	➔ Chapter 9.1.3, page 273
<i>High foam detected</i>	Only with option foam detection in exit gas: the sensor in the exit gas line detected foam during cultivation.	All relevant parameters for gassing are switched off. This prevents further gas formation (➔ Chapter 3.10.1, page 109).

System Alarm *Difference in board configuration*

A backup of the control board configuration is stored in the touch screen for the device. After a firmware update/control board or touch screen swap, the *Difference in board configuration* alarm might appear. This means that the back up does not match the current configuration.

To be able to select the corresponding configuration, the *Settings* submenu, *Controller Board Configuration* area now shows the **Synchronize differing board configuration** button.



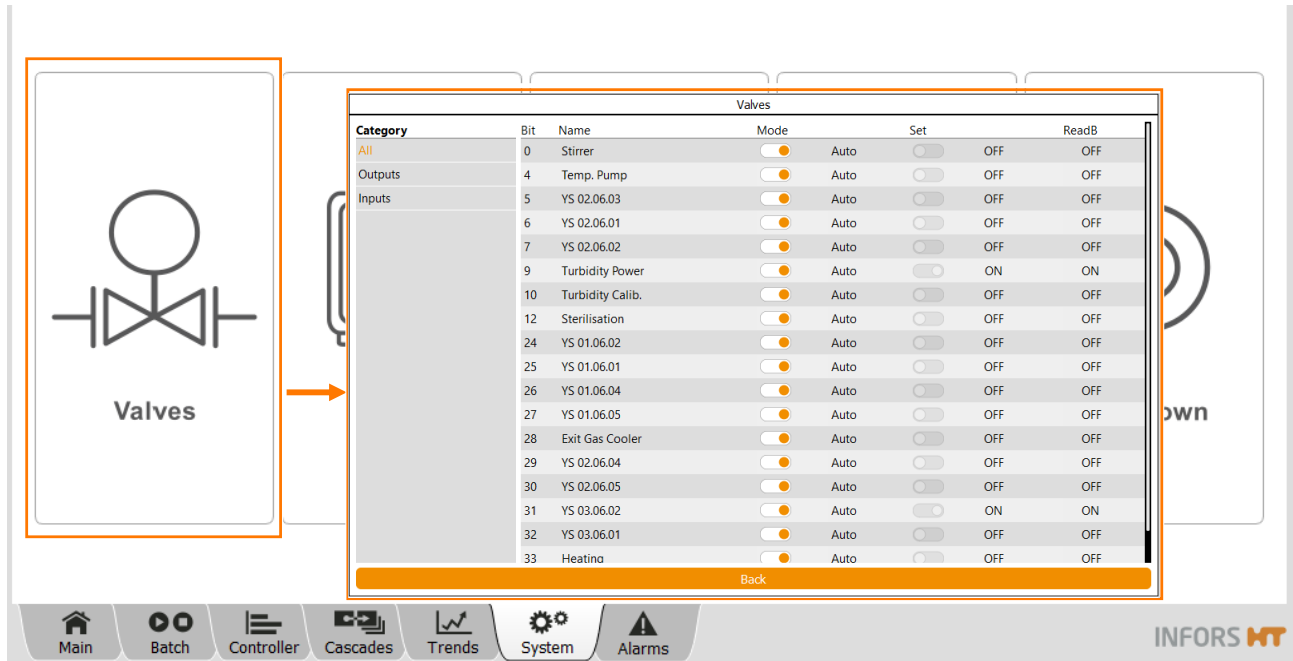
When this function is selected (by pressing the button), the menu appears with two options:

- **Use board configuration:** replace the backup in the touch screen with the current configuration of the control board. This option is useful after changing the touch screen.
- **Use stored board configuration:** the configuration of the control board is overwritten with that from the backup. This option is useful after a firmware update or changing the control board.

The alarm disappears as soon as the selection function has been executed.

8.3 Submenus

8.3.1 Valves – Digital Controller Outputs



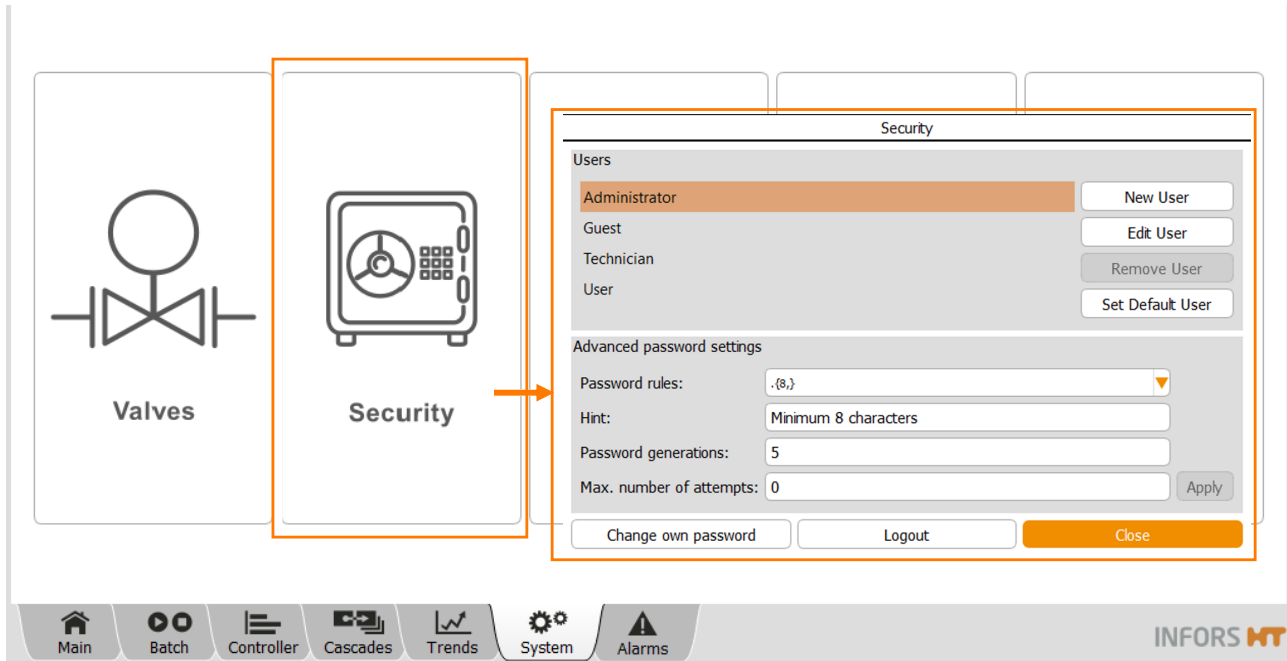
The submenu *Valves* displays the digital outputs and inputs of the control board. The overview is predominantly used for fault diagnosis. All valves and digital outputs are set to automatic mode (*Auto*) ex-factory. These settings must not be changed! The view of all (*All*) digital inputs and outputs or only the display of the inputs or outputs can be selected in column (*Category*). The main column contains:

<i>Bit / Name</i>	Channel number and designation	
<i>Mode</i>	<i>Auto</i>	Automatic switching
	<i>Manual</i>	Manual switching, outputs are forced, i.e. the automatic switching is thus disabled.
<i>Set</i> (Switching status of the digital output)	<i>OFF / ON</i>	Output is switched off / on
<i>ReadB</i> (Electronic feedback channel, which confirms the change in status)	<i>OFF / ON</i>	Readback is switched off / on
If the electrical connection is faulty, it is displayed as <i>FALSE</i> .		

Operation

8.3.2 Security – User Administration

8.3.2.1 Menu Overview



The *Security* submenu is used for logging on and off to and from the system. Users can also be added or deleted here, passwords can be set and access rights can be assigned. The number of functions available depends on the authorisation of the user that is logged on:

- **Login/Logout:** log in to/out of the system.
- **Change own password:** change your own password.
- **New User:** add a new user.
- **Edit User:** edit user settings.
- **Remove User:** delete user.
- **Set Default User/Clear Default User:** set/delete automatic user login.
- *Advanced password settings:* define password rules for password security.

The different user groups, access rights and functions are described in the following chapters.

8.3.2.2 User Groups

There are five user groups (*Groups*) with different access rights. Ex-factory, a user has been created for each of the groups, except for the *Service* group.

User groups	User	Password
<i>Guest</i> ¹⁾	<i>Guest</i>	No password
<i>Users</i>	<i>User</i>	qwertyuiop
<i>Technicians</i>	<i>Technician</i>	qwertyuiop
<i>Administrators</i>	<i>Administrator</i>	qwertyuiop
<i>Service</i> ²⁾	--	--

¹⁾ Without access rights, is logged on automatically if no other user is logged on.

²⁾ Can only be accessed by qualified INFORS HT service technicians and is blocked for all other users.



The passwords defined ex-factory should be changed and administrated by the authorized person (*Administrator*) during initial commissioning.

8.3.2.3 Access Rights

Legend

- V (= View) = visible, function cannot be executed. Depending on the function, visible means that only the button or the menu/dialog box is visible.
- E (= Execute) = visible and function can be executed.
- Blank field = neither visible nor can the function be executed.

CULTIVATION (<i>Bioreactor Operation</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Start / Stop (Start/Stop)	V	E	E	E	E

STERILIZATION	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Default: full sterilization (Full Sterilisation)	V	E	E	E	E
Default: sterilization harvest valve (SIP Harvest Valve)	V	E	E	E	E
Option: sterilization sample valve (SIP Sample Valve)	V	E	E	E	E

Operation

STERILIZATION	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Option: sterilization feed line (SIP Feed Line)	V	E	E	E	E
Option: sterilization Transfer block valve (SIP Transfer Block Valve)	V	E	E	E	E
Option: sterilization Transfer line (SIP Transfer Line)	V	E	E	E	E

PROCESSES DIVERSE	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Option: harvest (Harvest)	V	E	E	E	E
Option: transfer (Transfer)	V	E	E	E	E

RECIPES (<i>Recipes</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Load / Start	V	E	E	E	E
Save	V	V	E	E	E
Delete	V	V	E	E	E

PUMPS	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Calibrating (<i>Calibrate Pumps</i>)	V	E	E	E	E
Resetting the counter (<i>Reset</i>)	V	E	E	E	E
Manually setting the pump factor	V	E	E	E	E
Filling/emptying hoses (FILL/ EMPTY)	V	E	E	E	E

PARAMETER options	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Setpoint input (<i>Setpoint</i>)	V	E	E	E	E

Operation

PARAMETER options	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Alarm values and critical values (<i>Upper/Lower Alarm, Upper/Lower Critical</i>)	V	E	E	E	E
Activating and deactivating parameters (<i>Output active ON / OFF</i>)	V	E	E	E	E
Calibrating the pH sensor (Calibrate pH)	V	E	E	E	E
pH analog: changing <i>Slope</i> and/or <i>Offset</i> (calibration mode Manual)		E	E	E	E
Calibrating the pO ₂ sensor (Calibrate pO₂)	V	E	E	E	E
pO ₂ analog: Use As Setpoint function in calibration menu		E	E	E	E
Use As Setpoint function (if available) in all other calibration menus				E	E
<i>Calibrate</i> , all except the ones mentioned above			V	E	E
Calibration, manual (calibration mode Manual), all except the ones mentioned above				E	E
Option: turbidity sensor, calibrating the zero point (<i>Turbidity, Calibrate</i>)	V	E	E	E	E
Option: taring the vessel weight display (Tare Weight)	V	E	E	E	E
PID			E	E	E
<i>Options</i>					E

CASCADES (<i>Cascades</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Setting a cascade	V	E	E	E	E
Setting an advanced cascade (<i>Advanced</i>)			E	E	E

TREND LINES (<i>Trends</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Changing the display settings	E	E	E	E	E

Operation

ALARMS (<i>Alarms</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Confirming an alarm (Confirm)	V	E	E	E	E

SYSTEM (<i>System</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Viewing the statistics of the communication software with the bioreactor hardware (Statistics)	E	E	E	E	E
Viewing licenses for software libraries (Licenses)	E	E	E	E	E

DIGITAL INPUTS/OUTPUTS (<i>System, Valves</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Switching inputs/outputs manually (<i>Outputs / Inputs</i>)	V	V	E	E	E

USER ADMINISTRATION (<i>System, Security</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Logging in (Login)	E	E	E	E	E
Logging out (Logout)		E	E	E	E
Changing the password (Change Password)		E	E	E	E
Setting password rules (<i>Advanced password settings</i>)				E	E
Adding a new user (New User)		V	V	E	E
Removing a user (Remove User)		V	V	E	E
Changing user settings (Edit User)		V	V	E	E
Setting a default user (Set Default User)		V	V	E	E
List of all users (<i>Users</i>)				V	V

SYSTEM SETTINGS (<i>System/ Settings</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Network settings (IP Settings)	V	V	V	E	E
Changing the date and time (Change Time)	V	V	V	E	E
Saving data (Backup)			V	E	E
Restoring data backups (Restore)			V	E	E
Service menu		V	V	V	E
Exporting log files (Export Logs)		E	E	E	E
Setting codes for input channels (Input Channel Code)			V	V	E
Assigning/changing analog outputs (Analog Outputs Assign/Adjust)			V	V	E
Setting extended function codes for digital outputs (Extended Digital Output Function Code)			V	V	E
Synchronizing different board configurations (Synchronize differing board configuration)			E	E	E
Modbus settings (Modbus Mapping)			V	V	E
Setting function codes for digital outputs (Digital Output Function Code)			V	V	E
Balance Settings	V	V	V	E	E

SCREEN LOCK (<i>System, Wipe Screen</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Activating a temporary screen lock (Wipe Screen)	V	E	E	E	E

SYSTEM SHUTDOWN (<i>System, Shutdown</i>)	User groups				
	Guests	Users	Techn.	Admin.	Serv.
Shutting down the system (Shutdown)	V	E	E	E	E

8.3.2.4 Login/Logout – Logging in to/out of the System

To log in to the system, proceed as follows:

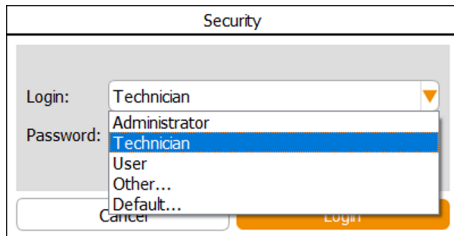
Operation

1. ➤ Call up the *System* main menu and press **Security**.

- ➡ The *Security* submenu appears.

The drop-down list in the *Login* field contains all users that are pre-set ex-factory and can be selected:

- *User*
- *Technician*
- *Administrator*
- *Other*: only for INFORS HT service staff
- *Default*: automatic user login without password input, if previously configured via **Set Default User**.



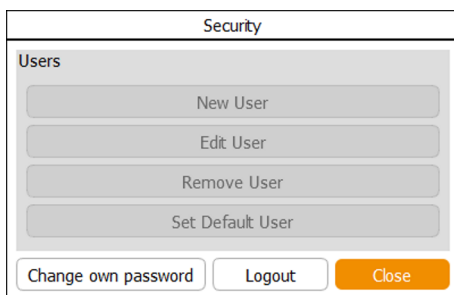
2. ➤ Select the desired user, e.g. *Technician*.

3. ➤ Enter the password, and press **Login**.

- ➡ The user is logged in.

- ➡ The *Security* menu now lists the different functions as buttons.

Change own Password (change your own password), **Logout** (log out of the system) and **Close** (leave menu) are available to all users (except for the *Guest* user).



For the *Administrators* user group, all password rules can also be set here, see ➡ Chapter 8.3.2.10 'Password Security – Setting Password Rules' on page 188.

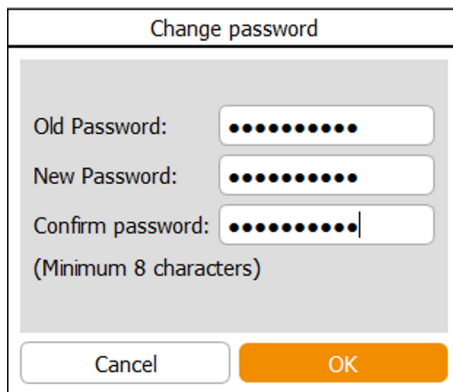
8.3.2.5 Change Own Password – Changing the (Own) Password

Users of all user groups can change their own password. To be able to change their password, the user must be logged in to the system.

To change the own password, proceed as follows:

1. ➤ Call up the *Security* submenu and press **Change own password**.

- ➡ The *Change password* dialog box appears.



Change password

Old Password:

New Password:

Confirm password: (Minimum 8 characters)

Cancel OK

2. Enter the old password.
3. Enter the new password and confirm by entering it again.

➔ All inputs are displayed as dots.



Depending on the password rules set, the password must meet various conditions. Password rules can be configured by *Administrator* users.

4. Press **OK**.

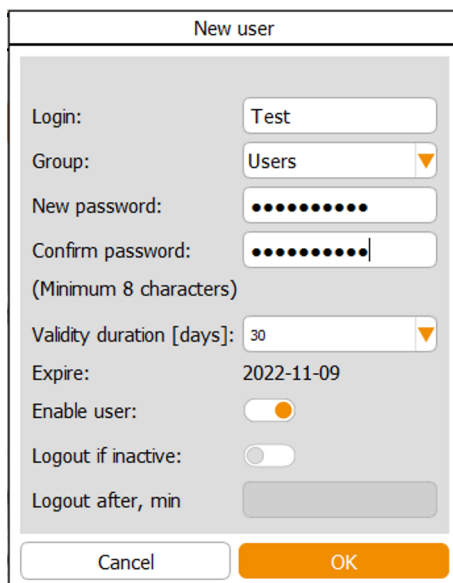
➔ The dialog box disappears, the password is saved.

8.3.2.6 New User – Adding a New User

To add a new user, proceed as follows:

1. As *Administrator* call up the *Security* submenu and press **New User**.

➔ The *New User* dialog box appears.



New user

Login:

Group:

New password:

Confirm password: (Minimum 8 characters)

Validity duration [days]:

Expire: 2022-11-09

Enable user: ☒

Logout if inactive: ☐

Logout after, min:

Cancel OK

2. Enter the new user (*Login*).
3. Select the user group in the *Group* drop-down list.
4. Enter the password in *New password* and confirm it by entering it again in *Confirm password*.



Depending on the password rules set, the password must meet various conditions. Password rules can be configured by *Administrator* users.

5. Select the validity period of the password in the *Validity duration [days]* drop-down list, by choosing between "unlimited", 30, 100 and 365 days.
- ➔ The corresponding expiry date is then shown in *Expire*.
6. Activate or deactivate the new user's access rights (*Enable user*); these are activated by default.



If the function is deactivated, the user has no access rights and a password cannot be assigned.

Operation

7. ➤ Activate or deactivate the automatic user logout (*Logout if inactive*) after expiry of a defined time period of screen inactivity, and set a time limit (*Logout after, min*) if necessary.

8. ➤ Press **OK**.

➡ The dialog box disappears, the new user appears in the user list of the *Security* submenu.

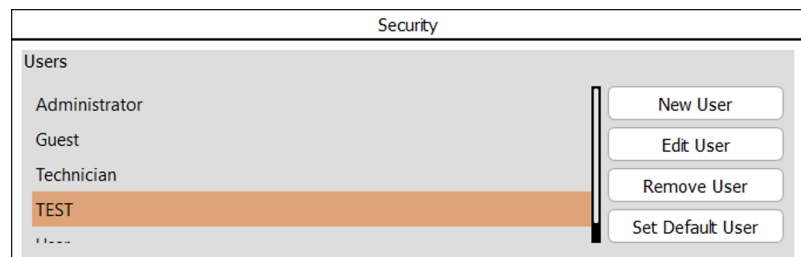
8.3.2.7 Edit User – Changing User Settings

Edit User can be used to change the following settings of an existing user:

- Assign a new user group.
- Change the password.
- Set automatic user logout on screen inactivity after a predefined time in minutes. The lowest user group *Guests* is then set automatically.

To make changes, proceed as follows:

1. ➤ As *Administrator* call up the *Security* submenu.



2. ➤ Select the desired user (here: *TEST*) from the selection list and press **Edit User**.

➡ The *Edit User* dialog box appears with almost identical options to those for entering a new user.

3. ➤ Make the desired settings.

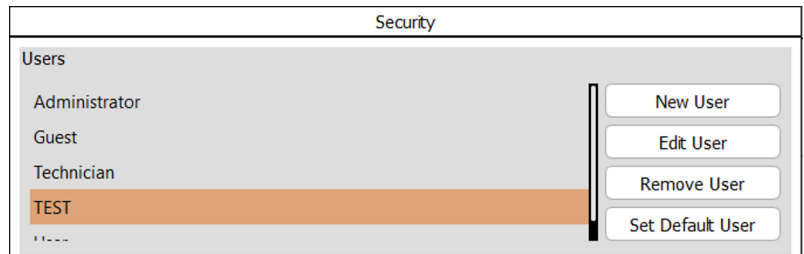
4. ➤ Press **OK**.

➡ The settings are applied, the dialog box disappears.

8.3.2.8 Remove User – Deleting a User

To delete a user, proceed as follows:

1. ➔ As *Administrator* call up the *Security* submenu.

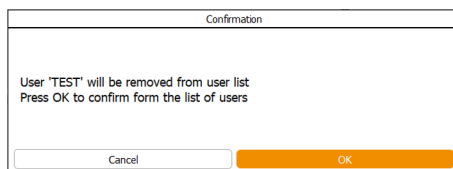


2. ➔ Select the desired user (here: *TEST*) from the selection list and press **Remove User**.

➔ The *Confirmation* dialog box appears with information and the prompt to confirm the deletion of the user.

3. ➔ Press **OK** to confirm the deletion.

➔ The dialog box disappears, the *TEST* user has been deleted.



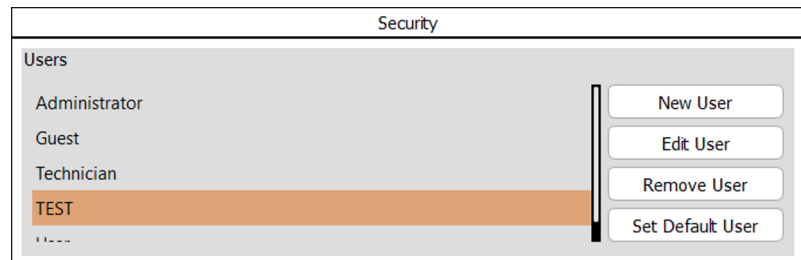
8.3.2.9 Set / Clear Default User – Setting up Automatic User Login

Set Default User is used to set up an automatic user login. That is, a user can be defined, which will be logged in automatically by the system next time it is switched on. This setting can be deleted via **Clear Default User**.

To do so, proceed as follows:

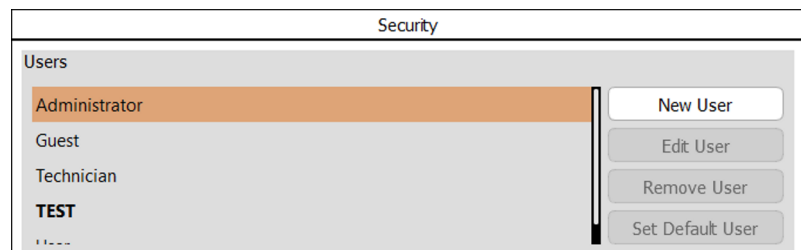
1. ➔ As *Administrator* call up the *Security* submenu.

Operation



2. ➔ Select the desired user (here: *TEST*) from the selection list and press **Set Default User**.

- ➔ The defined user for automatic user login is now displayed with a bold font, the **Set Default User** button is still visible but no longer available.



By selecting any other user, all buttons become available for changes again.

By selecting the defined user with automatic user log in, the **Clear Default User** button becomes available instead of **Set Default User**.

8.3.2.10 Password Security – Setting Password Rules

As *Administrator* user, the conditions for creating new user passwords can be configured in the *Security* submenu.

To do so, proceed as follows:

1. ➔ As *Administrator* call up the *Security* submenu.

- ➔ The lower menu section *Advanced password settings* is now visible and available.

- *Password rules*: a drop-down list with four password rules is available (see figure above). The password must contain at least:
 - 8 characters, which have to include at least 1 number, 1 upper case letter and 1 lower case letter
 - 8 characters, which have to include at least 1 number, 1 upper case letter, 1 lower case letter and a special character
 - 8 characters
 - 8 to a maximum of 10 characters
- *Hint*: when a password is being created, this shows the rules that have to be observed.
- *Password generations*: specifies the number of new passwords to be created before a password may be reused.
- **Apply**: apply the rule for new passwords to be created from now on.

2. Select the rule and enter the number of new passwords to be created.

3. Press **Apply**.

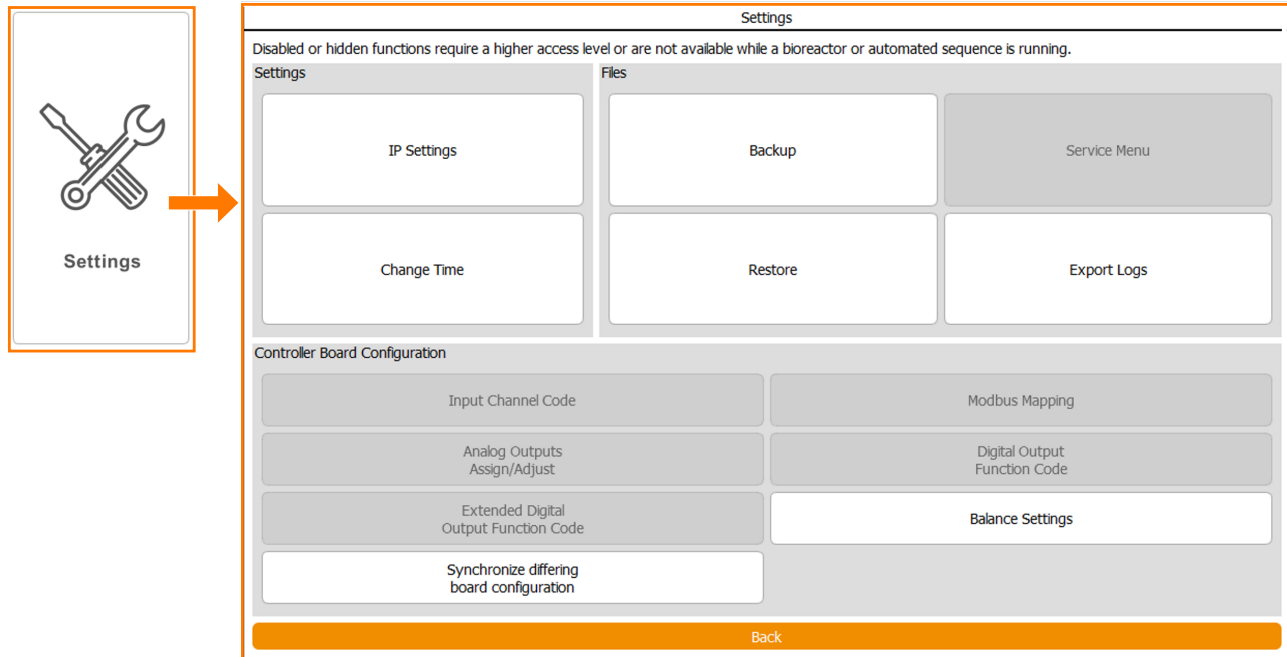
➡ The rule is saved and is displayed accordingly when the next password is to be created.

4. Close the *Security* submenu via **Close**.

Operation

8.3.3 Settings – Basic Settings of the Device

8.3.3.1 Menu Overview



The basic settings of the device are made in the *Settings* submenu. The number of buttons visible and available in this menu depends on the authorisation of the user that is logged on. The figure above shows the menu for an *Administrator* user. The menu is divided into three sections with different functions.

Settings

- **IP Settings:** network settings.
- **Change Time:** setting the time and date.

Files

- **Backup:** save data.
- **Restore:** upload saved data to the system.
- **Service Menu:** accessible only to INFORS HT service technicians or authorized licensed dealers.
- **Export Logs:** export log files.

Controller Board Configuration (Control Board Configuration)

- **Input Channel Code:** set codes for input channels.
- **Analog Outputs Assign/Adjust:** assign/change analog outputs.
- **Extended Digital Output Function Code:** set functions codes for extended digital outputs.
- **Synchronize differing board configuration:** synchronize differing board configuration.



This button only appears if a corresponding alarm (*Difference in board configuration*) has been triggered after a firmware update/change of control board or touch screen replacement and is displayed in the *Alarms* main menu.

- **Modbus mapping:** make modbus settings.
- **Digital Output Function Code:** set function codes for digital outputs.



This manual does not provide any further details on all the functions concerning inputs and outputs, function codes and modbus mappings. Only INFORS HT service technicians or authorized licensed dealers have access to these functions.

- **Balance Settings:** balance settings.

8.3.3.2 IP-Settings – Network Settings

IP-Settings can be used to configure a network connection. This can be done automatically or manually.



Settings can only be made if a network cable is connected. This manual does not cover how a network is set up or a network connection is established.

To call up this menu, proceed as follows:

1. ➔ As *Administrator* call up the *Settings* submenu.
2. ➔ Press **IP-Settings**.
 - ➔ The *Network Settings* menu appears.

Network Settings				
Obtain IP settings automatically		Use the following IP settings		
IP address:	192	168	8	162
Subnet mask:	255	255	255	0
Default gateway:	192	168	8	1
Adapter 'Ethernet' connected (192.168.8.162)				
Cancel		OK		

Operation

- **Obtain IP settings automatically:** automatically apply IP settings (default settings). Prerequisite: a DHCP server ¹⁾ is available in the network.
- **Use the following IP settings:** use the following IP settings. An entry can only be made in the following fields after pressing this button.
 - *IP address:* IP address or enter IP address manually.
 - *Subnet mask:* shows the current subnet mask or lets you enter one manually.
 - *Default gateway:* shows the default gateway or lets you enter one manually.



A status message ending with *...connected* indicates that the network connection has been established correctly. If that is not the case (no signal) the error message *No active LAN connection* appears.

¹⁾ *Dynamic Host Configuration Protocol*

8.3.3.3 Change Time – Changing the Date and Time

Change Time is used to adjust the date and time to the system's location. Ex-factory, the system is set to automatic synchronization with the time server. That is, it is displayed according to the selected time zone. Alternatively, settings can also be made manually.

To make settings, proceed as follows:

1. ➞ As *Administrator* call up the *Settings* submenu.
2. ➞ Press **Change Time**.
 - ➡ The *Change System time* dialog box appears with the configuration set ex-factory:
 - *Set time and date automatically:* activate or deactivate automatic time and date setting. This function is activated by default. This makes it possible to select the time zone and the cities assigned accordingly.
 - Drop-down lists for selecting time zones and cities: *Europe* and *Zurich* are set as the default.
 - *Specific NTP Server:* This option allows secure access to a time server (NTP server) to be set up from an internal network. To do this, either enter the desired host name or the corresponding IP address. If this field is left blank, the default NTP server stored in the system will be used.

To make manual settings, proceed as follows:

3. ➤ Deactivate automatic time and date setting.
 - ➔ Instead of the drop-down lists, input fields for year/month/day and hours/minutes/seconds appear now.
4. ➤ Set the desired values and use **OK** to confirm.
 - ➔ The entries are saved and the dialog box disappears.

8.3.3.4 Backup – Saving Data

The *Backup* function is used to save all settings of the touch screen software and the control board. This data can then be restored using the *Restore* function.

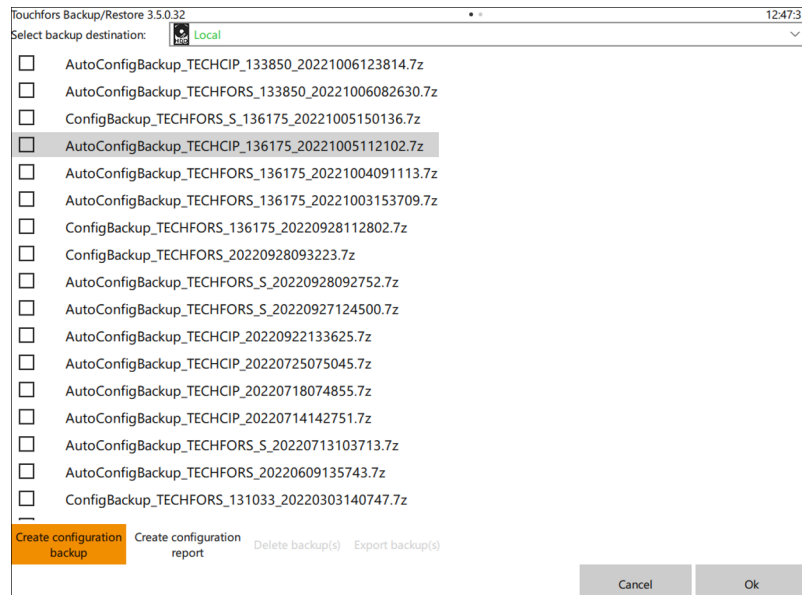
Please note:

- Data can be backed up to internal storage or a USB stick.
- A data backup can only be executed when all processes have stopped.
- Skip step 1 in the following description if you are not backing up the data onto a USB stick.

To back up data, proceed as follows:

1. ➤ Connect the special cable supplied by the device manufacturer to the operating panel and connect the USB stick to the cable.
2. ➤ As *Administrator* call up the *Settings* submenu.
3. ➤ In the *Files* section, press **Backup**.
 - ➔ The *Confirmation* dialog box appears with a note and a prompt for switching to backup mode.
4. ➤ Press **OK**.
 - ➔ The data backup menu appears.

Operation



- *Select backup destination:* choose a storage location, either *local* or *external* (on the connected USB stick).
- **Create configuration backup:** create a backup file of the current configuration.
- **Create configuration report:** output configuration data in a CSV file.
- **Delete backup(s):** delete saved backup file(s).
- **Export backup(s):** export the backup file(s) from the local storage location to the USB stick.

5. ➤ Select a storage location and press **Create configuration backup** to create the data backup.

- ➡ The configuration backup is stored as a 7zip file at the selected storage location.

6. ➤ Press **OK** to leave the menu.

7. ➤ Remove the USB stick, if you've used one.

8.3.3.5 Restore – Restoring Data Backups

The *Restore* function enables loading data to the system, which were saved using the *Backup* function. Also factory settings can be restored.

Please note:

- The data is loaded either from the internal storage or from a USB stick, see ➔ Chapter 8.3.3.4 'Backup – Saving Data' on page 193.
- The *Restore* function can only be executed when all processes are stopped.
- Skip step 1 in the following description if you are not loading the data from a USB stick.

To load data backups to the system, proceed as follows:

1. ➔ Connect the special cable supplied by the device manufacturer to the operating panel and connect the USB stick with the saved data (*Backup* data) to the cable.

2. ➔ As *Administrator* call up the *Settings* submenu.

3. ➔ In the *Files* section, press **Restore**.

➔ The *Confirmation* dialog box appears with a note and a prompt for switching to *Restore* mode.

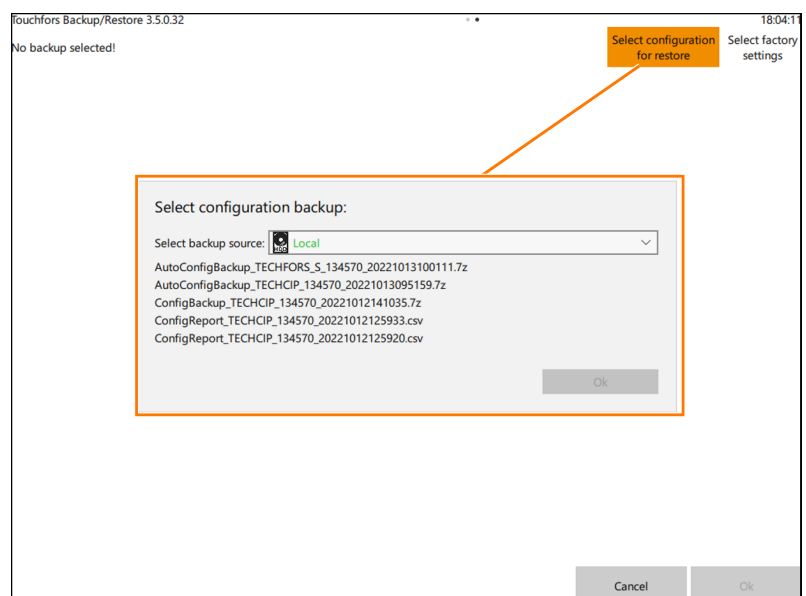
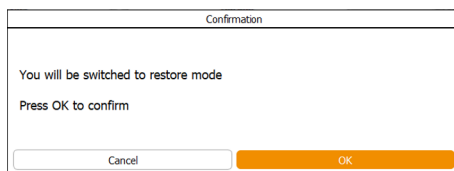
4. ➔ Press **OK**.

➔ The data backup/restore menu appears.

- **Select configuration for restore:** select configuration data backup for restoring.
- **Select factory settings:** select the factory setting.

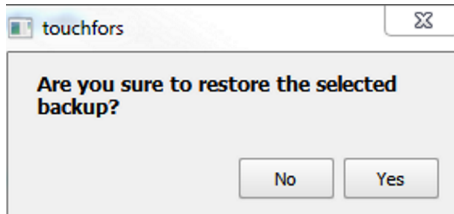
5. ➔ Press **Select configuration for restore**.

➔ The window for selecting the data source appears in the menu:



- *Local*: local, internal memory.
- *XY/:* (Drive): detected connected USB stick.

Operation



6. ➤ Select a data source and press **OK**.

- A dialog box with a confirmation prompt **No** or **Yes** for restoring the data appears.

7. ➤ Press **Yes**.

- The menu view changes, and the configuration comparison listing appears (not shown here).



The view of the differences within a file is primarily intended as information for the INFORS HT service technician. It represents the differences of the settings file to be restored compared to the version currently used in unified format (also unidiff).

8. ➤ Use **Cancel** to terminate the process or **OK** to execute the data restore.

9. ➤ Remove the USB stick, if applicable.

8.3.3.6 Export Logs – Exporting Log Files

The *Export Log* function can be used to store all log files as well as alarms and error messages on a USB stick.

Please note:

- A USB stick is required for the data export.
- A data export can only be executed when all processes have stopped.

To export the log files, proceed as follows:

1. ➤ Connect the special cable supplied by the device manufacturer to the operating panel and connect the USB stick to the cable.

2. ➤ As *Administrator* or *Technician*, call up the *Settings* submenu.

3. ➤ In the *Files* section, press **Export Logs**.

- The data export is started. As soon as this is done, an *Information* dialog box appears with the message that the log data has been successfully exported as a zip file (*Log files successfully exported to: xxxxx*).

4. ➤ Press **OK** to close the dialog box.

8.3.3.7 Balance Settings

The *Balance Settings* function is used to set up a maximum of 7 balances that can be connected (via the device manufacturer's Switchbox). Balances must be configured with the correct values. *Baud rate 9600 / 8 bits / no parity / 2 stop bits*.

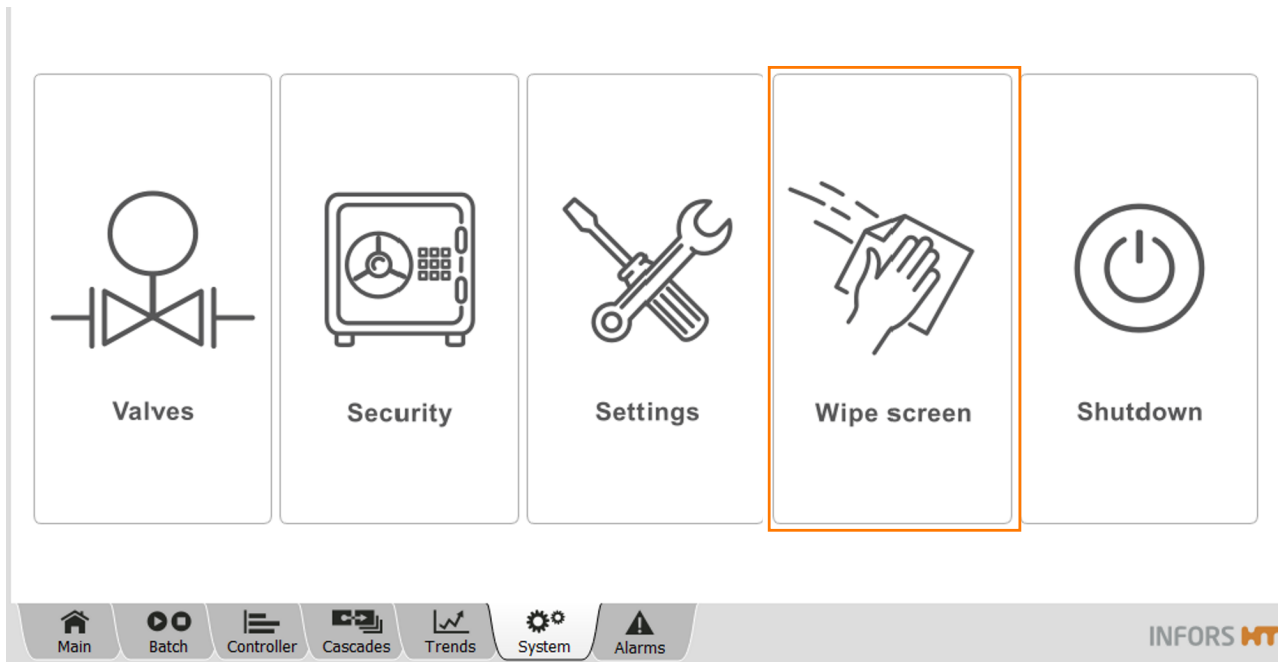
To make the settings, proceed as follows:

1. ➤ Connect the balance(s) or Switchbox.
2. ➤ As *Administrator* call up the *Settings* submenu.
3. ➤ Press **Balance Settings**.
 - ➡ The *Balance Configuration* appears with the mentioned configuration values for scales and drop-down lists for selecting the number and type of connected scales.

4. ➤ Select the number of balances in *Balances connected*:
 - *None*: none
 - *Single*: one balance; this means that the first drop-down list in the menu area becomes available.
 - *Infors Switchbox*: switchbox, this makes all 7 drop-down lists in the lower menu section available.
5. ➤ Select the type of balance(s) from the drop-down list(s).
6. ➤ Press **Back**.
 - ➡ The settings are applied, the configuration menu disappears.

Operation

8.3.4 Wipe Screen – (Temporarily) Locking the Screen



The *Wipe Screen* submenu has only one function: it locks all input on the screen for 20 seconds. This enables you to clean the screen within 20 seconds, if required.

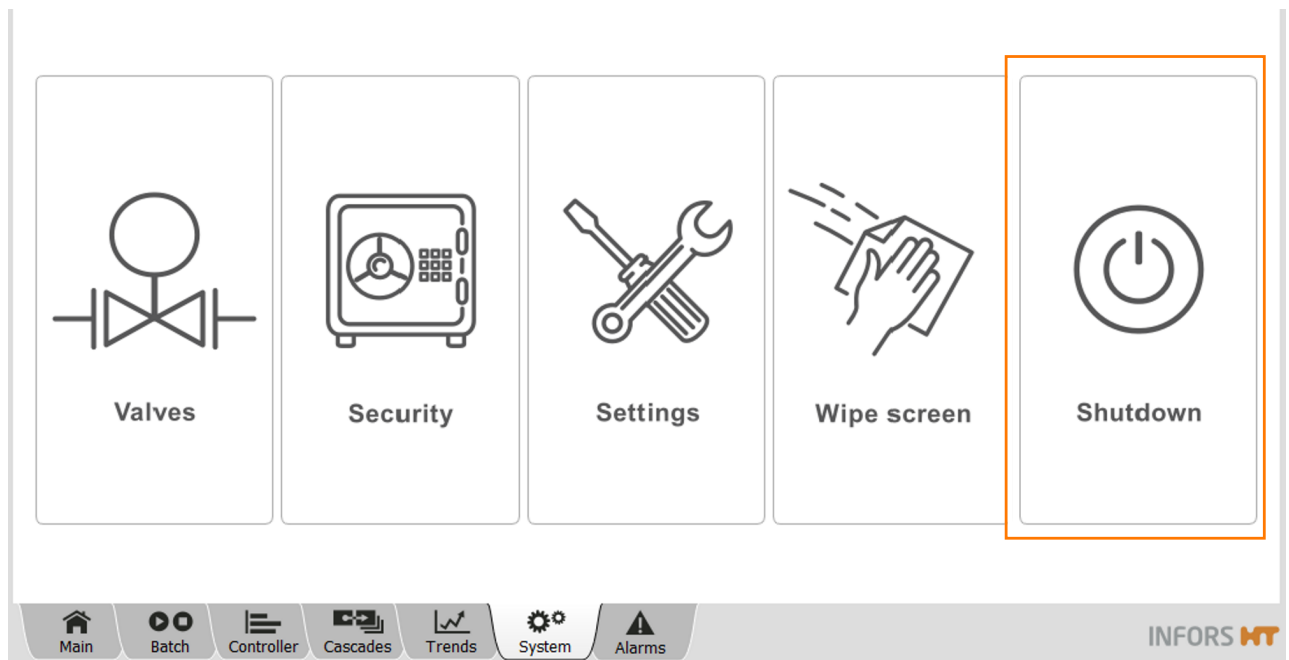
To activate the temporary screen lock, proceed as follows:

➔ Press **Wipe screen**.

Wipe time left: 17 seconds...

- ➔ The screen turns blank, the remaining time (*Wipe time left*) is displayed.
- ➔ At the end of this time, the last screen display reappears automatically.

8.3.5 Shutdown – Shutting Down the System



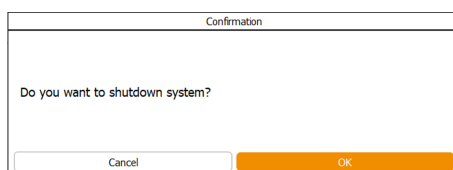
The *Shutdown* submenu has only one function: it shuts down the system. This is only possible when all processes have stopped.



ALWAYS shut down the system first, then switch off the device on the main switch!

Proceed as follows:

1. ➔ Call up the *System* main menu and press **Shutdown**.
 - ➔ The *Confirmation* dialog box appears with the query/prompt to confirm the shutdown.
2. ➔ Press **OK**.
 - ➔ The system shuts down.



Operation

8.4 Recipes

8.4.1 General Information

The different buttons of the *Recipes* function in the *Batch* main menu can be used to load and start, store or delete what are referred to as recipes. That is, the parameter settings (including cascades) of a cultivation can be stored and reused when the same work processes occur again.



All parameter settings, cascade settings and sensor calibration data are stored. Pump calibration data is not stored. Sensor calibration data is not loaded.

8.4.2 Save Recipe

Recipes can be saved when the cultivation is running or stopped.

1. ➤ Log in to the system as *Technician* or *Administrator*.
2. ➤ Call up the *Batch* main menu and press **Save Recipe**.
 - ➡ The *Save Recipe* dialog box appears for naming the recipe to be saved.
3. ➤ Enter a file name of your choice.
4. ➤ Press **OK**.
 - ➡ The recipe has been saved.

The 'Save Recipe' dialog box features a title bar 'Save Recipe', a text input field for the recipe name, and two buttons at the bottom: 'Cancel' and 'OK'.

8.4.3 Load/Start Recipe

Before loading and starting a recipe, all preparations for a cultivation should have been performed.

1. ➤ Call up the *Batch* main menu and press **Load/Start Recipe**.
 - ➡ The *Load Recipe* dialog box appears, listing all saved recipes with date and time.
2. ➤ Select a recipe.
 - ➡ The recipe is displayed highlighted in orange.
3. ➤ Press **Next**.
 - ➡ The *Load Recipe* dialog box changes the view.

The 'Load recipe' dialog box has a title bar 'Load recipe' and a table listing saved recipes. The first row, 'Recipe1', is highlighted in orange. At the bottom are 'Cancel' and 'Next' buttons.

Recipe name	Date of change
Recipe1	2022-10-13T09:52:42
Recipe2	2022-10-13T10:02:28
Recipe3	2022-10-13T09:53:01

Load recipe			
Parameter	Output Active	Setpoint	Units
Temperature	☐	37.0	°C
Stirrer	☒	300	1/min
pH	☒	7.00	
pO ₂	☒	100.0	%
Antifoam	☐	0	
Feed	☒	50.0	%
Feed 2	☐	50.0	%
GasMix	☒	100.0	%
Flow	☒	50.0	L/min

Cancel OK

Here, all parameters used in the recipe are listed. Setpoints can be changed subsequently and parameters can be activated or deactivated. Use **OK** to start the cultivation.

4. ➤ If necessary, change the setpoint and/or activate/deactivate parameters.

5. ➤ Press **OK**.

➔ The cultivation is started.

8.4.4 Delete Recipe

Recipes can only be deleted individually. A recipe can also be deleted during a running cultivation.

1. ➤ Log on to the system as *Technician* or *Administrator*.

2. ➤ Call up the *Batch* main menu and press **Delete Recipe**.

➔ The *Delete Recipe* dialog box appears, listing all saved recipes with date and time.

3. ➤ Select a recipe.

➔ The selected recipe is displayed highlighted in orange.

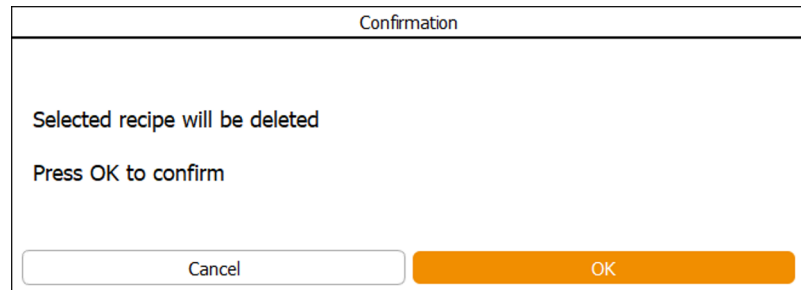
Delete Recipe	
Recipe name	Changed
Recipe1	2022-10-13T09:52:42
Recipe2	2022-10-13T09:52:53
Recipe3	2022-10-13T09:53:01

Cancel OK

Operation

4. ➤ Press **OK**.

- ➡ The *Confirmation* dialog box appears to confirm the deletion process.



5. ➤ Press **OK**.

- ➡ The recipe has been deleted.

8.5 Parameters

This chapter contains brief descriptions of all parameters. In addition to all parameters that are available by default in every device configuration, this also includes those parameters that are only configured if the corresponding device option is available.

Temperature

Measures and controls the temperature in the vessel. Measurements in °C are recorded by a platinum resistance temperature sensor (Pt100 sensor).

Stirrer

Measures and controls the rotation speed of the stirrer shaft in min⁻¹. The rotation speed range depends on factors such as vessel volume, number of impellers and the viscosity of the culture.

pH

Measures and controls the pH. This is controlled via the two digital peristaltic pumps *Acid* and *Base*. Their activity is time-specific. This means that they always operate in start/stop mode at the same speed. Control takes place using a PID loop. A deadband can be used to prevent unwanted rapid dosing of the pumps.

Temperature compensation is a special function of the pH parameter when using the analog pH sensor by the manufacturer METTLER. This function must be switched on during cultivation so that the temperature dependency of the measurement principle is corrected.

pO₂

Measures and controls the saturation of dissolved oxygen. Unlike e.g. pH measurements, which are calibrated to absolute measurements, 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 absolute concentration of dissolved oxygen in mmol/L may therefore vary at 100 % saturation, depending on the process. The PID controller output from the *pO₂* parameter is generally cascaded in combination with other parameters such as *Stirrer*, *Flow*, *Feed* or *GasMix*.

Operation

Antifoam

Detects foam and controls the addition of antifoam agent. The anti-foam pump is activated as soon as the antifoam sensor comes in contact with foam. The parameter output (*Output*) shows 100 % instead of 0 %. The activity of the pump is time dependent. This means that it always operates in start/stop mode at the same speed.

- The *Dose Time* must be set in seconds instead of the setpoint.
- The *Wait time* must be set in seconds instead of setting an alarm limit.

Level

Detects liquid in the vessel by means of the level sensor. As soon as this happens, the measurement display shows "100". The signal can be used as required for level control in the vessel. This can be done, for example, by using a simple cascade to control the feed pump or an optional pump. Special configurations are possible on request.

Feed

Controls the corresponding analog peristaltic pump for adding nutrient solution. The speed of the pump is variably adjustable in %.

Parameter	Controlled pump
Feed	Feed
Feed 2	Feed 2
Feed 3	Feed 3

Flow Parameter

Measures and controls the volume flow of the process gases via one or more mass flow controllers. The measurement system is completely electronic and the measurements are displayed in L min⁻¹.

Parameter	
Flow	Measures and controls the volume flow of two or more process gases in the vessel via a single mass flow controller (thermal mass meter with integrated control valve). If the <i>Flow</i> parameter is available this means that the individual process gas lines are equipped with solenoid valves, which are switched using the <i>GasMix</i> parameter.
Air Flow, O ₂ Flow and/or N ₂ Flow	Measures and controls the volume flow of two or more process gases in the vessel via a mass flow controller for each gas.
CO ₂ Flow	Measures and controls the volume flow of CO ₂ in the vessel via separate mass flow controller. This flow parameter is not part of the <i>GasMix</i> parameter.

GasMix

Controls the oxygen concentration in the inlet air. This is achieved by switching between air and oxygen or air and nitrogen for a 2-gas-mix system or air, oxygen and nitrogen for a 3-gas-mix system. Depending on the existing configuration this means that the relevant solenoid valve is switched on or the individual gas *Flow* parameters are controlled.

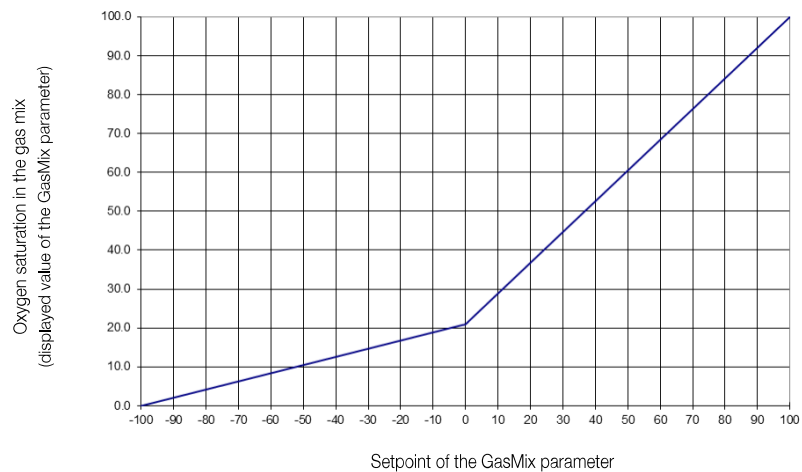


If the *GasMix* parameter and the *GM Flow* parameter and the *Air Flow*, *O₂ Flow* or/and *N₂ Flow* parameters have been installed and configured, the specified parameters in an advanced cascade for pO₂ control are preconfigured ex-factory by the device manufacturer.

The following applies to setpoint entry and value display in the touch screen software:

GasMix setpoint	Meaning	Value display
-100 %	Only nitrogen	0 % O ₂
0 %	Only air	21 % O ₂
100 %	Only oxygen	100 % O ₂

Operation



Example of a 2-gas-mix system with Air und O₂ with solenoid valves

The solenoid valves are switched according to the pre-set cycle time in the *PID* parameter option of the *GasMix* parameter.

Settings:

- Cycle time: 10 seconds (visible in input field *Eval. Time (s)* in option *PID* of parameter *GasMix*)
- Setpoint in the *GasMix* parameter: 20

This means that:

- The solenoid valve for oxygen opens for 2 seconds
- The solenoid valve for process air opens for 8 seconds
- Setpoint 100 corresponds to 10 seconds
- Setpoint 20 corresponds to 2 seconds



For this described configuration, the oxygen portion of the gas mixture cannot fall below 20.95 %.

GM Flow

Sets the gas flow rate of the gas mixture (*GasMix* parameter). The *GM Flow* parameter can only be used and set in conjunction with the parameters *GasMix*, *Air Flow* as well as *O₂ Flow* or/and *N₂ Flow*.

The device uses the gas flow rate of the gas mixture (*GM Flow*) and the setpoints of the *GasMix* parameter to calculate the flow rates of the individual gases. Only a setpoint input for the *GM Flow* parameter is required, the values of the parameters specified above are automatically determined and controlled.

Pressure

Measures and controls the pressure in the vessel in bar(g). The measurement takes place using a piezo-resistive pressure sensor and control takes place using the control valve in the exit gas line.

Weight

Measures the weight of the vessel and its content in kg. The weight display is tared using **Tare Weight**.

Turbidity

This is used to determine the turbidity of the culture. The turbidity can be used to draw conclusions regarding the biomass concentration in the culture. The measurement range and the measurand CU of the *Turbidity* parameter are set analogously to the measured value and range of the transmitter integrated into the sensor.

Exit CO₂ and Exit O₂

Measure the gas concentration of carbon monoxide (CO₂) and oxygen (O₂) in the exit gas stream of the bioreactor via a combined gas sensor and are used for exit gas analysis.

pCO₂

Measures the saturation of dissolved carbon dioxide (CO₂) in the culture using a digital CO₂ sensor with integrated temperature sensor. Measurements are displayed on the transmitter and in the touch screen software. The measurement range and the measurand CU of the pCO₂ parameter are set analogously to the measurement and range of the transmitter.

Redox

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

Conductivity

If the bioreactor is equipped with an ABER FUTURA biomass sensor, this can also be used to measure conductivity (measurement mS cm⁻¹). Sensors of the ABER Futura system 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.



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.

Operation

Capacitance

Measures the capacity (measured in pF cm^{-1}) that correlates to the live biomass. This is measurement takes place using an ABER FUTURA biomass sensor. Sensors of the ABER Futura system measure the permittivity (also: *Capacitance*) und *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.



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.

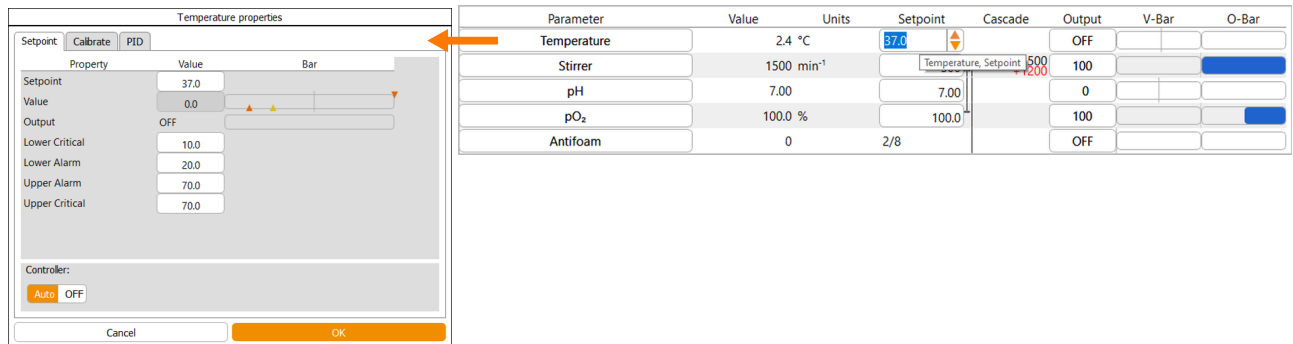
Ext. Feed 1, Ext. Feed 2

Control(s) external (optional) pump(s). The speed is variably adjustable in %.

8.6 Parameter Options

8.6.1 Overview of Settings Menu

Parameter options are called up via the *Controller* main menu. The settings menus are displayed as tab pages in *Properties* dialog boxes of the selected parameter.



Each *Properties* dialog box has two buttons:

- **OK:** save the entries, close the dialog box.
- **Cancel:** close the dialog box without making any changes.

Depending on the access rights and type of the parameters, a greater or smaller number of options will be available:

- *Setpoint:* this is where setpoints, alarm values and critical values are set, and parameters are activated and deactivated.
- *Calibrate:* this is where the measurements of the sensors are calibrated and the functionality of the measurement sections is checked.
- *PID:* this is where the controller settings are made.
- *Options:* only qualified INFORS HT personnel has access to this. This option is not available nor visible to any other user group.



If the weight measurement for the vessel is available, the weight display can be tared via **Tare Weight** in the *Batch* main menu. This function can only be executed there and is not available as an option in the *Weight* parameter.

The following chapters explain the individual setting menus. This is then followed either by detailed instructions for making the appropriate settings or a reference to the corresponding chapter.

Operation

8.6.2 Setpoint

8.6.2.1 Menu Content

- *Setpoint*: set the setpoint.
- *Value*: shows the current measurement (actual value).
- *Output*: shows the controller output in % or *OFF*.
- *Lower Critical* and *Upper Critical*: set the lower and the upper critical value.
- *Lower Alarm* and *Upper Alarm*: set the lower and the upper alarm limit.
- **Controller AUTO**: activate the parameter, automatic mode. In this mode, the parameter can be activated or deactivated via the controller output (*Output*) in the *Controller* main menu at any time while a cultivation is running.
- **Controller OFF**: deactivate the parameter. This mode also deactivates the controller output in the *Controller* main menu.

Function for pH Temperature Compensation

In the pH measurement system with analog pH sensor, the *pH* parameter has the additional function *pH temperature comp.* (pH temperature compensation). In the digital pH measurement system, this function is integrated into the pH sensor. The pH temperature compensation must be activated during a cultivation so that temperature compensated values can be generated. That is, this is used to correct the temperature dependence of the measurement principle.



The pH of liquids is also temperature dependent, which is why the pH also reacts to temperature deviations when temperature compensation is switched on.

For calibration of the pH sensor with simultaneous temperature measurement of the pH buffer solution or manual entry of the temperature of the buffer solution, this function must also be activated. For more information on the calibration, see ➔ Chapter 8.6.3.5 'Calibrating an Analog pH Sensor' on page 220.

8.6.2.2 Setting Setpoints, Activating and Deactivating Parameters

General Information

The setpoints of parameters are generally set in the configuration dialog of the cultivation. While the process is running, these can be changed via the *Controller* main menu.

The same applies for activating and deactivating parameters. For this, the controller output must be switched to automatic mode (Option *Setpoint, Controller* = **Auto**).

When the cultivation is stopped, all parameters are automatically deactivated.



The cultivation is started with the settings in the configuration dialog. Changes to these settings are saved and transferred into the next configuration dialog. Changes of parameter settings during the running process are only applied to the current cultivation.

Settings in the Configuration Dialog

Parameter	Output Active	Setpoint	Units
Temperature	☒	37.0	°C
Stirrer	☒	300	1/min
pH	☒	7.00	
pO ₂	☒	100.0	%
Antifoam	☐	0	
Feed	☒	50.0	%
Feed 2	☐	50.0	%
GasMix	☒	100.0	%
Flow	☒	50.0	L/min

Proceed as follows:

1. Call up the *Batch* main menu and press **Start**.

➔ The configuration dialog appears:

- All controlled parameters are listed on the left. The number of available parameters depends on the respective device configuration.
- On the right, there are switches for activating or deactivating the parameters and the start setpoints are listed in the corresponding input fields.

2. If necessary, change the setpoints and activate/deactivate parameters.

3. Press **OK**.

➔ The settings have been saved; the cultivation is started.

➔ Changed settings are transferred to the next configuration dialog.

Operation

Settings while the Cultivation is Running

There are two options for entering settings while the cultivation is running:

- Variant A: directly via the *Setpoint* input field/view box and controller output button in the *Output* column
- Variant B: via the *Setpoint* option of the selected parameter in the parameter column



Changed settings are only applied to the cultivation that is currently running.

For variant A), proceed as follows:

1. In the *Controller* main menu, press the *Setpoint* input field/view box of the desired parameter, e.g. *Temperature*.



Parameter	Value	Units	Setpoint	Cascade	Output	V-Bar	O-Bar
Temperature	2.4	°C	37.0		OFF		
Stirrer	1500	min ⁻¹	1500	Temperature, Setpoint	100		
pH	7.00		7.00		0		
pO ₂	100.0	%	100.0		100		
Antifoam	0	2/8			OFF		

2. Set the setpoint via the numeric keypad.
3. Activate the parameter via the controller output button.

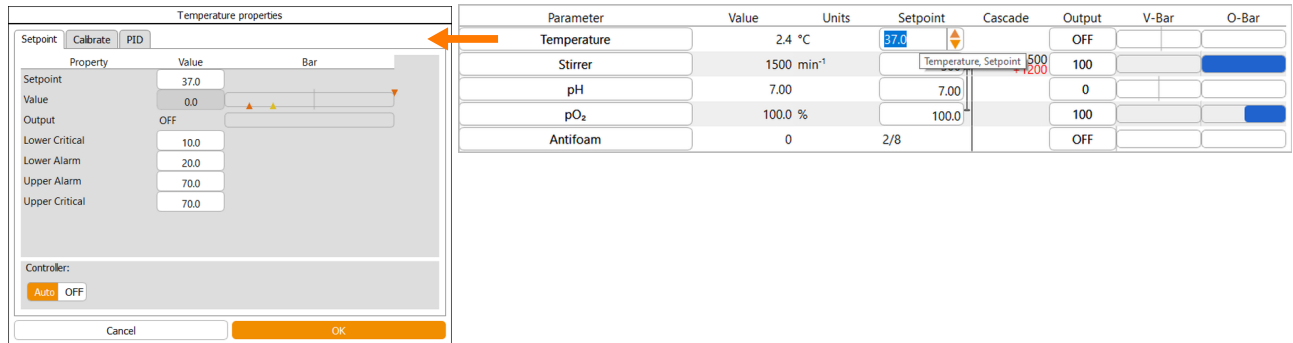
- ➡ The controller output switches from **OFF** to the corresponding numerical value in percent.



The parameter can only be activated or deactivated here, if the controller output is switched to automatic mode (Option *Setpoint, Controller = Auto*); refer also to the procedure in variant B.

For variant B), proceed as follows:

1. In the *Controller* main menu, press the button of the desired parameter.



➔ The *Setpoint* tab page appears.

2. Set the setpoint and, if necessary, change alarm limits and critical values.
3. Ensure that the controller output is in automatic mode, if not, activate it.
4. Press **OK**.

➔ The settings have been saved.

8.6.2.3 Setting Alarm Limits and Critical Values

The alarm limits and critical values of a parameter can be set symmetrically or asymmetrically:

- Symmetric = the difference between the setpoint and the upper alarm limit or upper critical value = difference between setpoint and lower alarm limit or lower critical value.
- Asymmetric = the difference between the setpoint and the upper alarm limit or upper critical value $\neq$ difference between setpoint and lower alarm limit or lower critical value.

The upper alarm limits can be set as $\leq$ the upper critical values. The lower alarm limits can be set as $\geq$ the lower critical values.

A parameter alarm is triggered as soon as the value falls below the lower alarm limit or exceeds the upper alarm limit. For more information, see ➔ Chapter 8.2.7.2 'Parameter Alarms' on page 175.

Alarm limits and critical values must be set in the *Controller* main menu via the *Setpoint* option of each parameter, irrespective of whether the cultivation is stopped or running. The procedure is the same as for setting the setpoints.

Operation

8.6.3 Calibrate

8.6.3.1 Menu Content

- *Reading*: shows the current measurement in digital units.
- *Value*: shows the current measurement, depending on the last calibration.
- *Slope*: shows the digital value of the calculated linear slope.
- *Offset*: describes the intersection of the calibration line with the x-axis.

Reading, *Slope* and *Offset* are not relevant for measurement systems with digital pH and pO₂ sensors. These values are stored directly in the integrated electronic system of the respective sensor.

- **Calibrate**: open the calibration menu.



The calibration menus for pH and pO₂ can also be opened directly via the **Calibrate pO₂** and **Calibrate pH** buttons in the *Batch* main menu.

8.6.3.2 General Information on Calibrating

Sensors for measuring the pH, pO₂ and turbidity are usually calibrated before each cultivation.

- pH sensors: pH sensors must be calibrated before each sterilization. That is, this is done before mounting in the vessel.
- pO₂ sensors: as a rule, a 1-point calibration to 100 % is usually sufficient for exact measurement, and should be carried out before each cultivation. If necessary, 2-point calibration to 100 % and 0 % is also possible.



The prerequisites for exact calibration results are available in separate documentation from the sensor's manufacturer. The calibration conditions and how these can be met are specified by the operator and are not part of this operating manual.

Depending on the selected variant, the device is equipped and configured with a digital or analog pH and pO₂ measurement system.

8.6.3.3 Calibrating a Digital pH Sensor

General Information

The pH buffers and their temperature dependence are saved in the digital pH sensors and are automatically detected during calibration. It is therefore not necessary to carry out a separate temperature measurement of the buffer solution.



If a digital pH sensor has already been calibrated externally, the bioreactor will use this data and there is no need for calibration on the touch screen software.

Calibrating

Proceed as follows:

1. → Connect the sensor cable.
2. → Carefully remove the cap with the storage solution from the pH sensor and rinse the sensor with distilled water, do not rub it!

! NOTICE

Wiping or rubbing the pH sensor after rinsing can generate an electrostatic charge. This can greatly increase the response time and generate incorrect measurements. At most, lightly dab the pH sensor after rinsing, NEVER wipe or rub.



Only sensor type Easyferm Plus ARC: an *ERROR Glass resistance too high* that might appear after initialization can be ignored. This can occur if the sensor is in contact with air or non-conductive liquid such as distilled water.

Operation

3. In the *Batch* main menu, press **Calibrate pH**.

➔ The calibration menu opens with four options:

- **1-Point Calibration** and **2-Point Calibration**: select 1-point or 2-point calibration.
- **Product Calibration**: select product calibration.
- **Show Sensor Status**: menu with dates and values that are output by the sensor manufacturer's firmware that is integrated in the sensor (➔ 'Sensor Status' on page 218).

Calibrate pH

Select Calibration Type:

1-Point Calibration 2-Point Calibration

Product Calibration Show Sensor Status

Back Close

4. Select 2-point calibration.

➔ The menu opens and guides you through the calibration step by step (1 to 6).

- Step 1 and 4: select the first or second reference value in drop-down lists. If the connected sensor allows the use of different calibration buffers or an automatic detection of the calibration buffer ("auto"), this can be selected. Otherwise, the calibration buffer to be used is displayed.
- Step 2 and 5: display of measurements, wait for stabilization.
- Step 3 and 6: use **CALIBRATE** to start the calibration process.

As soon as the bar of the status display is filled and *Ready* is displayed, the button switches to **CONFIRM** to save the calibration point. **CANCEL** is available for aborting the calibration process.

Status display *Ready*:

- Variant METTLER ISM: measured value is stable, calibration point can be saved.
- Variant HAMILTON Easyferm Plus ARC: calibration point ready to save, regardless of whether the measured value is stable.

Calibrate pH

2-Point Calibration Bioreactor A

1 Immerse pH Sensor into the 1st buffer auto

2 Wait until measurement is stable 7.00

3 Perform or restart the calibration at the 1st point 4.01

 Status of the 1st calibration CALIBRATE

4 Immerse pH Sensor into the second buffer

5 Wait until measurement is stable

6 Perform or restart the calibration at the 2nd point CALIBRATE

 Status of the 2nd calibration

 CANCEL

Back Close



The calibration process can be continued from the last saved point at any time, if the menu was closed using **Close**. However, this does not apply if another calibration process is started.

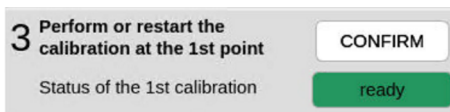
5. → Hold the pH sensor in the appropriate buffer solution of the first calibration point and, if possible, select reference value or automatic buffer recognition in drop-down list (step 1).



HAMILTON Easyferm Plus ARC: Always start with the lower calibration buffer (4.01).

6. → Wait until the measurement is stable (step 2).

7. → Press **CALIBRATE** (step 3 a).



- ➔ The calibration process starts. The **CALIBRATE** button turns into **CONFIRM**. The status display turns green:
 - Variant METTLER ISM: as soon as the status display is full, the calibration point can be confirmed.
 - Variant HAMILTON Easyferm Plus ARC: the calibration point can be confirmed if the measured value in line 2 is defined as stable by the operator.

8. → Press **CONFIRM** (step 3 b).

- ➔ The calibration point is saved.



If the calibration process fails, an error message is displayed with a corresponding notice. In this case, restart the calibration.

If the calibration was successful, the drop-down list for selecting the second reference value and the **CALIBRATE** button become available for calibrating the second point.

The calibration process for the second point is the same as for the first point. After rinsing the pH sensor with distilled water, the same *Error...* might occur. This can also be ignored.

After the 2nd calibration point has been saved successfully via **CONFIRM**, calibration is complete and the menu can be closed using **CLOSE**.

Operation

Sensor Status

SHOW SENSOR STATUS is used to show data and values produced by the firmware of the sensor manufacturer integrated in the sensor. In addition to information on the sensor type and information on calibration, the following two values are displayed for METTLER ISM sensors:

- **ACT** (Adaptive Calibration Timer): adaptive calibration timer in days, determines the time of the next calibration to ensure that optimal measurement performance is guaranteed. After successful calibration, it is reset to its start value.
- **DLI** (Dynamic Lifetime Indicator): dynamic display of the lifetime. Shows the number of days remaining and is pre-set by the sensor manufacturer.

8.6.3.4 Product Calibration of a Digital pH Sensor

General Information

It is possible to adjust the calibration curve to the current process conditions using product calibration. This could be necessary if there is a possibility of drift of the displayed pH during a long-term cultivation, for example.



Product calibration can only be carried out and is only effective if the externally measured and entered pH value does not deviate from the original pH value by more than 2 pH units.

Calibrating

Proceed as follows:

1. Call up the calibration menu of the pH sensor and press **Product Calibration**.

- ➡ The menu for product calibration opens and guides you through the product calibration step by step (1 to 4):

Calibrate pH	
Product Calibration	Bioreactor A
1 Start the product calibration	START
2 Take a sample for offline measurement and confirm	CONFIRM
Status of the calibration	assigned
Sample was taken at	-
3 Measure the pH of the sample and enter the value	7.000
4 Start the calibration	CONFIRM
	CANCEL
Back Close	

- Step 1 and 2: confirm product calibration via **START** and sampling via **CONFIRM** to generate a time stamp (*Sample was taken at*).

Status display of the calibration with the following possible displays:

- *ready*: time stamp for completed sampling can be generated via **CONFIRM**.
 - *measured*: time stamp has been generated.
 - *assigned*: last product calibration was successful and is active. A new product calibration can be performed.
 - *aborted*: last product calibration was aborted via **CANCEL** or was not successful; restart product calibration.
- Step 3 and 4: enter an external measurement and use **CONFIRM** to confirm in order to start the calibration.



The calibration process can be continued from the last saved point at any time, if the menu was closed using **Close**. However, this does not apply if another calibration process is started.

2. ➔ Press **START**.

3. ➔ Take a sample from the process.

There are two possible approaches:

- Variant a): confirm the sampling (generate a time stamp), carry out a laboratory measurement of the pH value for the sample, enter the measurement and carry out product calibration.
- Variant b): confirm the sampling (generate a time stamp), leave the calibration menu by choosing **Close** and carry out the product calibration with an external measurement at a later time.

4. ➔ Choose **Close** to leave the menu.

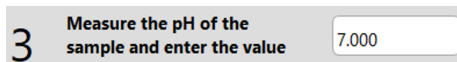
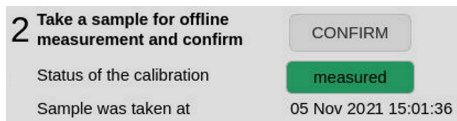


An new product calibration or 1-point calibration or 2-point calibration cancels the active product calibration.

Details for Variant a)

After sampling:

Operation



1. ➤ Press **CONFIRM**.

➡ The status display changes to *measured*. The date and time of sampling are now displayed.

2. ➤ Carry out a laboratory measurement of the pH value for the sample.

3. ➤ Enter the measured pH value of the sample, in the example to the left that is pH 7.0.

4. ➤ Press **CONFIRM** to start the calibration.

5. ➤ Wait until calibration is complete.

➡ That is, the status display changes to *assigned*. The status allows you to perform another product calibration or leave the menu.

6. ➤ Choose **Close** to leave the menu.

Details for Variant b)

After sampling:

1. ➤ Press **CONFIRM**.

➡ As in variant a), the status display changes to *measured*, and the date and time of sampling are displayed underneath. This indicates that sampling was carried out but product calibration is not yet active. If a sample is lost, step 1 can be repeated.

2. ➤ Leave the calibration menu using **Close** and carry out a laboratory measurement of the pH value for the sample at a later time.

3. ➤ To carry out product calibration, proceed as in Variant a) from step 2.

8.6.3.5 Calibrating an Analog pH Sensor

General Information

The correct temperature of the buffer solution must be measured to achieve extremely exact calibration results. This can be measured directly using the temperature sensor of the device¹⁾ during calibration. Another option is to measure the temperature externally and enter the value manually in the touch screen software. In both cases, the temperature compensation of the pH parameter must be activated. This is used to correct the temperature dependence of the measurement principle. If not measured or manually input, the buffer temperature is assumed to be 20 °C.

¹⁾ Only possible with temperature sensor for vessel sizes 15 L and 30 L TV.

Calibrating

Proceed as follows:

1. ➔ Connect the sensor cable.

Ensure the sensor cable is not buckled or twisted.

! NOTICE

The screening on the sensor cable may become damaged if it is kinked or twisted. This may lead to faulty measurements.

If the externally measured temperature of the pH buffer solutions is to be entered or their temperature is to be measured using the temperature sensor:

2. ➔ In the *Setpoint* parameter option, activate temperature compensation (*pH temperature comp.*).
3. ➔ Carefully remove the cap with the storage solution from the pH sensor and rinse the sensor with distilled water, do not rub it!

! NOTICE

Wiping or rubbing the pH sensor after rinsing can generate an electrostatic charge. This can greatly increase the response time and generate incorrect measurements. At most, lightly dab the pH sensor after rinsing, NEVER wipe or rub.

4. ➔ In the *Batch* main menu, press **Calibrate pH**.

➔ The calibration menu opens and guides you through the calibration step by step (1 to 4).

2-point calibration mode is selected automatically. The *Ref. Temp* display/input field for temperature compensation is displayed.



Without activating pH temperature compensation first, this display/input field is not visible.

The *Sensor quality* bar graphically depicts the quality of the sensor on a scale from 0 to 100 %



Calibrate pH sensor

Calibration mode: **2 Points** 1 Point Manual

- 1 Please set value of the first calibration point
2
- 2 Put sensor into media and confirm measure
Sensor data: 2.3 mV Confirm Measure
- 3 Please set value of the second calibration point
12
- 4 Put sensor into media and confirm measure
Sensor data: -296.6 mV Confirm Measure

Sensor quality: 93%

Ref. Temp.: 37.0093

Restart Cancel OK

Operation

- 5.** ➤ Enter the value of the lower (or upper) reference button in the input field in line 1.



The order in which the reference points are calibrated is irrelevant.

If temperature compensation is active:

- 6.** ➤ Enter the temperature of the buffer solution in the *Ref. Temp* display/input field or hold the temperature sensor together with the pH sensor in the buffer solution at step 7.

- 7.** ➤ Place the pH sensor in the relevant buffer solution.

➡ The measurement (in mV) is displayed in line 2 in *Sensor data*.

As soon as the measurement is stable:

- 8.** ➤ Press **Confirm Measure** in line 2.

➡ The calibration value is accepted. The input fields and buttons in lines 3 and 4 are now available.



The signal characteristics are asymmetric. In other words, the closer the signal comes to the real value, the slower the change. The calibration is not accurate, if the measurement is confirmed with **OK** before the sensor signal is completely stable. Wait a few minutes before confirming with **OK** and check the measurement again, if in doubt.

- 9.** ➤ Rinse the pH sensor with distilled water, do not rub!

- 10.** ➤ For the second calibration point, repeat the same steps as for the first point.

As soon as the second calibration value has been accepted:

- 11.** ➤ Press **OK**.

➡ The dialog box disappears, the calibration values are stored.

- 12.** ➤ Rinse the pH sensor with distilled water, do not rub!

8.6.3.6 Recalibrating an Analog pH Sensor

General Information

To compensate for a deviation (drift) of a measurement of an analog pH sensor during a long-term cultivation, a re-calibration is possible and sufficient. There are two different ways in which this can be done:

- 1-point calibration
- Manual correction of the "offset"

Calibrating

Proceed as follows:

1. In the calibration menu, use **1 Point** to select 1-point calibration mode.
➡ The menu view changes.
2. Enter the externally measured pH of a sample taken as a reference value in line 1.
3. Use **Confirm Measure** to confirm the value.
➡ The calibration value is accepted.
4. Press **OK**.
➡ The calibration menu disappears, the value is saved.

The screenshot shows the 'Calibrate pH sensor' interface. At the top, the title is 'Calibrate pH sensor'. Below it, the 'Calibration mode' is set to '1 Point' (highlighted in orange), with options for '2 Points' and 'Manual'. The main area is divided into two steps:

- 1 Please set value of the first calibration point**: A text input field contains the value '2'.
- 2 Put sensor into media and confirm measure**: This section contains a 'Sensor data' field showing '299.8 mV' and a 'Confirm Measure' button.

Below these steps, there are two sub-sections:

- Sensor quality**: A green progress bar indicates '93%'.
- Ref. Temp.**: A text input field contains the value '37.0018'.

At the bottom, there are three buttons: 'Restart' (grey), 'Cancel' (white), and 'OK' (orange).

Manual Correction

Proceed as follows:

1. Determine the difference between the pH measured via an external measuring device and the pH of the culture measured via the connected pH sensor.
2. In the calibration menu, use **Manual** to switch to manual calibration mode.
➡ The menu view changes.

Operation

3. ➔ Depending on the difference between the two pH measurements, either add the result to the displayed "Offset" or subtract it and enter it.

4. ➔ Press **OK**.

➔ The calibration menu disappears, the value is saved.

8.6.3.7 Calibrating Digital a pO₂ Sensor

General Information

2-point calibration can only be performed in the correct sequence: 1st calibration point = 100 %, 2nd calibration point = 0 %. The following example describes a 2-point calibration.



Digital pO₂ sensors are preconfigured by the device manufacturer to the measurement %-sat.

Calibrating

As soon as the desired calibration conditions for 100 % calibration are reached, proceed as follows:

1. ➔ In the *Batch* main menu, press **Calibrate pO₂**.

➔ The calibration menu opens with three options:

- **1-Point Calibration** and **2-Point Calibration**: select 1-point or 2-point calibration.
- **Show Sensor Status**: shows dates and values that are output by the firmware that is integrated into the sensor.

2. Select 2-point calibration.

➔ The menu opens and guides you through the 2-point calibration:

- Step 1 and 4: select the first or second reference value in drop-down list. If the connected sensor allows the use of different reference values or an automatic detection of the reference value ("auto"), this can be selected. Otherwise, the reference value to be used is displayed.
- Step 2 and 5: display of measurements, wait for stabilization.
- Step 3 and 6: use **CALIBRATE** to start the calibration process.

As soon as the status display bar is filled and *Ready* is displayed, the button switches to **CONFIRM** to save the calibration point. **CANCEL** is available for aborting the calibration process.

Status display *Ready*:

- METTLER ISM: measured value is stable, calibration point can be saved.
- HAMILTON VisiPerm DO ARC / RS485-ECS: calibration point ready to save, regardless of whether the measured value is stable.



The calibration process can be continued from the last saved point at any time, if the menu was closed using **Close**. However, this does not apply if another calibration process is started.

3. ➔ If possible, select reference value 100 (= 100 %) in the drop-down list (step 1).

4. ➔ Wait until the measurement is stable (step 2).

5. ➔ Press **CALIBRATE** (step 3a).

➔ The calibration process starts. The **CALIBRATE** button turns into **CONFIRM**. The status display turns green:

- Variant METTLER ISM: as soon as the status display is full, the calibration point can be confirmed.
- Variant HAMILTON VisiPerm DO ARC / RS485-ECS: the calibration point can be confirmed if the measured value in line 2 is defined as stable by the operator.

Calibrate pO ₂	
2-Point Calibration Bioreactor A	
1 Immerse pO ₂ Sensor into the 1st buffer	100.00
2 Wait until measurement is stable	99.4
3 Perform or restart the calibration at the 1st point	CALIBRATE
Status of the 1st calibration	
4 Immerse pO ₂ Sensor into the second buffer	
5 Wait until measurement is stable	
6 Perform or restart the calibration at the 2nd point	CALIBRATE
Status of the 2nd calibration	
CANCEL	
Back	Close

3 Perform or restart the calibration at the 1st point	CONFIRM
Status of the 1st calibration	ready

Operation

6. ➔ Press **CONFIRM** (step 3 b).

➔ The calibration point is saved.



If the calibration process fails, an error message is displayed with a corresponding notice. In this case, restart the calibration.

If the calibration was successful, the drop-down list for selecting the second reference value and the **CALIBRATE** button become available for calibrating the second point.

7. ➔ Establish correct calibration conditions for the 0 % calibration.

Once these are met:

8. ➔ For the second calibration point for 0 %, proceed in the same way as described starting from step 4.

After the 2nd calibration point has been saved successfully via **CONFIRM**, calibration is complete and the menu can be closed using **CLOSE**.

8.6.3.8 Calibrating an Analog pO₂ Sensor

General Information



Polarographic pO₂ sensors must be polarized for commissioning or after they have been disconnected from the power source. Otherwise, correct calibration is not possible. For detailed information on polarization, refer to the separate documentation provided by the sensor manufacturer.

2-point calibration of an analog pO₂ sensor can be performed in 2-point calibration mode or sequentially in 1-point calibration mode. The 2-point calibration must take place in the correct order. 1st calibration point = 0 %, 2nd calibration point = 100 %. The following example describes a 2-point calibration.

Calibrating

As soon as the desired calibration conditions for 0 % calibration are reached, proceed as follows:

1. Call up the *Batch* main menu and press **Calibrate pO₂**.

➔ The calibration menu appears. 2-point calibration mode is selected automatically. The menu guides you through the calibration step by step.



The **Use As Setpoint** button is only relevant and can only be used under certain circumstances (➔ 'Use As Setpoint Function').

2. In line 1, enter the value 0 (zero = 0 %) for the first calibration point.

3. Wait until the measurement (*Sensor data*, line 2) is stable.

4. Press **Confirm Measure**.

➔ The value is accepted as 0 % oxygen.

5. Establish correct calibration conditions for the 100 % calibration.

Once these are met:

6. In line 3, enter the value 100 (= 100 %) for the second calibration point.

7. Wait until the measurement (*Sensor data*, line 4) is stable.

8. Press **Confirm Measure**.

➔ The value is accepted as 100 % oxygen saturation.

9. Press **OK**.

➔ The dialog box disappears, the calibration values are stored.

Use As Setpoint Function

Operators can use the **Use As Setpoint** buttons in the calibration menu of the analog pO₂ sensors under the following conditions:

- Configuration with GasMix air/O₂/N₂ is available.
- The GasMix parameter is configured in a cascade for the pO₂ control.



For all other parameters, the **Use As Setpoint** button is only relevant for INFORS HT service technicians.

How it works:

Operation

- 0 % calibration: the input 0 (%) in the input field of the first calibration point and pressing the **USE AS SETPOINT** button causes the GasMix parameter to switch to nitrogen for this value.
- 100 % calibration: (2nd point), prior to entering the value 100: the input of 21 (%) in the input field of the second calibration point and pressing the **USE AS SETPOINT** button causes the GasMix parameter to switch to air for this value. The value can then be changed to 100 (%) in the input field and the calibration completed.

8.6.3.9 Calibrating the Turbidity Sensor

General Information

Turbidity sensors ASD25-N are pre-calibrated ex-factory. Inserts are available for reference measurement. Due to the different light absorption of different media, zero point calibration of the turbidity sensor should be performed before each cultivation process. This can be done either before or after in situ sterilization, depending on the application in question.

Conditions for zero point calibration of the sensor: the sapphire windows of the turbidity sensor must be clean and free of air or gas bubbles. The light absorption of the medium before activation of the gassing and before inoculation can be used as a reference value for the zero point.

Calibrating

Proceed as follows to calibrate the zero point of the (optional, only for the Optek system) turbidity sensor:

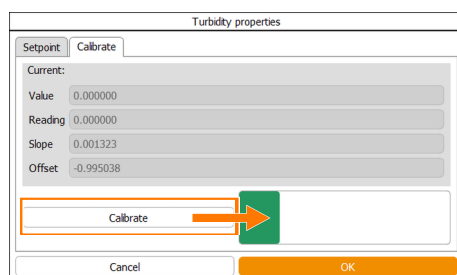
1. ➤ Connect the sensor cable.
2. ➤ Call up the *Controller* main menu and wait until the measurement of the *Turbidity* parameter is stable.
3. ➤ Call up the *Calibrate* option of the parameter and press **Calibrate**.

- A display bar now briefly appears to the right of the **Calibrate** button, which graphically depicts the calibration progress. The progress is shown using a green color.

If the bar disappears after a few seconds, the calibration is complete.

4. ➤ Press **OK**.

- The calibration is saved; the menu disappears.



8.6.4 PID Controller Settings

8.6.4.1 Menu Content

Temperature properties

Setpoint Calibrate PID

PID:

Prop. Term: 15.000000 Diff. Term [s]: 0.200000

Integ. Term [1/s]: 0.002000 Neg Factor: 0.500000

Advanced:

Dead Band: 0.000000 Integ. Limit [%]: 45.000000

Ramp:

Ramp Output: ☐

Ramp Size: 5

General:

Eval. Time [s]: 20.0

Cancel OK

The *PID* menu contains input fields for setting up PID control (Proportional Integral Derivative control).

The table in the following chapter explains the functions of the setting value in more detail.

Please note the following points:

- If *Ramp Output* is deactivated, the value in *Ramp Size* is not relevant.
- For parameters that are not controlled but only measured, only the value in *Eval Time [s]* is relevant. This is always > 0 (zero).

8.6.4.2 Table with Settings for the PID Controller

Setting	Description
P (Prop. Term)	Proportional term: the greater the difference between setpoint and actual value, the greater the controller output.
I (Integ. Term [1/s])	The integral factor sums up all errors over the term. If the setpoint is not reached with the proportional factor, the integral factor successively adjusts the output until the setpoint is reached. If the integral factor is set too high, this leads to fluctuations of the control loop.
D (Diff Term [s])	The differential quotient calculates the change in the actual value over time and counteracts this change.
Neg. Factor	The negative factor can be used to weight a two-sided control (+100 to -100 percent) (e.g. strong acid, weak base). Here, 1 is the balance and 0.5 or 2 the corresponding halving or doubling of the controller output. Example: nitrogen affects the pO ₂ value less than oxygen, so a negative factor of 2 can rebalance the regulator's response.
Deadband	If a deadband value is entered, no control takes place within this value around the setpoint (symmetrical, +/-). That is, the controller output is = 0. The deadband is used for pH control.
I Limit (Integ. Limit [%])	To ensure that the integral factor cannot increase indefinitely, the integral influence is used. This limits the error summation. The integral influence is set between 0 % and 100 % of the controller output.
Ramp output	To make changes slowly and incrementally, a ramp can be activated. This makes sense, in particular, for the stirrer speed or a mass flow valve.
Ramp Size	Time period over which the setpoint of the controller is gradually brought up to the newly entered setpoint.

Operation

Setting	Description
Eval Time [s]	The eval. time shows the intervals in seconds of the new calculation of the PID value. The controller speed is defined by this. 10 seconds is a good average value for the eval. time.

8.6.4.3 PID Control Explained

The PID function is based on the generic formula provided as the example:

$$Error_n = \frac{Set - Act}{Max.Value - Min.Value}$$

$$Output_n = P.Term * \left\{ Error_n + I.Term \cdot \int_{i=0}^n Error_i + D.Term \cdot (Error_n - Error_{n-1}) \right\}$$

The Formula Explained

- *Error* = deviation between setpoint and actual value
- *P* = proportional factor, also called slope, with which a setpoint is reached. The larger the value, the faster the control.
- *I* = Integral factor of the error in 1/second. A typical integral factor is < 0.05
- *D* = Differential quotient of the deviation (*Error*). This is set in seconds (mostly to 0).

The following has to be kept in mind in relation to the individual factors:

Factor	Explanation
Proportional factor	Changing the proportional factor has a big impact on a running process. Increasing it too much leads to oscillation of the control loop around the setpoint. <u>Using the pH parameter as an example</u> To reach the setpoint, a little acid is alternately added, then some base, acid again, then base, and so on. If the proportional factor is reduced too much, the controller hardly reacts to deviations and never reaches the setpoint.

Factor	Explanation
Integral Term	The integral factor should have a small value and only be changed a little in small steps with very large pauses. Ideally, switch off the device briefly after changing the integral factor in order to delete the pending error calculation. A typical integral factor is < 0.05. It should be the reciprocal of two to four times the period of the system. The bigger the value, the less time in seconds remains for the control. Typically, a value greater than 0.05 does not make sense as it exceeds the minimum time required for the control. This leads to oscillations of the control circuit.
Differential quotient	The differential quotient is rarely required. It is set to 0 (zero) at the start. A high value is only necessary, if greater changes are taking place rapidly. It leads to a more rapid speed of response of the controller output for a given error value.

Example for Calculating the Integral Factor

The period of oscillation of the system is detected with 50 seconds from amplitude to amplitude. The integral factor is calculated as follows then:

$$1 / (50 \text{ s} \times 2) = 0.01 \text{ s}^{-1}$$

$$1 / (50 \text{ s} \times 4) = 0.005 \text{ s}^{-1}$$

Integ. Term (integral factor)	Seconds
0.1	10
0.05	20
0.001	100
0.005	200

Operation

8.6.4.4 Tips for Readjusting a PID Controller

To readjust the PID controller, proceed as follows:

1. ➤ Write down the factory setting or ensure that these can be restored if need be.
2. ➤ Start by setting the proportional factor when readjusting a PID controller. Choose the proportional bandwidth as large as possible.
3. ➤ Set the integral factor and differential quotient to zero.
4. ➤ Increase the proportional factor until the controller causes oscillations of the actual value.
5. ➤ Measure the period of oscillation, e.g. with the bioprocess platform software eve® of the device manufacturer.
6. ➤ Halve the proportional factor and vary the integral factor between the reciprocal of twice and four times the period of oscillation.

8.6.5 Tare Weight Function - Taring the Weight Display

Tare Weight

↓

Tare Weight

Property	Value	Units
Tare value:	0	kg

Cancel
OK

Tare Weight in the *Batch* main menu is generally used to define the zero point of the vessel weighing system. This sets the vessel weight to zero (tares it) so that only the weight of the vessel contents can be measured.



If certain applications require it, any numerical value can be entered as the tare weight instead of the value 0.

Keep in Mind

Before setting the weight display to zero, the vessel must be fully equipped and all hoses (e.g. reagent hoses) must be filled with liquid. Otherwise, the weight displayed in the *Weight* parameter will not correspond to the amount of liquid in the vessel.

After taring, any change to the vessel, e.g. by dismantling built-in-parts, emptying hoses, etc., also means a change in weight. As a result, the weight measurement is falsified.

8.7 Cascade Control

8.7.1 Cascade Control Explained

The *Cascade* main menu provides the option of setting up a cascade control of a process parameter, usually pO_2 . This means that the controller output (= *Output*) of the primary parameter (e.g. pO_2) is used as the reference variable for the secondary parameter(s) in the cascade.

Serial Cascade



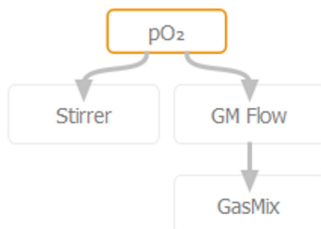
The *Stirrer* parameter is activated as the first one in the cascade to control the pO_2 parameter. The *Air Flow* parameter is only activated when the setpoint of the pO_2 parameter has not been achieved by the *Stirrer*.

Parallel Cascade



The parameters *Stirrer* and *Air Flow* are activated at the same time to control the pO_2 parameter.

Parallel Serial Cascade

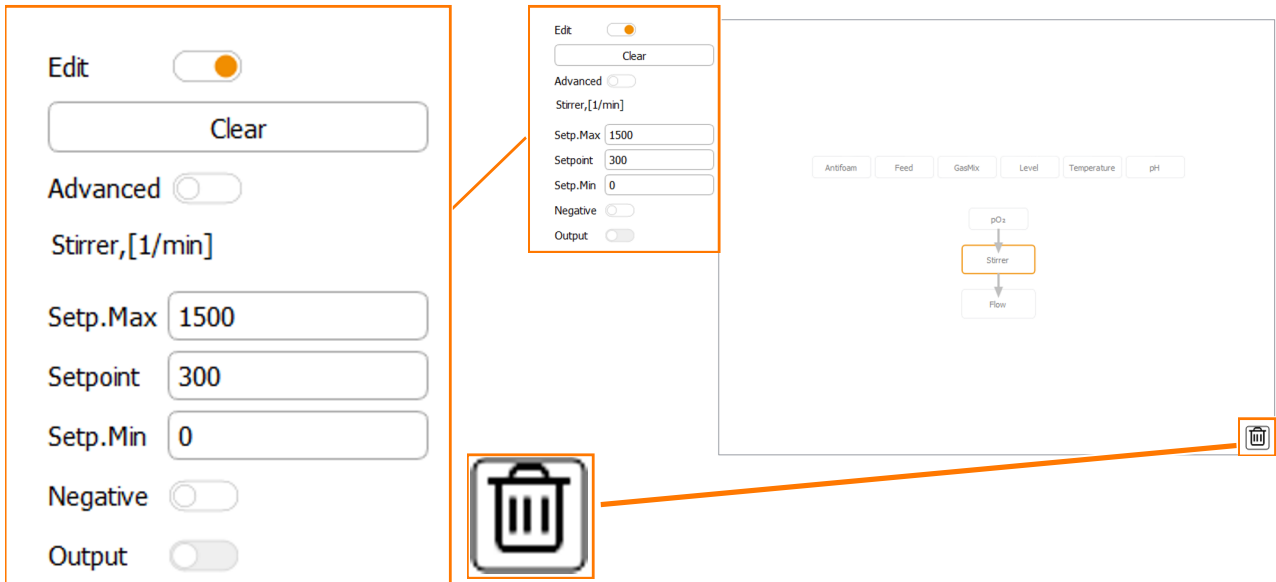


The parameters *Stirrer* and *GM Flow* are activated at the same time to control the pO_2 parameter. The *GasMix* parameter is only activated when the setpoint of the pO_2 parameter has not been achieved by the *Stirrer* and the *GM Flow*.

Operation

8.7.2 Setting a Cascade

8.7.2.1 Menu and Functions



Overview

The various cascade settings are made in the left menu area. To activate the view of the existing process parameters in the main area and to be able to make settings, the edit function (*Edit*) at the top left must be activated.

In the main area, the process parameters can then be combined into a cascade using drag & drop or removed individually from the cascade (recycle bin).

Each parameter can generally only be used once in a cascade. A selected parameter is visually highlighted to distinguish it from the other parameters. At the same time, its settings menu becomes visible to its left.

Settings

Input / Function	Description
<i>Edit</i>	Activate or deactivate the edit function.
Clear	Delete a (simple) cascade.

Input / Function	Description
<i>Advanced</i>	Activate or deactivate the setting mode for an advanced cascade. Advanced cascades are used for customer-specific device configurations. They are set exclusively by the device manufacturer ex-factory. In this case, their settings and change options are created for the specific device and can be requested from the manufacturer.
<i>Setp. Max. and Setp. Min.</i>	Values set ex-factory. These define the value range of the selected parameter, in which the cascade can change the setpoint to control the setpoint of the primary parameter. These values can be changed within this predefined value range.
<i>Setpoint</i>	Setpoint of the parameter. ■ For the primary parameter: the setpoint to be controlled. ■ For the secondary parameter: the initial setpoint of the parameter from which the setpoint can be varied by the cascade within the value range of <i>Setp. Min.</i> to <i>Setp. Max.</i> We generally recommend setting the setpoint for secondary parameters to the lower end of the value range (<i>Setp. Min.</i>).
<i>Negative</i>	Activate or deactivate the Negative function of the cascade. The Negative function causes a change in sign of the controller output. This means that a negative controller output causes the addition of a positive value for the setpoint of the cascaded parameter and vice versa. The function can be used for secondary parameters if an increase in the setpoint of the secondary parameter results in a decrease in the actual value of the primary parameter. The pH control with base and CO₂ instead of acid is a classic example of this: to reduce the pH, the CO₂ flow rate (<i>CO₂ Flow</i> parameter) needs to increase.

Operation

8.7.2.2 Cascade Progress Display

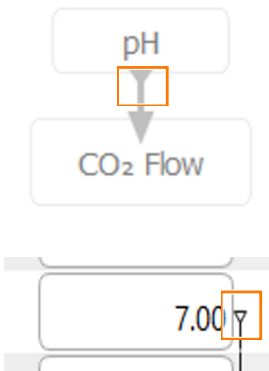
Overview

A cascade and its progress can be seen in the *Controller* main menu.

Parameter	Value	Units	Setpoint	Cascade	Output	V-Bar	O-Bar
Temperature	37.0 °C		37.0		100		
Stirrer	1500 min ⁻¹		500	1500 +1000	100		
pH	7.00		7.00		0		
pO ₂	100.0 %		100.0		100		
Antifoam	0	2/8			OFF		
Level	0.0		0.0		0		
Feed	100.0 %		100.0		100		
Weight	0 kg	--	--		--		
GasMix	100.0 %O ₂		100.0		100		
Flow	20.00 $\frac{L}{min}$		15.00	20.00 +5.00	100		
Turbidity	0.00 CU		--		--		

In addition to arrows showing the direction of the cascade control, the setpoint and the control output of the cascade that is added to or subtracted from the setpoint is displayed in the *Cascade* column. These values are specified in the relevant parameter unit.

Negative Function Display

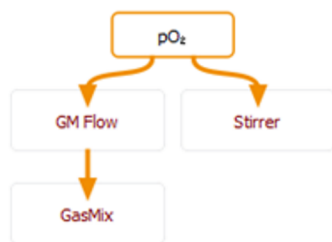


The fact that the Negative function is active is indicated by the triangle symbol on the arrow that indicates the direction of the cascade control.

This arrow shape can be seen in the *Controller* menu.

Color Scheme

The color of an added/subtracted setpoint in the *Controller* menu and the name of the parameter in the *Cascade* menu indicates the progress of the cascade. According to the following scheme, it shows how much leeway of the cascade remains in the value range of a secondary parameter in order to control the primary parameter:



Color	Value range utilisation
Grey	Inactive
Green	0 to 90 %
Yellow	90 to 99 %
Red	100 %
Blue	0 %

Calculation Example

The *Stirrer* parameter is used as the example for secondary parameter from the setpoint to the max. setpoint.

- Setpoint max: 1200 min⁻¹
- Setpoint: 500 min⁻¹
- Difference (=value range): 700 min⁻¹

Conversion:

- 700 min⁻¹ = 100 %
- 630 min⁻¹ = 90 %

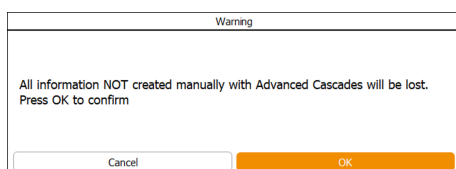
This results in a setpoint of 1130 min⁻¹ (500 + 630), from which 90 % of the value range is reached. For this display according to the aforementioned color scheme, this means:

- Green: up to 1130 min⁻¹
- Yellow: up to 1193 min⁻¹
- Red: at 1200 min⁻¹

8.7.2.3 Deleting a Cascade

To delete all settings of a cascade (does not apply to extended cascades), proceed as follows:

1. In the *Cascade* main menu, press **Clear**.
 - ➡ A dialog box appears with the warning that all settings that were NOT made in *Advanced* cascade mode will be deleted.
2. Press **OK**.
 - ➡ The cascade is deleted.



Operation

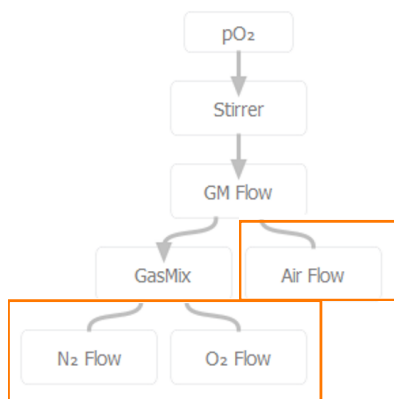
8.7.2.4 Special Configurations

For bioreactors with the "High-End" gassing strategy (configuration with several mass flow controllers and GasMix), the gases to be used, e.g. *Air Flow*, *N₂ Flow* and *O₂ Flow* must be assigned to the two gas mix controlling parameters *GasMix* and *GM Flow* in the cascade configuration. To do so, set up the following cascades in addition to the desired cascade configuration, provided the corresponding parameters are available:

- The *Air Flow* parameter as the secondary parameter for the *GM Flow* parameter
- The *O₂ Flow* parameter as the secondary parameter for the *GasMix* parameter
- The *N₂ Flow* parameter as the secondary parameter for the *GasMix* parameter

If both *O₂ Flow* and *N₂ Flow* are available, they will form a parallel cascade under the *GasMix* parameter.

To distinguish the assignment of these parameters from regular cascade elements, the connections are shown without an arrow.



8.8 Pumps

8.8.1 Control and Settings

Control

The peristaltic pumps are controlled in accordance with the respective parameters:

Pump	Parameter
<i>Acid</i> (digital)	<i>pH</i>
<i>Base</i> (digital)	<i>pH</i>
<i>Antifoam</i> (digital)	<i>Antifoam</i>
<i>Feed</i> (analog)	<i>Feed</i>
<i>Feed 2 / Feed 3</i> (analog, optional)	<i>Feed 2 / Feed 3</i>

Digital pumps and time-depending and always operate at the same speed in start/stop mode. Analog pumps run continuously at a speed that can be set. Both digital and analog pumps are controlled within a range of 0 % up to 100 %.

Example

- Analog: 50 % of the maximum flow rate = pump runs at half speed.
- Digital: 50 % of the maximum flow rate = pump runs half the time.

Settings

The following settings can be made for the pumps:

- Feed pump(s): set the speed in 0.1 % increments in the range of 0 % to 100 %.
- Antifoam pump: set the dose/wait time in s.
- Calibrate the pumps.
- Manually reset the pump counter to zero.
- Fill and empty pump hoses manually or in a time-controlled manner.

8.8.2 Calibrating the Pumps

Calibration of the pumps enables display and recording of the actual pumped volume. The quantity conveyed is stated in mL.

Operation

Tools

Provide the following tools:

- Graduated measuring cylinder/cup or balance and empty vessel.
- Reagent bottle equipped with silicone hose and filled with the reagent to be pumped or equally viscous liquid.



For very precise results, the reagent bottle should be placed on a balance that can also be connected to the bioreactor or a PC with the eve® bioprocess platform software installed.

Requirements

Please note the following points:

- Always use similar hoses with the same dimensions for calibrating and conveying the media.
- For calibration, use the same or equally viscous liquid as that used for conveying during the process.

Calibration

To calibrate a pump, e.g. the acid pump (*Acid*), proceed as follows:

1. ➔ Connect the reagent bottle to the pump.
2. ➔ Hang the output side of the hose into the measuring cylinder/beaker or place the reagent bottle on the balance and tare to zero, hang the output side of the hose in the empty vessel.
3. ➔ Fill the hose completely.
4. ➔ Call up the *Batch* main menu and press **Acid Pump**.
 - ➔ The *Calibrate Acid Pump* dialog box appears and guides you through the calibration step by step.
5. ➔ At step 4 (*Select pump speed*) select the pump speed in percent or manually enter a value via the **Other** option.



For best results, the pump should be calibrated at the speed expected during operation.

6. ➔ At step 5 (*Select calibration time*) select the calibration time or set it manually.

Calibrate Acid Pump	
1	Insert / prepare tube
2	Fill tube
3	Tare balance (or empty measuring cup)
4	Select pump speed 25% 50% 75% 100% Other
5	Select calibration time 30m 1h 6h 12h 1 min
Cancel OK	

7. ➤ Press **OK**.

- ➔ Calibration starts. The remaining time (*time left...*) in h/min/s is displayed next to the **Stop** button that is now available.

As soon as this time has expired, the second dialog box appears (*Calibrate Acid Pump Part 2*).

8. ➤ Enter the pumped liquid in mL or g (*Enter Weight or Volume*).

- ➔ After entering the pumped quantity, the automatically calculated pump factor is displayed. For a calibrated pump, the pump factor is always $\neq 1$.

9. ➤ Press **OK**.

- ➔ The dialog box disappears, the calibrated value is saved. *Completed at* with date and time next to **Stop** shows that the pump has been calibrated as well as when this happened.

8.8.3 Resetting the Pump Counter to Zero

The number of revolutions (pump not calibrated) or the quantity conveyed in mL (pump calibrated) of the peristaltic pumps are continuously displayed during a cultivation. After the end of the process, this display continues until a new cultivation is started.

However, the counter can also manually be reset to zero:

Press a pump button in the *Main* menu to open the pump dialog box, in the example on the left, this is the acid pump (*Acid*). The displayed number of revolutions (*Duration*) and quantity conveyed in ml (*Value*) can be reset here via *Reset*.



By manually changing the pump factor (*Pump factor*) the previously performed calibration is discarded. For a calibrated pump, the pump factor is always $\neq 1$.

8.8.4 Filling and Emptying the Pump Hoses

The pump hoses can be filled and emptied either in a time-controlled manner or manually. Time controlled filling or emptying of the pump hoses is only possible only when the cultivation is stopped.

Operation

Manual Filling and Emptying

Acid pump properties

Pump factor:

Duration:

Value:

Reset: ☐

Manual control

Press a pump button in the *Main* menu to open the pump dialog box e.g. *Acid* with **FILL** for filling and **EMPTY** for emptying. The pump runs as long as the corresponding button is pressed.



The pump hoses can also be filled and emptied manually via the rocker switches on the instrumentation cabinet, see Chapter 8.8 'Pumps' on page 239.

Time-Controlled Filling and Emptying

Automatic time-controlled filling or emptying of the pump hoses is possible when the cultivation is stopped.

Please note the following points first:

- Test the pumping time of a pump in advance with the liquid having the same or similar viscosity as the liquid to be pumped.
- Observe the hose lengths and hose sizes of the pumps and, if necessary, test the pumping time of each pump individually, taking into account the condition mentioned above.

Fill/Empty Pumps in the *Batch* main menu opens the *Fill/Empty Pumps* dialog box.

Fill/Empty Pumps

	Running time, s			Running time, s		
Acid Pump	10	Fill	☐	10	Empty	☐
Base Pump	10	Fill	☐	10	Empty	☐
Antifoam Pump	10	Fill	☐	10	Empty	☐
Feed Pump	10	Fill	☐	10	Empty	☐
Feed 2 Pump	10	Fill	☐	10	Empty	☐

Here, an individual filling duration and empty duration in seconds can be defined for each pump.

The filling and emptying process is started via **Fill** and **Empty**. Next to each of these buttons is a button for immediately stopping the current fill / empty procedure.



If a filling or emptying procedure is active, the remaining filling or emptying time is displayed. The menu cannot be closed while at least one filling or emptying procedure is active.

Operation

8.9 Processes

8.9.1 General Information

The following processes can be performed with the bioreactor:

- Full sterilization (default)
- Sterilization of the harvest valve (default)
- Sterilization of the sample valve (option)
- Sterilization of the feed line (option)
- Sterilization of the transfer block valve (option)
- Sterilization of the transfer line (option)
- Cultivation (default)
- Transfer (option)
- Harvest (option)



The bioreactor is CIP-enabled. However, the CIP process is controlled via the optional separate TechCIP mobile CIP unit of the device manufacturer INFORS HT. The instructions for this are available in the separate operating manual of the mobile CIP unit.

Process Configuration and Start

All processes are started and executed with the values set in the configuration dialog of the process ¹⁾. The order in which the processes are performed can be selected freely and is specified by the operator. Whether and when processes can run in parallel or be started is predefined and recorded in a process compatibility chart ("interlock list") in the separate technical documentation.

¹⁾ *Only during cultivation can process parameter settings be changed while the process is running.*

Process Sequence and End

All processes (except cultivation) run through with predefined steps until the end, or until the "holding phase" (full sterilization). In addition to the running process sequence, the active process step as well as the running time (*in progress since in h:min:s*) are displayed. If manual operator interactions are required during a process, this is indicated by means of corresponding instructions in dialog boxes.

A full sterilization must be actively terminated in the "holding phase" using **Stop**. Alternatively, it can also be terminated by starting **(Start)** the cultivation. The cultivation must be actively terminated using **Stop**.

Process Abortion

There are two different types of process abortions:

- Automatic process abortion triggered by the system due to a faulty system state.
- Manual process abortion triggered by the operator via **Stop**.

In any case, a safe abortion defined via the system takes place. A process abortion is shown as *aborted at* with date and time.

Process Descriptions

The following chapters describe each process and its sequence in table form with status displays and dialog boxes in the touch screen software (chapter "Process Sequence"). The parameters with value ranges that can be set for a process are listed in the respective "Process Configuration" chapter. Prerequisites and instructions for carrying out the process follow afterwards (chapters "Before Starting the Process" and "Executing the Process"). If necessary, correspondingly named chapters follow with additional information on the end of the process or a manual process abortion. For more information on process sequences, refer to the "Process Sequences" document in the separate technical documentation of the bioreactor.

8.9.2 Safety Notes



WARNING

The vessel of the bioreactor is under pressure during the full sterilization. This can also be the case during other operations.

Removing built-in-parts or the vessel top plate may result in liquid splashing out or leaking and/or gases escaping. This can lead to severe burns, burns or poisoning.

Always make sure that the vessel is free of pressure before manipulating built-in-parts and the vessel top plate.



CAUTION

Risk of burns due to contact with the hot surfaces! The vessel, piping and associated components of the bioreactor can get hot. Touching these components can lead to burns.

8.9.3 Full Sterilization

8.9.3.1 Process Sequence

For full sterilization, the water in the vessel jacket is heated by feeding in steam. The steam generated by the liquid in the vessel also sterilizes the inlet air and exit gas filters at the same time.

Operation

Process step	D = Dialog box, user interaction required	
	S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instruction(s)
Delayed start	S	<i>starting inhibitor</i> + <i>time left</i> in h:min:s
	Step is skipped if function is deactivated.	
Heat up to degassing temperature	S	<i>heating up to degassing temperature</i> + set temperature in °C + current temperature display
	Step is skipped if value for degassing time = 0.	
Degas at degassing temperature	S	<i>degassing at degassing temperature</i> + set temperature in °C + <i>time left</i> in h:min:s
	Step is skipped if value for degassing time = 0.	
Heat up to sterilization temperature	S	<i>heating up to sterilisation temperature</i> + set temperature in °C + current temperature display
Sterilization at sterilization temperature	S	<i>sterilising at sterilisation temperature</i> + set temperature in °C + <i>time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
	The dialog box only appears if a resterilizable feed line (option) is used.	
Cool down to 95 °C	S	<i>cooling down to 95 °C</i> + current temperature display
Cool down to 70 °C	S	<i>cooling down to 70 °C</i> + current temperature display
	From a temperature of < 70 °C, an immediate process abortion is possible.	
Cool down to holding phase temperature +10 °C	S	<i>cooling down to holding phase temperature +10 °C</i> set temperature in °C + current temperature display
Cool down to holding phase temperature	S	<i>cooling down to holding phase temperature</i> + set temperature in °C + current temperature display
Holding phase	S	<i>holding phase</i> + set temperature in °C
	Holds holding phase temperature until cultivation is started or full sterilization is stopped.	
Full sterilization complete	S	<i>completed at</i> with date and time in h:min:s

Degassing

If the medium is heated too quickly, foaming may occur due to escaping gases. During the "degassing" phase, a specified temperature is therefore maintained for a defined time to allow gases to escape in a controlled manner. The time and temperature are set in the configuration dialog.

8.9.3.2 Process Configuration

Input field		Value range	Unit
<i>Stirrer</i> (rotation speed stirrer)		20 to 1000	min ⁻¹
<i>Degassing temperature</i>		up to 95	°C
<i>Degassing time</i>		0 to 120	min
<i>Sterilisation temperature</i>		110 to 125	°C
<i>Sterilisation time</i>		10 to 120	min
<i>Cooling flow</i> (air flow during cooling phase to prevent vacuum in the vessel)	10 L WV	10.0 to 20	L/min
	20 L WV	20.0 to 40	L/min
	30 L WV	30.0 to 60	L/min
<i>Holding phase temperature</i>		up to 79	°C
<i>Holding phase flow</i> (air flow in holding phase)	10 L WV	0 / 0.2 to 20	L/min
	20 L WV	0 / 0.4 to 40	L/min
	30 L WV	0 / 0.6 to 60	L/min
<i>Holding phase pressure</i> (pressure in holding phase) (Only with optional pressure control)		0 to 1.5	bar
<i>Heating up time max.</i>		90 to 300	min
<i>Start inhibitor</i> (activate or deactivate start delay)		No / Yes	
<i>Hours</i>		0 to 99	h
<i>Minutes</i>		0 to 59	min
(Start process in ... hours and ... minutes)			

Operation

8.9.3.3 Before Starting the Process

Before starting the process, check and ensure that:

- All required services are available and activated.
- All services have the correct connection pressure.
- The mechanical seal is lubricated (➔ chapter 2.9.3, page 54).
- The antifoam sensor (variant with dosing needle) has been removed.
- If available: the inoculation needles have been removed.
- If available: the push valves are closed.

8.9.3.4 Executing the Process

To execute the process, proceed as follows:

1. ➔ In the *Batch* main menu, press **Full Sterilisation**.
 - ➔ The configuration dialog appears with more or fewer input fields depending on the device configuration.
2. ➔ Enter the setpoints.
3. ➔ Press **OK**.
 - ➔ The dialog box for user interaction appears with more or fewer procedures to be performed depending on the device configuration.

Full sterilisation: user interaction required
1. Set valve 02.16.01 to position "STER" 2. Set ball valve 03.41.01 to position "Sterilisation" 3. Set ball valves 01.41.01 and 01.41.02 to position "Tap water" 4. Connect condensate line to block valve 13.16.01 / 13.16.03 5. Open valve 13.16.01
OK

The figure shows, as an example, the dialog box of a device with gas sensors for exit gas analysis, ball valves for switching from tap water to chilled water and a resterilizable feed line.

4. ➔ Execute all the steps of the procedure in sequence.

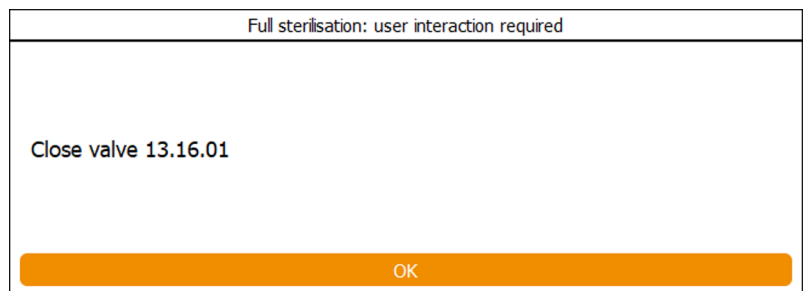
5. ➤ Press **OK**.

- ➔ The process now runs automatically until the holding phase is reached. ¹⁾



If the sterilization temperature falls below the set setpoint, this is indicated by *temperature is low*. The countdown is stopped until the temperature has reached the setpoint again. The process is then continued.

¹⁾ With a resterilizable feed line, a second dialog box appears first after the set sterilization time has elapsed:

**1.** ➤ Execute the step.**2.** ➤ Press **OK**.

- ➔ The process runs automatically until the holding phase is reached.

8.9.3.5 Terminating the Process

The holding phase temperature is maintained until the cultivation is started via **Start** or the process is stopped via **Stop** next to **Full Sterilisation**.

8.9.3.6 Aborting the Process

For safety reasons, an immediate process abortion is only possible at a temperature of < 70 °C. That is, at ≥ 70 °C the cool down phase is initiated first.

Operation

8.9.4 SIP Harvest Valve – Sterilization Harvest Valve

8.9.4.1 Process Sequence

The harvest valve *05.12.01* can be sterilized as often as desired independently of the full sterilization.

The process is started and terminated in the touch screen software, and the sterilization time is set in the configuration dialog. The addition of steam is manually controlled via valve *05.16.01*.



This process also applies to sterilization with the optional sampling set.

Process step	D = Dialog box, user interaction required S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instructions
Sterilization	S	<i>sterilisation + time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
Sterilization harvest valve completed	S	<i>completed at</i> with date and time in h:min:s

8.9.4.2 Process Configuration

Input field	Value range	Unit
<i>Sterilisation time</i> (sterilization duration)	10 to 60	min

8.9.4.3 Before Starting the Process

Before starting the process, check and ensure that:

- All required services are available and activated.
- All services have the correct connection pressure.
- Harvest valve *05.12.01* is closed.

8.9.4.4 Executing the Process

To execute the process, proceed as follows:

1. ➤ In the *Batch* main menu, press **SIP Harvest Valve**.
 - ➡ The configuration dialog appears.
2. ➤ Enter the desired sterilization duration.
3. ➤ Press **OK**.
 - ➡ The first dialog box for user interaction appears with instructions.

Sterilisation harvest valve: user interaction required
1. Connect steam trap or sampling set to harvest valve 05.12.01 2. Open valve 05.16.01
OK

4. ➤ Execute the steps of the procedure in the order listed.
5. ➤ Press **OK**.
 - ➡ The process starts.

As soon as the set sterilization time has elapsed, the second dialog box appears with instructions.

Sterilisation harvest valve: user interaction required
Close valve 05.16.01
OK

6. ➤ Execute the step.
7. ➤ Press **OK**.
 - ➡ The process is finalized.

8.9.4.5 Aborting the Process

The process can be aborted at any time. The same dialog box appears as for the normal process end.

Operation

8.9.5 SIP Sample Valve – Sterilization Sample Valve

8.9.5.1 Process Sequence

The (optional) sample valve *17.13.01* can be sterilized any number of times, irrespective of a full sterilization. Between sterilization and sampling, you should wait long enough to allow the valve to cool down. The process is started and terminated in the touch screen software, and the sterilization time is set in the configuration dialog. The addition of steam is controlled via valve *17.16.01* on the hose line on the sample valve.

Process step	D = Dialog box, user interaction required S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instructions
Sterilization	S	<i>sterilisation + time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
Sterilization of sample valve complete	S	<i>completed at</i> with date and time in h:min:s

8.9.5.2 Process Configuration

Input field	Value range	Unit
<i>Sterilisation time</i> (sterilization duration)	10 to 60	min

8.9.5.3 Before Starting the Process

Before starting the process, check and ensure that:

- All required services are available and activated.
- All services have the correct connection pressure.
- Sample valve *17.13.01* is closed.
- The steam hose is connected.
- The steam trap is connected to the condensate collection line.

8.9.5.4 Executing the Process

To execute the process, proceed as follows:

1.  In the *Batch* main menu, press **SIP Sample Valve**.
 - ➡ The configuration dialog appears.

2. Enter the desired sterilization time.

3. Press **OK**.

➡ The dialog box for user interaction appears.

Sterilisation sample valve: user interaction required
1. Connect steam trap to sample valve 17.13.01 2. Open valve 17.16.01
OK

4. Execute the steps of the procedure in the order listed.

5. Press **OK**.

➡ The process starts.

As soon as the set sterilization time has elapsed, the second dialog box appears with instructions.

Sterilisation sample valve: user interaction required
Close valve 17.16.01
OK

6. Execute the step.

7. Press **OK**.

➡ The process is finalized.

8.9.5.5 Aborting the Process

The process can be aborted at any time. The same dialog box appears as for the normal process end.

8.9.6 SIP Feed Line – Sterilization Feed Line

8.9.6.1 Process Sequence

The (optional) resterilizable feed line is first autoclaved and sterilized in additional sub-steps. For more information on this subject, see ➡ Chapter 3.3 'Resterilizable Feed Line' on page 95 The process is

Operation

started and terminated in the touch screen software, and the sterilization and ventilation time is set in the configuration dialog. All valves of the feed line are opened and closed manually.

Process step	D = Dialog box, user interaction required	
	S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instructions
Sterilization	S	<i>sterilisation + time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
Ventilation	S	<i>ventilation+ time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
Sterilization of feed line complete	S	<i>completed at</i> with date and time in h:min:s

8.9.6.2 Process Configuration

Input field	Value range	Unit
<i>Sterilisation time</i>	10 to 60	min
<i>Ventilation time</i>	0 to 60	min

8.9.6.3 Before Starting the Process

Before starting the process, check and ensure that:

- All required services are available and activated.
- All services have the correct connection pressure.
- Block valve *13.16.02 / 13.16.04* is connected.
- The steam hose is connected.



To be able to start the process while a cultivation is running, the *Feed* parameter must be deactivated.

8.9.6.4 Executing the Process

To execute the process, proceed as follows:

1. ➤ In the *Batch* main menu, press **SIP Feed Line**.
 - ➡ The configuration dialog appears.
2. ➤ Enter the desired sterilization and ventilation time.
3. ➤ Press **OK**.
 - ➡ The first dialog box for user interaction appears with instructions.

Sterilisation feed line: user interaction required
1. Connect condensate line to block valve 13.16.02 / 13.16.04 2. Close valves 13.16.01 and 13.16.04 3. Open valve 13.16.02 4. Open valve 13.16.03
OK

4. ➤ Execute the steps of the procedure in the order listed.
5. ➤ Press **OK**.
 - ➡ The process starts.

As soon as the set sterilization time has elapsed, the second dialog box appears with instructions.

Sterilisation feed line: user interaction required
1. Close valve 13.16.02 2. Close valve 13.16.03 3. Open valve 13.16.01
OK

6. ➤ Execute the steps of the procedure in the order listed.
7. ➤ Press **OK**.
 - ➡ Ventilation starts.

As soon as the set ventilation time has elapsed, the third dialog box appears with instructions.

Sterilisation feed line: user interaction required
Open valve 13.16.04
OK

Operation

8. ➤ Execute the step.

9. ➤ Press **OK**.

➡ The process is finalized.

8.9.6.5 Aborting the Process

The process can be aborted at any time.



The valves of the feed line must be returned to their original position. To do this, follow the instructions in the dialog boxes.

8.9.7 SIP Transfer Block Valve – Sterilization Transfer Block Valve

8.9.7.1 Process Sequence

The (optional) resterilizable transfer line is prepared and sterilized in stages. For more information on this, see ➡ Chapter 3.4 'Resterilizable Transfer Line' on page 99.

Process step	D = Dialog box, user interaction required	
	S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instructions
Sterilization	S	<i>sterilisation + time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
Sterilization transfer block valve completed	S	<i>completed at</i> with date and time in h:min:s

8.9.7.2 Process Configuration

Input field	Value range	Unit
<i>Sterilisation time</i> (sterilization duration)	10 to 60	min

8.9.7.3 Before Starting the Process

Before starting the process, check and ensure that:

- All required services are available and activated.
- All services have the correct connection pressure.
- Harvest valve *05.12.01* is closed.

8.9.7.4 Executing the Process

To execute the process, proceed as follows:

1. In the *Batch* main menu press **SIP Transfer Block Valve**.

➡ The configuration dialog appears.

2. Enter the desired sterilization duration.

3. Press **OK**.

➡ The first dialog box for user interaction appears with instructions.

Sterilisation transfer block valve: user interaction required
1. Connect block valve 19.16.01 / 19.16.02 to harvest valve 05.12.01 2. Connect blind plug to block valve 19.16.01 / 19.16.02 3. Open valves 19.16.01 and 19.16.02 4. Open valve 05.16.01
OK

4. Execute the steps of the procedure in the order listed.

5. Press **OK**.

➡ The sterilization starts.

As soon as the set sterilization has elapsed, the second dialog box appears with instructions.

Sterilisation transfer block valve: user interaction required
1. Close valve 05.16.01 2. Close valve 19.16.02 3. Close valve 19.16.01
OK

6. Execute the steps of the procedure in the order listed.

Operation

7. ➤ Press **OK**.

➡ The process is finalized.

8.9.7.5 Aborting the Process

The process can be aborted any time. Pressing **Stop** leads to the same dialog box for the manual valve switching like before the regular process end.

8.9.8 SIP Transfer Line – Sterilization Transfer Line

8.9.8.1 Process Sequence

Process step	D = Dialog box, user interaction required S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instructions
User interaction	D	<i>user interaction required</i> with instructions
Sterilization	S	<i>sterilisation + time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
Sterilization transfer line completed	S	<i>completed at</i> with date and time in h:min:s

8.9.8.2 Process Configuration

Input field	Value range	Unit
<i>Sterilisation time</i> (sterilization duration)	10 to 60	min

8.9.8.3 Before Starting the Process

Before starting the process, check and ensure that:

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

8.9.8.4 Executing the Process

To execute the process, proceed as follows:

1. In the *Batch* main menu, press **SIP Transfer Line**.
 - ➔ The configuration dialog appears.
2. Enter the desired sterilization duration.
3. Press **OK**.
 - ➔ The first dialog box for user interaction appears with instructions.

Sterilisation transfer line: user interaction required
1. Connect block valve 19.16.01 / 19.16.02 to harvest valve 05.12.01 2. Connect block valve 19.16.03 / 19.16.04 to transfer unit 3. Connect clean steam to block valve 19.16.03 / 19.16.04 4. Close valves 19.16.01 and 19.16.04 5. Open valve 19.16.02
OK

4. Execute the steps of the procedure in the order listed.
5. Press **OK**.
 - ➔ The second dialog box for user interaction appears with an instruction.

Sterilisation transfer line: user interaction required
Open valve 19.16.03
OK

6. Execute the step.
7. Press **OK**.
 - ➔ As soon as the set sterilization has elapsed, the third dialog box appears with instructions.

Sterilisation transfer line: user interaction required
1. Close valve 19.16.02 2. Close valve 19.16.03
OK

8. Execute the steps of the procedure in the order listed.

Operation

9.  Press **OK**.

➡ The process is finalized.

After completion of this sterilization process, all components of the transfer line are sterile and the line is ready for use.

8.9.8.5 Aborting the Process

The process can be aborted any time. Pressing **Stop** leads to the same dialog box for the manual valve switching like before the regular process end.

8.9.9 Bioreactor Operation – Cultivation

8.9.9.1 Process Sequence

Process step	D = Dialog box, user interaction required S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instructions
Cultivation running	S	<i>in progress since</i> + running time in h:min:s
User interaction	D	<i>user interaction required</i> with instructions
Cultivation stopped	S	<i>stopped after</i> + cultivation time with date and time in d:h:min:s

8.9.9.2 Process Configuration

Input field		Value range	Unit
<i>Temperature</i>		0 / 20 to 79	°C
<i>Stirrer</i> (rotation speed stirrer)	10 L WV	0 / 20 to 1500	min ⁻¹
	20 L WV	0 / 20 to 1200	min ⁻¹
	30 L WV	0 / 20 to 1200	min ⁻¹
<i>pH</i>		2 to 12	--
<i>pO₂</i>		0 to 100	%
<i>Antifoam</i>		OFF / ON	
<i>Feed</i>		0 to 100	%

Input field		Value range	Unit
<i>Feed 2 / Feed 3 / Ext. Feed 1 / Ext. Feed 2¹⁾</i>		0 to 100	%
<i>GasMix²⁾</i>		-100 to +100	%
<i>Flow / Air Flow / O₂ Flow / N₂ Flow / GM Flow</i> (Gas flow)	10 L WV	0 / 0.2 to 20	L/min
	20 L WV	0 / 0.4 to 40	L/min
	30 L WV	0 / 0.6 to 60	L/min
<i>CO₂ Flow¹⁾</i>	10 L WV	0 / 0.1 to 10	L/min
	20 L WV	0 / 0.2 to 20	L/min
	30 L WV	0 / 0.3 to 30	L/min
<i>Pressure¹⁾</i>		0 to 1.5	bar

¹⁾ Option

²⁾ The setting range depends on the type and number of gases used (air, O₂, N₂).

³⁾ Depending on the selected gassing strategy and the number of gases, more or fewer Flow parameters exist and are configured.

8.9.9.3 Before Starting the Process

Before starting the process, check and ensure that:

- All required services are available and activated.
- All services have the correct connection pressure.
- The mechanical seal is lubricated (➔ Chapter 2.9.3, page 54).

8.9.9.4 Starting the Process

To start the cultivation, proceed as follows:

Operation

1. ➤ In the *Batch* main menu, press **Start**.

- ➡ The configuration dialog appears with more or fewer parameters depending on the device configuration. The setpoint settings of the parameters from the last cultivation are visible here.



The cultivation is started with the settings in the configuration dialog. Changes to these settings are saved and transferred into the next configuration dialog. Changes of parameter settings during the running process are only applied to the current cultivation.

2. ➤ Make required settings.

3. ➤ Press **OK**.

- ➡ The dialog box for user interaction appears with more or fewer user instructions depending on the device configuration.

Bioreactor operation: user interaction required
1. Set valve 02.16.01 to position "OP" 2. Set ball valve 03.41.01 to position "Bioreactor Operation" 3. Set ball valves 01.41.01 and 01.41.02 to position "Tap water" or "Chilled water" 4. Open valves 13.16.01 and 13.16.04
OK

The figure shows, as an example, the dialog box of a device with gas sensors for exit gas analysis, ball valves for switching between tap water / chilled water and a resterilizable feed line.

4. ➤ Execute all the steps of the procedure in sequence.

5. ➤ Press **OK**.

- ➡ The cultivation is started.
 - The actual values and control outputs of the parameters are visible in the *Controller* main menu.
 - A record of actual values and a display as a diagram are available in the *Trends* main menu.

8.9.9.5 Terminating the Process

To stop the cultivation, proceed as follows:

1. In the *Batch* main menu, press **Stop** next to **Start**.

➡ The dialog box for confirming the cultivation stop appears.

Bioreactor operation: user interaction required

Bioreactor operation will be stopped

Press OK to confirm

Cancel

OK

2. Press **OK**.

➡ The cultivation is stopped.

8.9.10 Harvest

8.9.10.1 Process Sequence

At the end of the cultivation process the culture can be harvested. For this purpose, a suitable harvest hose must be connected to the harvest valve on the operator's side. The process is controlled via the touch screen software, provided the optional pressure control is installed.

Process step	D = Dialog box, user interaction required S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instruction
Pressure build up	S	<i>pressure build up</i>
Pressure stabilization (1 min)	S	<i>pressure stabilisation + time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instruction
User interaction	D	<i>user interaction required</i> with instruction
Pressure release (1 min)	S	<i>pressure release + time left</i> in h:min:s
End of harvest	S	<i>completed at</i> with date and time in h:min:s

Operation

8.9.10.2 Process Configuration

Input field	Value range	Unit
<i>Overpressure</i>	0 to 1.0	bar

8.9.10.3 Before Starting the Process

Before starting the process, check and ensure that:

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

8.9.10.4 Executing the Process

To execute the process, proceed as follows:

1. ➤ In the *Batch* main menu, press **Harvest**.
 - ➡ The configuration dialog appears.
2. ➤ Enter the desired overpressure.
3. ➤ Press **OK**.
 - ➡ The first dialog box for user interaction appears with more or fewer user instructions depending on the device configuration.

Harvest: user interaction required
1. Connect harvest hose to harvest valve 05.12.01 2. Set valve 02.16.01 to position "STER" 3. Set ball valve 03.41.01 to position "Sterilisation"
OK

The figure shows as an example the dialog box of a device with gas sensors for exit gas analysis.

4. ➤ Execute the steps of the procedure in the order listed.

5. ➤ Press **OK**.

- ➡ The pressure build-up begins.
- ➡ As soon as the pressure is stable, the second dialog box for user interaction appears.

Harvest: user interaction required
Open harvest valve 05.12.01 Press OK to confirm
OK

6. ➤ Execute the step.

7. ➤ Press **OK** to confirm the start of the harvesting.

- ➡ At the same time the third dialog box for user interaction appears.

Harvest: user interaction required
Harvest is in progress When harvest is complete, close harvest valve 05.12.01 Press OK to finish
OK

After the harvest is completed:

8. ➤ Execute the step.

9. ➤ Press **OK**.

- ➡ The pressure release begins, the process is afterwards completed.

8.9.10.5 Aborting the Process

The process can be aborted any time, the program automatically starts with the pressure release as necessary.

Operation

8.9.11 Transfer

8.9.11.1 Process Sequence

The resterilizable transfer line enables the contents of the bioreactor to be transferred in a sterile manner into a user-side tank, container or bioreactor. Before the actual transfer, the resterilizable transfer line must have been prepared accordingly, see

➔ Chapter 3.4.2 'Preparing the Resterilizable Transfer Line for Cultivation' on page 100, ➔ Chapter 8.9.7 'SIP Transfer Block Valve – Sterilization Transfer Block Valve' on page 256 and ➔ Chapter 8.9.8 'SIP Transfer Line – Sterilization Transfer Line' on page 258).

Process step	D = Dialogue box, user interaction required	
	S = Status display, no user interaction	
Configuration	D	<i>configuration</i> for process configuration
User interaction	D	<i>user interaction required</i> with instruction
Pressure build up	S	<i>pressure build up</i>
Pressure stabilization	S	<i>pressure stabilisation + time left</i> in h:min:s
User interaction	D	<i>user interaction required</i> with instruction
User interaction	D	<i>user interaction required</i> with instruction
User interaction	D	<i>user interaction required</i> with instruction
End of transfer	S	<i>completed at</i> with date and time in h:min:s

8.9.11.2 Process Configuration

Input field	Value range	Unit
<i>Overpressure</i>	0 to 1.0	bar

8.9.11.3 Before Starting the Process

Before starting the process, check and ensure that:

- All required services are available and activated.
- All services have the correct connection pressure.
- The transfer hose line is connected and has been prepared accordingly.

8.9.11.4 Executing the Process

To execute the process, proceed as follows:

1. In the *Batch* main menu, press **Transfer**.
 - ➡ The configuration dialog appears.
2. Enter the desired overpressure.
3. Press **OK**.
 - ➡ The first dialog box for user interaction appears with more or fewer user instructions depending on the device configuration.

Transfer: user interaction required
1. Connect block valve 19.16.01 / 19.16.02 to harvest valve 05.12.01 2. Connect block valve 19.16.03 / 19.16.04 to transfer unit 3. Close valves 19.16.02 and 19.16.03 4. Open valves 19.16.01 and 19.16.04 5. Set valve 02.16.01 to position "STER" 6. Set ball valve 03.41.01 to position "Sterilisation"
OK

The figure shows as an example the dialog box of a device with gas sensors for exit gas analysis.

4. Execute the steps of the procedure in the order listed.
5. Press **OK**.
 - ➡ As soon as the pressure has been stabilized, the second dialog box for user interaction appears.

Transfer: user interaction required
Open harvest valve 05.12.01 Press OK to confirm
OK

6. Execute the step.

Operation

7. ➤ Press **OK** to confirm the transfer start.

- ➡ The transfer begins, and the third dialog box for user interaction appears.

Transfer: user interaction required
Transfer is in progress When transfer is complete, close harvest valve 05.12.01 Press OK to finish
OK

The transfer is finished when a clearly audible “air noise” is heard in the transfer line.

Once finished:

8. ➤ Execute the step.

9. ➤ Press **OK** to confirm the end of the process.

- ➡ The last dialog box for user interaction appears with instructions.

Transfer: user interaction required
Close valves 19.16.01 and 19.16.04
OK

10. ➤ Execute the steps of the procedure in the order listed.

11. ➤ Press **OK**.

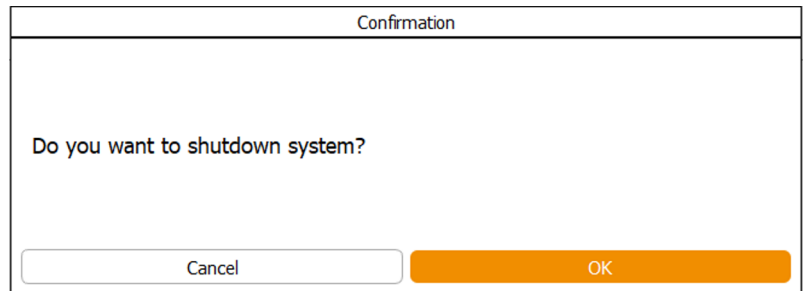
- ➡ The process is finalized.

8.10 Shutting Down the System; Switching off the Device

To shut down the system and switch off the device, proceed as follows:

1. In the *System* main menu, press **Shutdown**.

➔ The *Confirmation* dialog box for confirming the shutdown appears.



2. Press **OK**.

➔ The system shuts down.

As soon as the screen is dark:

3. Turn the main switch to the *0 / OFF* position.

➔ The device is switched off.

4. Shut off the supply lines und ensure that they are depressurized.



WARNING

Due to stored energy, the vessel will be pressurized even after switching off via the main switch.

Prior to each manipulation of the vessel and its components, check the vessel pressure on the manometer and, if necessary, depressurise the vessel.

Operation

8.11 Emergency Shut-Off – Shut Down in Case of an Emergency

To shut down the device in dangerous situations, proceed as follows:

1.  Immediately switch off the device at the main switch.
 - ➡ The device is de-energized.
 - ➡ Any cultivation that might be running will be continued when the device is switched on again.
 - ➡ If the mobile CIP unit *TechCIP* of the device manufacturer is used: the software connection to the mobile CIP unit is terminated. The system alarm *TechCIP communication error* appears there.
2.  Resolve the emergency shut-off situation.

8.12 Switching On Again after Emergency Shut-Off



CAUTION

Premature restarting when the emergency shut-off situation has not yet been rectified can be dangerous and result in material damage.



NOTICE

Any cultivation running when the emergency shut-off is triggered will continue after restarting and, if necessary, has to be aborted separately via **Stop**. All other process remain stopped in any case and have to be started again.



If additional switches for the power supply/interruption have been fitted on the operating side, the internal safety regulations for this must be observed.

After faults and the emergency shut-off situation have been rectified:

1.  Ensure the emergency shut-off situation has been resolved.
2.  Switch the device on via the main switch.
 - ➡ The system alarm *System restarted after a power failure* appears.
3.  Start the desired process(es) again, if necessary, terminate and restart.

9 Rectifying Faults

The following chapter describes possible reasons for faults and how to resolve them. Reduce the service intervals in correspondence with the actual loads if faults become increasingly common. Contact the manufacturer or licensed dealer in case of faults that cannot be resolved by following the notices below.

9.1 Fault Tables

9.1.1 General Faults

Fault description	Cause	Remedy	Personnel
The device does not work, the green power indicator light is not lit, the screen of the operating panel remains dark.	The device is not switched on.	Switch the device on via the main switch.	Operator
	Power supply to device interrupted.	1. → Check if the plugs are plugged in correctly. 2. → Check the mains connection.	Operator
	Circuit breaker(s) has/have tripped.	1. → Open the instrumentation cabinet. 2. → Switch on both circuit breakers. If they are triggered again consult an INFORS HT service technician.	Technician
The green power indicator light is lit, the screen of the operating panel remains dark.	The screen of the operating panel is switched off.	Switch on the screen of the operating panel via the ON/OFF key on the monitor.	Operator
	The power cable is not connected to the operating panel.	Connect the power supply cable to the DC connection of the operating panel.	Operator
No communication between the device and the operating panel (alarm <i>no communication</i>)	Display cable is not connected to the operating panel.	Connect the display cable to the COM1 connection of the operating panel.	Operator
	Display cable is not connected to the control board in the instrumentation cabinet.	1. → Open the instrumentation cabinet. 2. → Connect the display cable to the control board.	Technician

Rectifying Faults

9.1.2 Faults Drive System

Fault description	Cause	Remedy	Personnel
Motor does not start.	The <i>Stirrer</i> parameter is not activated.	Activate the <i>Stirrer</i> parameter.	Operator
	Setpoint of <i>Stirrer</i> parameter = 0.	1. ➤ Set setpoint > 0. 2. ➤ Check value of the <i>Dead Band</i> in the <i>PID</i> parameter option: it must have a value of 0.	Operator
	Parameter <i>pO₂</i> is activated and set to oxygen control via rotation speed stirrer (option <i>Cascade</i> in parameter <i>pO₂</i>).	Switch <i>Cascade</i> off and test the function via the <i>Stirrer</i> parameter.	Operator
The motor does not start, the <i>Stirrer</i> parameter is activated, the <i>Cascade</i> option in <i>pO₂</i> is not activated.	The motor cable is not connected properly.	Connect the motor cable correctly.	Technician
	The motor has overheated or does not have sufficient mains voltage.	1. ➤ Turn off the device at the main switch. 2. ➤ Wait approx. 20 seconds. 3. ➤ Switch the device on via the main switch. 4. ➤ If this does not work, contact an INFORS HT service technician.	Operator
Motor control erratic	Incorrect settings in the <i>PID</i> option of the <i>Stirrer</i> parameter.	Reset the <i>PID</i> settings to their default values.	Operator

Rectifying Faults
9.1.3 Faults Temperature Control System

Fault description	Cause	Remedy	Personnel
No temperature control.	Temperature control has not been activated.	Activate the <i>Temperature</i> parameter.	Operator
No cooling or inadequate cooling.	No water supply or inadequate flow.	Check the water supply and turn on the supply tap if necessary.	Operator
	<i>Neg. factor</i> in the <i>PID</i> option in the <i>Temperature</i> parameter is incorrect.	Check the <i>Neg. factor</i> (negative factor) in the <i>PID</i> option: the value must be positive.	Operator
Temperature fluctuations.	Incorrect PID settings.	Check the PID settings (<i>PID</i> parameter option) and adjust as necessary (in particular <i>P-Term</i>).	Operator
Alarm <i>no water detected in temperature control system, refill failed</i> . The temperature control switches off, the circulation pump and heating are deactivated, the running process continues.	The (open) temperature control circuit is not filled.	Fill the temperature control circuit (according to the description in "Process Sequences" of the device's technical documentation).	Technician
Negative temperature display.	Cable broken or other defect in the temperature sensor cable.	Replace the temperature sensor.	INFORS HT service technician or licensed dealer
System alarm <i>Circulation pressure too low</i> , temperature control is switched off.	Insufficient pressure in the (closed, optional) temperature control circuit.	1. → Increase pressure in expansion vessel via ball valve 01.05.02. 2. → If necessary, adjust the pressure on pressure reducing valve 01.09.01.	Technician
System alarm <i>Max. heating up time exceeded</i> , the sterilization is aborted.	Temperature setpoint for sterilization not reached during the set heating time.	1. → Check if steam is available. 2. → If yes: restart the sterilization and set the maximum value of <i>Heating up time max</i>. 3. → If this does not work, contact an INFORS HT service technician.	Operator

Rectifying Faults

9.1.4 Faults Gassing System

Fault description	Cause	Remedy	Personnel
No gassing.	The on-site gas supply has been interrupted.	1. Stop the cultivation. 2. Check the on-site gas supply and switch it on, if necessary.	Operator
	The <i>Flow</i> parameter is not activated.	Activate the <i>Flow</i> parameter.	Operator
	Setpoint in <i>Flow</i> parameter(s) = 0.	Setpoint in <i>Flow</i> parameter(s) > 0.	Operator
	The <i>GM Flow</i> parameter = 0 and/or the <i>GasMix</i> parameter has not been activated.	Set the <i>GM Flow</i> parameter > 0 and activate <i>GasMix</i> .	Operator
	Inlet air escapes via unused twist valves on the filters.	Close unused twist valves on the inlet air and exit gas filter.	Operator
	The inlet air filter is blocked.	Replace the inlet air filter under sterile conditions.	Operator
The desired gas flow rate is not reached.	The inlet air filter or the exit gas filter is blocked.	Replace the filter under sterile conditions.	Operator
	Incorrect gas connection pressure.	Check the connection pressures, set it properly if necessary.	Operator
Sudden increase in evaporation losses in the vessel.	The exit gas cooler does not cool.	1. Check the building's water supply to the exit gas cooler, restore it if necessary. 2. Check and ensure that valve 01.06.06 is in automatic mode and activated: set Cooler in main menu <i>Main</i> to <i>AUTO</i>, green font = <i>Exit Gas Cooler</i> in submenu <i>Valves</i> to <i>ON</i>.	Operator

Rectifying Faults

9.1.5 Faults pH Control

Fault description	Cause	Remedy	Personnel
No display or incorrect display of pH. Digital measurement systems: error message <i>ERROR</i> instead of actual value.	Sensor cable is not connected or not properly connected.	Connect the sensor cable correctly.	Operator
	Analog measurement systems: <i>Temp. Compens.</i> (temperature compensation) function is deactivated.	Activate the function in the <i>Setpoint</i> option of the <i>pH</i> parameter.	Operator
	pH drift during long cultivation.	Recalibrate the pH with external measurements, or perform a product calibration.	Operator
	Faulty pH sensor.	1. → Test calibration with pH 4 and pH 7 buffer. 2. → Digital measurement systems: observe the error message when calling up the calibration menu (<i>Show Sensor Status</i>). 3. → Regenerate or replace the sensor, if necessary. Consult the documentation of the sensor manufacturer!	Operator
No pH control.	The <i>pH</i> parameter is not activated.	Activate the <i>pH</i> parameter.	Operator
	Incorrect deadband setting in PID.	Check the deadband (<i>Dead Band</i> in the <i>PID</i> parameter option): switch off or enter a small value.	Operator
	No addition of reagents (acids and base).	1. → Check the reagent bottles: refill if necessary. 2. → Check the hose connections between the reagent bottle and the vessel: connect properly if necessary. 3. → Remove/open clamps if necessary. 4. → Open the push valve(s) if necessary.	Operator

Rectifying Faults

Fault description	Cause	Remedy	Personnel
No pH control.	The (base/acid) pump does not operate properly.	1. Use FILL/EMPTY to check the functionality of the pump. 2. Check the hose type and replace if necessary.	Operator
	If CO ₂ gassing line is present and is used for pH control:	1. Check the CO₂ gas supply and turn it up if, necessary. 2. Check cascade settings: <i>CO₂ Flow</i> parameter is set as secondary parameter to pH, setpoint and setpoint min. are set to "0" (zero), the negative function is activated. 3. If necessary, check the PID settings and adjust them.	
The pH value drifts up and down over time or acid and base are added almost continuously in turn.	The PID settings in the <i>pH</i> parameter are incorrect.	Check the PID settings (<i>PID</i> parameter option) and correct if necessary. Specifically, change the proportional factor (<i>Prop. Term</i>) or the <i>Deadband</i> setting.	Operator
	Incorrect strength of reagents: concentration is too weak or too high.	Check the strength of the reagents. Adjust if necessary: 0.1 mol to 2.0 mol.	Operator

9.1.6 Faults pO₂ Control

Fault description	Cause	Remedy	Personnel
No display or incorrect display of pO ₂ . Digital measurement systems: error message <i>ERROR</i> instead of actual value.	Sensor cable is not connected or not properly connected.	Connect the sensor cable correctly.	Operator
	Analog measurement systems: pO ₂ sensor is not polarized.	Polarize the pO ₂ sensor.	Operator
	Faulty pO ₂ sensor.	1. → Check calibration. 2. → Digital measurement systems: observe the error message(s) when calling up the calibration menu (<i>Show Sensor Status</i>). 3. → If necessary, replace the pO₂ sensor. Consult the documentation of the sensor manufacturer!	Operator
No pO ₂ control.	The <i>pO₂</i> parameter and/or cascaded parameter is/are not activated.	Activate the parameter.	Operator
	The cascade settings are incorrect.	Check the cascade settings and change as necessary.	Operator
	No gas flow into vessel.	→ Chapter 9.1.4 'Faults Gassing System' on page 274.	Operator
Unstable pO ₂ control	Incorrect PID settings in the <i>pO₂</i> parameter.	Check the PID settings (<i>PID</i> parameter option) and correct if necessary. Specifically, the proportional factor (<i>Prop. Term</i>) and the deadband (<i>Dead Band</i>). The value in the deadband must be 0 (zero).	Operator

Rectifying Faults

9.1.7 Faults Antifoam Control

Fault description	Cause	Remedy	Personnel
Foam is not detected, frequently detected or constantly detected.	The sensor cables are not connected correctly.	Connect the sensor cable correctly.	Operator
	The insulation of the antifoam sensor is damaged.	Replace insulation of the sensor.	Operator
The antifoam pump does not work.	The <i>Antifoam</i> parameter has not been activated.	Activate the parameter.	Operator
	The (<i>Dose time</i>) in the <i>Antifoam</i> parameter = 0 (zero).	Set the dose time > 0 (zero).	Operator
No or inadequate anti-foam agent flow.	The reagent bottle is empty.	Fill the reagent bottle.	Operator
	Incorrect antifoam agent or incorrect concentration of antifoam agent used.	Change the antifoam agent.	Operator
	The hose line is blocked or clamped.	1. → Check the hose line between the reagent bottle and the vessel: if necessary, connect them correctly. 2. → If necessary, open/remove the hose clamp.	Operator
	If in use: a push valve is closed.	Open the push valve.	Operator
	The antifoam pump does not work.	1. → Check the function of the pump using the rocker switch. 2. → Check hose type and replace if necessary.	Operator

Rectifying Faults
9.1.8 Faults Feed and Pump

Fault description	Cause	Remedy	Personnel
No or inadequate flow of liquid via the feed pump.	The <i>Feed</i> parameter is not active.	Activate the <i>Feed</i> parameter.	Operator
	Setpoint of the <i>Feed</i> parameter = 0 (zero).	Set the setpoint > 0 (zero).	Operator
	The reagent bottle is empty.	Fill the reagent bottle.	Operator
	The hose line is blocked or clamped.	1. → Check the hose line between the reagent bottle and the vessel: if necessary, connect them correctly. 2. → If necessary, open/remove the hose clamp.	Operator
	If in use: the valve(s) of the resterilizable feed line is/are closed.	Open valves <i>13.16.01</i> (vessel feed line) and <i>13.16.04</i> (reagent feed line).	Operator
	If in use: a push valve is closed.	Open the push valve.	Operator
	The pump does not work.	1. → Check the function of the pump using the rocker switch. 2. → Check hose type and replace if necessary.	Operator

Rectifying Faults

9.1.9 Interferences Turbidity Measurement

Fault description	Cause	Remedy	Personnel
Displayed measured value is not plausible/unusual.	Sensor cable is twisted or kinked or not properly connected.	1. → Check the connection of the sensor cable, connect it properly, if necessary. 2. → Check and ensure that the cable is not kinked or twisted. twisted.	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 the sensor cable.	INFORS HT service technician or licensed dealer
	Faulty sensor.	Replace the sensor.	Operator



If the temperature of the sensor rises above 65 °C during operation in the medium, an automatic switch-off takes place.

After the medium has cooled down, the measurement continues automatically.

9.1.10 Behavior in Case of a Power Interruption

If the power supply to the device is interrupted during the running cultivation (e.g. by flicking the main switch or in case of a power failure), all parameter setpoints are stored. After restoring the power supply, the interrupted cultivation is automatically continued with the last stored setpoints. All other processes remain stopped.

The system alarm *Restart after power failure* indicates that there has been a power interruption. However, the alarm provides no information on the duration of the event.

9.2 Returning for Repair

The provider must return the device 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.



If the device, component or accessory has to be returned to the manufacturer for repair, a legally compliant declaration of decontamination is required for the safety of all parties involved and to comply with legal requirements (→ Chapter 1.8 'Declaration of Decontamination' on page 23).

Cleaning and Maintenance

10 Cleaning and Maintenance

The following chapters contain general descriptions regarding the cleaning of the vessel and its accessories, and how these can be stored.

In addition, the chapter contains a maintenance plan and corresponding descriptions for the procedures to be performed by the operator.

10.1 Cleaning Agent and Disinfectant

Purpose of use	Allowed products/tools
Vessel, slightly soiled	Water
Cleaning agent for denaturation of proteins	0.1 N NaOH
Cleaning agent for smaller parts	Ultrasonic bath
Cleaning agent for surfaces	Water
Disinfectant for surfaces	Ethanol, 70 %



CAUTION

Using spray bottles with ethanol can result in explosive mists being created!

All cleaning operations with ethanol must be carried out in an environment that is separate from the device, well ventilated and meets internal safety regulations.

10.2 Cleaning the Bioreactor

Overview of the Activities

The following checklist lists all the activities that must be carried out as part of routine cleaning (e.g. after cultivation).

No.	Activity	Additional Information	☒
1.1	Clean the vessel.	➔ Chapter 2.6.6, page 44	☐
1.2	Clean the vessel top plate.	➔ Chapter 2.6.7, page 45	☐
1.3	Clean the exit gas cooler.	➔ Chapter 2.12.3, page 69	☐
1.4	Clean reagent bottles, hoses and accessories.	➔ Chapter 10.2, page 283	☐
1.5	Clean the sensors.	➔ Chapter 10.2, page 284	☐
1.6	Clean the surfaces of the instrumentation cabinet and operating panel.	➔ Chapter 10.2, page 284	☐

Cleaning the Reagent Bottles, Hoses and Accessories

1. ➔ If necessary, empty the reagent bottle and dispose of the contents in accordance with internal safety guidelines.
2. ➔ Use water to thoroughly rinse reagent bottles and hoses as well as all built-in-parts and accessories, such as inoculation needles, push valves etc.
3. ➔ Check the silicone hoses and pump hoses for damage and replace if necessary.



Depending on the operator's specifications, new hoses might be used for every cultivation.

4. ➔ Check the reagent bottles and their components for damage and replace if necessary.
5. ➔ Check the O-rings on the built-in-parts and accessories as well as the lid seals of the reagent bottles for damage, and replace them if necessary.
6. ➔ Store reagent bottles, hoses, built-in-parts and accessories dry and on a clean underlay.

Cleaning and Maintenance

Cleaning the Sensors

Cleaning and maintenance of the individual sensors are described in the corresponding, separate documentation of the respective sensor manufacturer. Read these manuals and follow the instructions therein.

Sensors from the device manufacturer (antifoam and level) are cleaned and maintained like other built-in-parts, e.g. inoculation needles and push valves. When not in use, these must be stored clean and dry.

Cleaning the Surfaces of the Instrumentation Cabinet and Operating Panel

NOTICE

When cleaning, observe protection classes IP43 (instrumentation cabinet) and IP66 (operating panel)!

1. → Wipe the surfaces of the instrumentation cabinet including the operating panel with a slightly damp, soft cloth. If necessary, clean with a suitable (non-aggressive!) disinfectant.
2. → Wipe the screen of the operating panel with a cloth that is suitable for PC screens.

10.3 Maintenance Plan

WARNING

Failure to observe the maintenance plan bears a significant risk.

Users are responsible for compliance with the maintenance plan; failure to comply with it will result in exclusion of liability (see GTC).

The following sections describe the maintenance work that is required for optimal and fault-free operation.

If increased wear is detected during regular checks, the required maintenance intervals must be shorted in accordance with the actual signs of wear. Contact the manufacturer if you have questions about maintenance work and intervals.

Interval	Maintenance work	Personnel
Prior to each use	Check the hoses and hose connections.	Operator
	Check that O-rings and flat gaskets are leak-proof, replace if necessary.	Operator
	Check the reagent bottles and all other glass items for damage, and replace if necessary.	Operator

Cleaning and Maintenance

Interval	Maintenance work	Personnel
Prior to each use	Lubricate the mechanical seal (for details, see ➔ Chapter 2.9.3 'Lubricating the Mechanical Seal' on page 54).	Operator
	Check the air filters with a filter test device (if available).	Operator
After each use	Sterilize the vessel, vessel top plate, all built-in-parts as well as reagent bottles and hoses and then clean them.	Operator
	Preventatively replace silicone hoses (depending on their use).	Operator
Regularly (interval to be defined by provider)	Safety valve vessel: check operability by venting it in accordance with the safety valve's manufacturer's instructions.	Technician
After 20 to 50 sterilizations (recommended)	Replace the air filters. Reduce the maintenance interval if necessary.	Operator
Every 6 months	Replace all pumps and silicone hoses on the reagent bottles.	Operator
	Replace O-rings and flat gaskets. Reduce the maintenance interval if necessary.	Technician
	Check the functionality of the measurement sections (temperature, pH, etc.), use a simulator where appropriate.	Technician
	Check that the safety valves are operational according to the manufacturer of the safety valve's specifications.	Technician
Annually	Replace flat gasket(s), valve diaphragm(s) and gaskets of the vessel sight glass.	Technician
	Recommendation: complete device maintenance.	INFORS HT service technician or licensed dealer
As required	Wipe down the surfaces of the instrumentation cabinet and operating panel.	Operator
	Replace hoses and hose connections.	Technician
According to national requirements for safety valves.	Have safety valves tested by a competent external body in accordance with nationally applicable regulations.	Technician
After a defect or at the maintenance interval specified by the provider:	Replace the mechanical seal.	INFORS HT service technician or licensed dealer

Cleaning and Maintenance



For detailed information on care and maintenance of built-in-parts and accessories from other manufacturers, please refer to the documentation of the respective manufacturers and follow the instructions contained therein. This applies in particular to the safety valves.

11 Disposal

General Information

Once the end of use has been reached, the device must be dismantled and disposed of in an environmentally friendly manner. The materials must be disposed of in accordance with national and local legislation. The local municipal authority or specialist waste disposal companies can provide information on environmentally friendly disposal.

If no special return arrangements have been agreed, INFORS HT devices can be returned to the manufacturer or licenced dealer for disposal with the required declaration of decontamination (➔ Chapter 1.8 'Declaration of Decontamination' on page 23).



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.
- Before disposal, ensure that the device is free of toxic or infectious substances.

Disposal Information in accordance with the WEEE Directive (2012/19/EU)

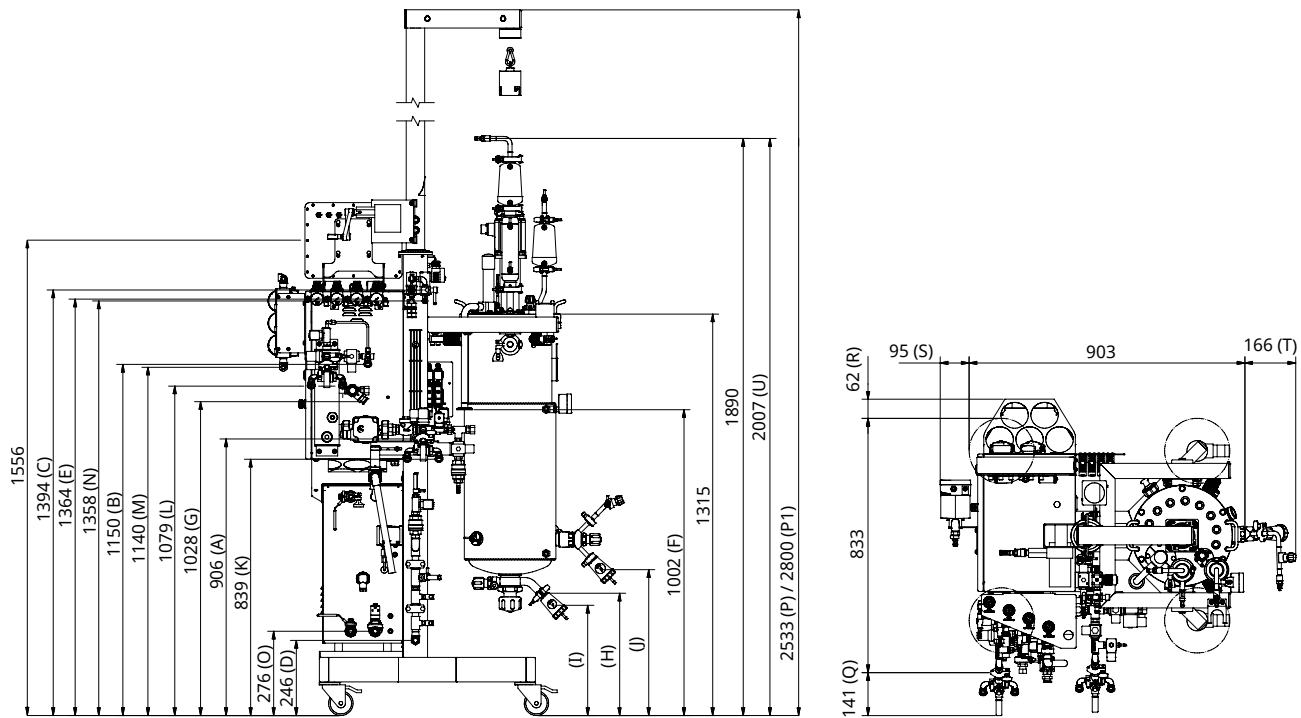


The device is marked with the symbol of a crossed-out wheeled bin in accordance with Directive 2012/19/EU on waste electrical and electronic equipment (WEEE). This symbol indicates that the device must not be disposed of with household waste. To prevent environmental damage and health risks caused by improper disposal, the device must be taken to a separate collection point for electrical and electronic equipment at the end of its service life.

Technical Data

12 Technical Data

12.1 Dimensions



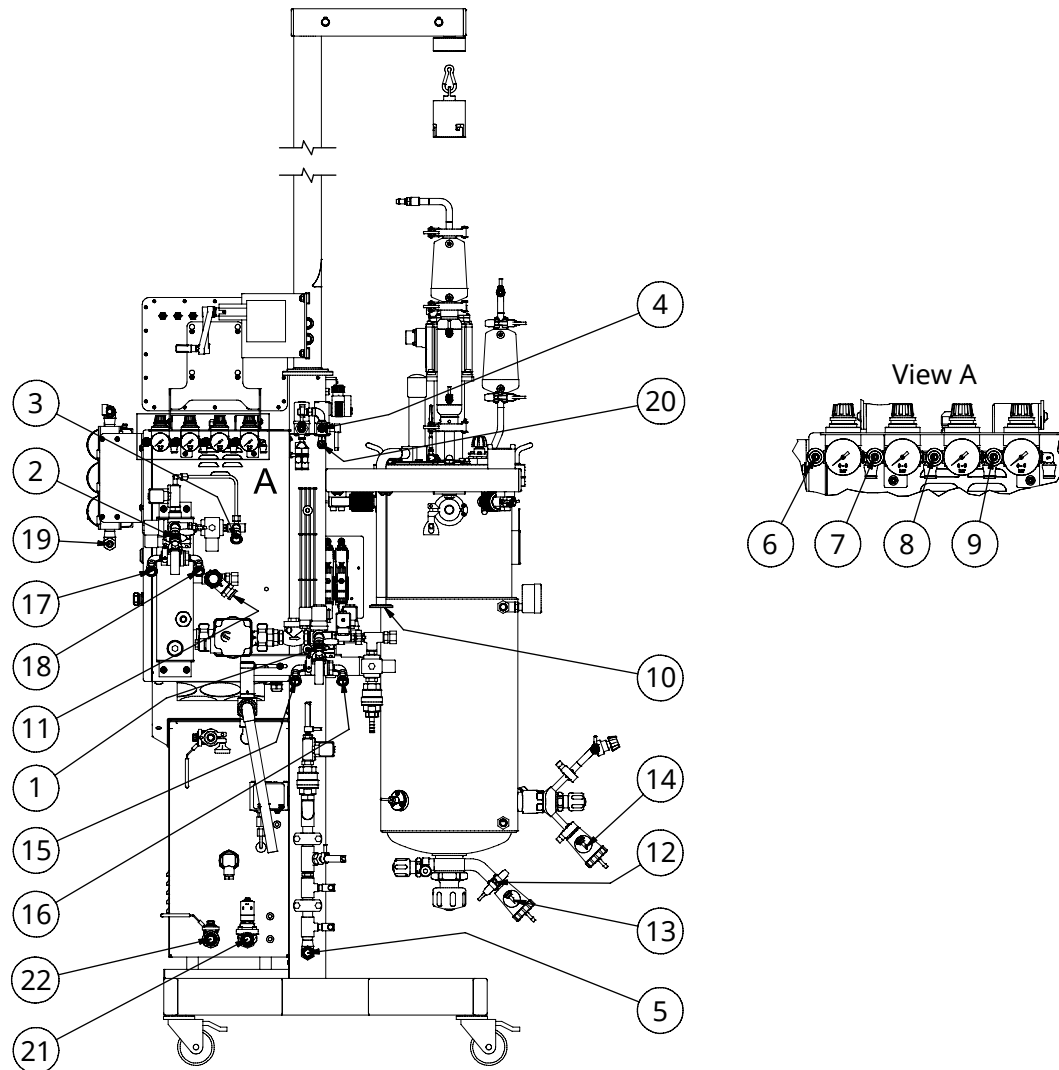
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|---|---|
| A Tap water in | M Option: exit gas analysis |
| B Tap water out / clean steam in | N Exit gas |
| C Exit gas | O Option: water inlet/outlet steam generator |
| D Condensate (contaminated) out | P Option: lifting device vessel top plate |
| E Process gas(es) in | P1 Required min. height for mounting of lifting device vessel top plate |
| F Safety valve (vessel) | Q Option: switchover tap water / chilled water |
| G Safety valve (temperature control system) | R Option: steam generator |
| H Harvest | S Option: exit gas analysis |
| I Option: sampling with sampling set | T Option: sample valve |
| J Option: sampling with sample valve | U Option: foam detection exit gas |
| K Option: inlet tap water / chilled water | |
| L Option: outlet tap water / chilled water | |

Designation		Vessel volume (WV)		
		10 L	20 L	30 L
H	Harvest	730	594	401
I	Sampling with optional sampling set	690	554	361
J	Sampling with optional sample valve	793	670	478

All dimensions in mm

12.2 Connections and Connection Values

Overview of Connections



Technical Data

Connection Values

Pos.	Connection	Type	Value bar(g)
1	Tap water in	Tri-Clamp 3/4"	2.0 to 2.5
2	Tap water out	Tri-Clamp 3/4"	(no backpressure)
3	Clean steam in	Tri-Clamp 3/4"	2.0 to 2.2
4	Exit gas	Hose nozzle DN13	(no backpressure)
5	Condensate (contaminated) out	Tri-Clamp 3/4"	(no backpressure)
6	Air in	Hose nozzle DN8	4.0 to 6.0
7	O ₂ in	Hose nozzle DN8	4.0 to 6.0
8	N ₂ in	Hose nozzle DN8	4.0 to 6.0
9	CO ₂ in	Hose nozzle DN8	4.0 to 6.0
10	Safety valve vessel	Tri-Clamp DN15	(no backpressure)
11	Safety valve temperature control system	Tri-Clamp 3/4"	(no backpressure)
12	Harvest	Tri-Clamp 1"	--
13	Sampling (optional sampling set)	Needle OD = 6 mm	--
14	Sampling (optional sample valve)	Needle OD = 6 mm	--
15	Tap water in (option)	Tri-Clamp 3/4"	2.0 to 2.5
16	Chilled water in (option)	Tri-Clamp 3/4"	2.0 to 2.5
17	Tap water out (option)	Tri-Clamp 3/4"	(no backpressure)
18	Chilled water out (option)	Tri-Clamp 3/4"	(no backpressure)
19	Exit gas (exit gas analysis)	Hose nozzle DN13	(no backpressure)
20	Exit gas	Hose nozzle DN13	(no backpressure)
21	Water in steam generator (option)	Tri-Clamp 3/4"	min. 3.0
22	Water out steam generator (option)	Tri-Clamp 3/4"	(no backpressure)

Electric Connection Values

Data	Value	Unit
Voltage (1 phase L1 + N (neutral) + PE (earth))	220 to 240	V
Frequency	50 / 60	Hz
Max. current consumption	15	A

Technical Data

Data	Value	Unit
Leakage current	> 3.5	mA

Connectors

Data	Value
USA and Canada	NEMA L6-20P 20A
Rest of the world	CEE16/3

12.3 Specifications of the Basic Unit

12.3.1 Instrumentation Cabinet

Data	Value	Unit
Width	320	mm
Depth	450	mm
Height	550	mm
Protection type	IP43	
Material	1.4301	

12.3.2 Operating Panel

Data	Value
HMI	15.6" color touch screen
Ingress protection	IP66

Technical Data

12.3.3 Vessel

Vessel Sizes

Total volume (TV)	Working volume (WV)		Total volume (TV) vessel jacket
	Max.	Min. ¹⁾	
15 L	10 L	3.4 L	1.3 L
30 L	20 L	5.7 L	2.0 L
45 L	30 L	7.0 L	3.3 L

¹⁾ Values apply to cultivation

Dimensions

Vessel WV	Height ¹⁾	ID	Ratio H/D
10 L	498 mm	200 mm	2.5 : 1
20 L	633 mm	250 mm	2.5 : 1
30 L	826 mm	267 mm	3.0 : 1

¹⁾ Without top plate and nozzle for bottom valve

Limits

Data	Value	Unit
Temperature range vessel inside	-10 to +150	°C
Temperature range vessel jacket	-10 to +150	°C
Pressure range vessel inside	-1 to +4	bar(g)
Pressure range vessel jacket	-1 to +4	bar(g)

Materials

Data	Value
Parts in contact with medium	AISI 316L
Parts not in contact with medium	AISI 304

Technical Data

Surface Roughness

Data	Value
Parts in contact with medium	$Ra \leq 0.6 \mu\text{m}$, electropolished
Parts not in contact with medium	$Ra \leq 1.2 \mu\text{m}$, electropolished

Conformity



The vessel was manufactured either in accordance with the Pressure Equipment Directive 2014/68/EU or in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. The applicable design is specified in the separate vessel documentation. Where applicable, this documentation also includes information on permitted load changes.

Ports and Ingold Nozzles

Vessel top plate port	10 L WV	20 L WV	30 L WV
ID = 28 mm (exit gas)	1	1	1
ID = 12 mm (inlet air/gas)	1	1	1
19 mm Rd28x1/8" (accessories)	8	9	9
Tri-Clamp 1 1/2" (safety valve)	1	--	--
Tri-Clamp 1 1/2" with NA connect (safety valve)	--	1	1

Vessel port	10 L WV	20 L WV	30 L WV
Ingold nozzle (15°), ID = 25 mm, (sensors)	2	3	4
Ingold nozzle (0°), ID = 25 mm, (sample valve)	1	1	1
ID = 15 mm (0°), (temperature sensor)	1	1	1
19 mm Rd28x1/8" (manometer)	1	--	--

Bottom Valve (Harvest Valve)

Activity	Process connection
Harvest	Tri-Clamp 1" (22.1 mm)

Technical Data

Activity	Process connection
Sampling (optional) with sampling set with needle	OD = 6 mm
	ID = 4 mm

Sample Valve (Optional)

Activity	Process connection
Sampling with needle	OD = 6 mm
	ID = 4 mm
Sampling direct	Tri-Clamp 1/2", ID = 9.4 mm

12.3.4 Temperature Control System

Temperature Sensor

Data	Value
Type	Pt100 class A

Temperature Range

Data	Value	Unit
Sterilization	110 to 125	°C
Cultivation ¹⁾	20 to 79	°C

¹⁾ The minimum temperature depends on the ambient temperature, the cooling system used, stirrer speed and viscosity of the medium.

Accuracy Measurement and Control (Cultivation)

Data	Value	Unit
Accuracy at ≤ 60 °C	± 0.3	°C
Accuracy at > 60 °C	± 0.5	°C

12.3.5 Stirrer

Drive

Data	Value
Type	Top, with single mechanical seal
Direction of rotation stirrer shaft	Clockwise (top view)
Motor type	AC servo motor, brushless

Technical Data
Rotation Speed und Accuracy

Data	Value	Unit
Rotation speed 10 L WV vessel	20 to 1500	min ⁻¹
Rotation speed 20 and 30 L WV vessel	20 to 1200	min ⁻¹
Control accuracy at ≤ 1000 min ⁻¹	± 5	min ⁻¹
Control accuracy at > 1000 min ⁻¹	1 % setpoint	

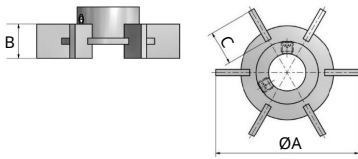
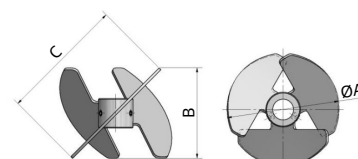
Rotation speed ranges apply in liquid with viscosity similar to water, without gassing with 2 or 3 rushton impellers and at max working volume.

Impellers

Data	Value
Type (standard)	Rushton, 6 blades
Type (option)	Pitched blade, 3 blades ¹⁾
Material	AISI 316L
Surface	Ra 0.8 µm, electropolished
Quantity 10 L WV	2
Quantity 20 L and 30 L WV	3

¹⁾ Flow direction downwards and upwards available.

Dimensions Impellers

Rushton		10 L WV	20 L WV	30 L WV
	A	66 mm	80 mm	89 mm
	B	13 mm	16 mm	18 mm
	C	16 mm	20 mm	23 mm
Pitched blade impeller		10 L WV	20 L WV	30 L WV
	A	100 mm	125 mm	133 mm
	B	79 mm	100 mm	107 mm
	C	110 mm	140 mm	150 mm

Technical Data

12.3.6 Gassing System

12.3.6.1 Components

Mass Flow Controller (MFC)

Data	Value
Type	Red-y smart, Hi-Performance

Control Ranges of MFCs

Vessel size (WV)	MFCs air, O ₂ , N ₂	MFC CO ₂
10 L	0.20 to 20.0 L min ⁻¹	0.10 to 10.0 L min ⁻¹
20 L	0.40 to 40.0 L min ⁻¹	0.20 to 20.0 L min ⁻¹
30 L	0.60 to 60.0 L min ⁻¹	0.30 to 30.0 L min ⁻¹

Specific gas flow rate calculated for max. WV: 2 min⁻¹



The mass flow controllers are calibrated by the manufacturer ex-factory at standard conditions, i.e. at 1.013 bar(a) and 20 °C. Therefore, for every gas flow rate the standard volume flow is stated as L min⁻¹.

Filter

Data	Value
Type	Novasip, can be sterilized with steam
Model	C3PFRP1A

Data	Value	Unit
Max. pressure	6.5	bar(g)
Max. temperature	142	°C
Retention rate	0.2	µm

Steam Trap

Data	Value
Type	Thermal steam trap
Material	Stainless steel

Technical Data
12.3.6.2 Gassing Variants
General

Data	Value
Gas entry	Ring sparger
Gas(es)	Air, O ₂ , N ₂ , CO ₂

Standard Variant

Data	Value
Gas flow control	1 MFC
Gasmix control (if present)	1 solenoid valve per gas

Data	Value	Unit
Accuracy measurement and control gas flow	± 2	% FS

High End Variant

Data	Value
Gas flow control and Gasmix (if present)	1 MFC per gas

Data	Value	Unit
Accuracy measurement and control gas flow	± 2	% FS

12.3.7 Exit Gas System
Exit Gas Cooler

Data	Value
Material	Stainless steel

Technical Data

Filter

Data	Value
Type	Novasip, can be sterilized with steam
Model	C3PFRP1A

Data	Value	Unit
Max. pressure	6.5	bar
Max. temperature	142	°C
Retention rate	0.2	µm

Steam Trap

Data	Value
Type	Thermal steam trap
Material	Stainless steel

12.3.8 pH Control

Data	Value
Control	Peristaltic pumps for acid and base
Control range	pH 2 to pH 12
Measurement accuracy	pH ± 0.1

Analog Measurement System

Data	Value
Sensor type	405-DPAS-SCK8S/ 120
Sensor measurement principle	Potential measurement against reference
Measurement range	pH 0 to pH 12

Technical Data
**Digital Measurement System,
HAMILTON Variant**

Data	Value
Sensor type	Easyferm Plus ARC
Sensor measurement principle	Potential measurement against reference with integrated electronics
Measurement range	pH 0 to pH 14



The pH sensors of the Easyferm Plus ARC type have been preconfigured (baud rate 38400 / Modbus-ID 18) and equipped with an electrically conductive O-ring by the device manufacturer INFORS HT. The sensor's original O-rings/support rings have been removed. Replacement sensors must be configured and equipped identically before use!

**Digital Measurement System,
METTLER Variant**

Data	Value
Sensor type	InPro 3253i, ISM with M100 transmitter
Sensor measurement principle	Potential measurement against reference with integrated electronics
Measurement range	pH 0 to pH 12

12.3.9 pO₂ Control

Data	Value
Control via cascade	Parameters in cascade are dependent on device configuration

Data	Value	Unit
Control range	0 to 100	%-sat
Measurement accuracy	± 1	%

Technical Data

Analog Measurement System

Data	Value	
Sensor type	InPro 6820/25/080	
Sensor measurement principle	Amperometric/polarographic	
Data	Value	Unit
Measurement range	0 to 150	%-sat

Digital Measurement System, HAMILTON Variant

Data	Value	
Sensor type	Visiform RS485-ECS	
Sensor measurement principle	Optical	
Data	Value	Unit
Measurement range	0 to 300	%-sat

Digital Measurement System, METTLER Variant

Data	Value	
Sensor type	InPro6860i, ISM	
Sensor measurement principle	Optical	
Data	Value	Unit
Allowed temperature	0 to 60	°C
Measurement range	0 to 285	%-sat



Digital pO₂ sensors have been preconfigured by the device manufacturer INFORS HT. Replacement sensors must be configured before use:

- Baud rate 38400 / Modbus-ID 17
- Additional setting HAMILTON variant:
unit = %-sat.
- Additional setting METTLER variant: offset = 0

Technical Data
12.3.10 Antifoam Control

Data	Value
Sensor	Conductive, adjustable mounting depth
Display	0 (no foam) / 100 (foam)
Control	Peristaltic pump Antifoam

Sensor Variants

Data	Value
Standard	Sensor and dosing needle combined, stainless steel (insulation with heat-shrink hose)
Option	Only sensor, ceramic tube (insulation)

12.3.11 Pumps
Digital Pumps

Data	Value
Type	Peristaltic pump with pump head 114DV
Number	3 (<i>Acid, Base, Antifoam</i>)

Data	Value	Unit
Speed (fixed rotation speed)	200	min ⁻¹
Accuracy	± 5	min ⁻¹

Technical Data

Analog Pumps

Data	Value
Type	Peristaltic pump with pump head 114DV
Default number	1 (<i>Feed</i>)
Number of optional ones	2 (<i>Feed 2, Feed 3</i>)

Data	Value	Unit
Speed	0 to 200	min ⁻¹
Setting range (0.1 % increments)	0 to 100	%
Accuracy	± 5	min ⁻¹

Pump Hoses

Data	Value	Unit
Inner diameter	0.5 to 4.8	mm
Wall thickness	1.6	mm

Delivery Rates

Inside diameter hose	Speed	
	1 %	100 %
0.5 mm	0.038 mL min ⁻¹	3.917 mL min ⁻¹
1.6 mm	0.26 mL min ⁻¹	27.2 mL min ⁻¹
3.2 mm	0.85 mL min ⁻¹	84.97 mL min ⁻¹
4.8 mm	1.7 mL min ⁻¹	172.2 mL min ⁻¹

Values are valid for new marprene pump hoses

12.3.12 Vessel Pressure Display (Manometer)

Data	Value
Connection	19 mm port
O-ring material	EPDM

Data	Value	Unit
Measurement range	-1 to 5	bar(g)

Technical Data
12.3.13 Safety Valves
Vessel Safety Valve

Data	Value
Type	Clean service spring-loaded safety valve

Data	Value	Unit
Response pressure	4	bar(g)

Temperature Control Circuit Safety Valve

Data	Value
Type	Standard safety valve, angle type, spring-loaded

Data	Value	Unit
Response pressure	3	bar(g)

12.4 Specifications of the Options
12.4.1 Steam Generator
6 kW Variant

Data	Value	Unit
Power	6	kW
Max. steam power	8	kg/h
Suitable for vessel WV	10	L

10 kW Variant

Data	Value	Unit
Power	10	kW
Max. steam power	14	kg/h
Suitable for vessel WV	20 and 30	L

Technical Data

Electric connection values

Type	Voltage	Frequency range	Rated current	Connector
6 kW	400 V ($\pm 5\%$); 3 phases L1 + L2 + L3 + N (neutral) + PE (earth)	50 / 60 Hz	14 A	CEE16/5
10 kW	400 V ($\pm 5\%$); 3 phases L1 + L2 + L3 + N (neutral) + PE (earth)	50 / 60 Hz	25 A	CEE32/5

12.4.2 Recirculating Chiller

Variant 50 Hz

Data	Value	Unit
Max. cooling power	1.7	kW
Tension	230 ($\pm 5\%$)	V
Frequency	50	Hz

Variant 60 Hz

Data	Value	Unit
Max. cooling power	1.7	kW
Tension	230 ($\pm 5\%$)	V
Frequency	60	Hz

12.4.3 Level Detection

Data	Value
Sensor	Conductive, adjustable mounting depth
Sensor standard	Stainless steel (insulation with heat-shrink hose)
Sensor option	Ceramic tube (insulation)
Display	0 (no liquid) / 100 (liquid)

12.4.4 Pressure Control

Data	Value
Sensor type	Piezo-resistive pressure transmitter
Control	Proportional valve with electronic open-loop control

Data	Value	Unit
Measurement range	0 to 2.0	bar(g)
Control range	0 to 1.5	bar(g)
Measurement and control accuracy	± 0.1	bar(g)

12.4.5 Weight Measurement Vessel – Load Cell

Data	Value
Sensors	Bending rod load cells

Data	Value	Unit
Measurement accuracy	± 100	g

Technical Data

12.4.6 Turbidity Measurement

Data	Value
Sensor type	ASD25-N
Optical path length	OPL01, OPL05 or OPL10
Measurement principle	Single channel light absorption

Data	Value	Unit
Absorption measurement range	0 to 4	CU
Measurement wavelength	840 to 910	nm
Constant temperature	5 to 65 ¹⁾	°C
Max. temperature (60 min/day)	135	°C

¹⁾ The measurement system switches off automatically if the temperature of the sensor exceeds 65 °C during operation in the culture medium. Once the culture medium has cooled down, the measurement is continued automatically.

12.4.7 Exit Gas Analysis

For Aerobic Bioprocesses

Sensor type selection	Measurement range vol. % CO ₂	Measurement range vol. % O ₂
BlueInOne Ferm	0 to 10	1 to 50
BlueVary with O ₂ cartridge ZrO ₂	0 to 10	0.1 to 50

For Aerobic and Anaerobic Bioprocesses

Sensor type selection	Measurement range vol. % CO ₂	Measurement range vol. % O ₂
BlueInOne Cell	0 to 10	0 to 100
BlueVary with O ₂ cartridge ec	0 to 25	0 to 25
BlueVary with O ₂ cartridge ec	0 to 10	0 to 100

12.4.8 pCO₂ Measurement

Data	Value
Sensor type	InPro5000i, ISM (digital)
Measurement principle	Potentiometric
Transmitter type	M400

Data	Value	Unit
Measurement range	0 to 1000	hPa

12.4.9 Redoxmessung

Data	Value
Typ Sensor	Easyferm Plus ORP ARC
Messprinzip Sensor	Oxidations-Reduktionspotential-messung gegen Referenz

Data	Value	Unit
Messbereich	-1500 bis +1500	mV
Genauigkeit	± 10	mV



Redoxsensoren sind vom Gerätehersteller INFORS HT vorkonfiguriert (Baudrate 38400 /Modbus-ID 22) und mit einem elektrisch leitenden O-Ring bestückt. Sensoreigene O-Ringe/Stützringe sind entfernt. Ersatz-Sensoren müssen vor Gebrauch neu konfiguriert und identisch bestückt werden!

Technical Data

12.4.10 Permittivity Measurement

Data	Value
Measurement system (sensor and transmitter)	ABER Futura

Data	Value	Unit
Permittivity	0 to 400	pF cm ⁻¹
Conductivity	0 to 40	mS cm ⁻¹

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

12.5 Operating Conditions

Data	Value	Unit
Ambient temperature	5 to 35	°C
Relative humidity, non-condensing	20 to 90	%
Altitude operating location	Max. 2000	m.a.s.l
Pollution degree as per EN 61010-1	2	
Min. distance from walls, ceilings and other equipment	150	mm

The distance from the ceiling has to be selected so that the vessel top plate with its built-in-parts can be comfortably lifted off the vessel.

12.6 Operating Materials

Purpose of use	Allowed products
Lubricant for mechanical seal	Medicinal glycerine 85 % Quality: PhEur

12.7 Emissions

Data	Value	Unit
Sound pressure level	< 70	dB(A)

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