



my-Control for Autoclavable Bioreactors 2 and 3L



HARDWARE MANUAL

Hardware Version 3

Document Version 3.28

TABLE OF CONTENTS

1	Safety.....	4
1.1	Safety Symbols	4
1.2	Safety Warnings.....	5
1.3	EU Declaration of Conformity.....	8
2	General	10
2.1	Introduction.....	10
2.2	The User Interface.....	10
2.3	Related Manuals.....	11
3	The <i>my</i> -Control.....	12
3.1	Front view of the <i>my</i> -Control.....	12
3.2	Rear View of the <i>my</i> -Control.....	13
3.3	Modules to be Mounted inside the <i>my</i> -Control.....	14
3.4	Colors of the Front Panel	15
3.5	Front Panel Illumination	15
3.6	Actuator control	16
3.6.1	Digital actuators versus Continuous Actuators	16
3.6.2	Actuator for Level / Foam Control.....	16
3.7	Sensor Input Specifications.....	17
3.8	Analog and Digital I/O Connections.....	18
3.9	Environmental Conditions	20
3.10	Storage Instructions.....	20
3.11	Cleaning Instructions	20
3.12	Related Manuals.....	20
4	Internal Actuators	21
4.1	Solenoid Valve with Tuning Valve.....	21
4.2	Mass Flow Controllers	22
4.3	Connection for Sparging and Overlay.....	23
4.4	Tubing Pump Assembly.....	24
4.4.1	Loading the Pump Tubing.....	25
4.4.2	Pump Tubing Connection.....	26
5	External Actuators	27
5.1	Actuators for Temperature Control.....	27
5.1.1	Heating Blankets	27
5.1.2	Cold Water Valve and Condenser Regulator Valve.....	28
5.2	Actuators for Mixing.....	29
5.2.1	Stepper Stirrer Motor.....	30
5.2.2	Brushless DC Stirrer Motor M10.....	31
5.2.3	Brushed DC Stirrer Motor P100.....	32
6	Reactors and Auxiliaries.....	33
6.1	Reactor Types	33
6.1.1	2 Liter Dished Bottom Reactor	33
6.1.2	3 Liter Dished Bottom Reactor	34
6.2	Stirrer Assemblies	35
6.2.1	Top Stirrer Assemblies.....	35
6.2.2	Impellers.....	35
6.2.3	Baffles	36
6.2.4	Optimum impeller configuration.....	37
6.2.5	Calculations of Stirrer Power Requirements	38
6.3	Aeration.....	39

6.3.1	Gas In-/Outlet Filter	39
6.3.2	Spargers	39
6.3.3	Air Overlay Assembly	40
6.3.4	Pressure Relief Valve	40
6.3.5	Air Outlet Condenser.....	41
6.3.6	Tuning Valve.....	41
6.4	Addition	42
6.4.1	Septum Holder.....	42
6.4.2	Addition Pipe.....	42
6.4.3	Medium Inlet Triple	43
6.4.4	Liquid Entry System.....	43
6.4.5	Rapi-Lok Sterile Connector.....	44
6.4.6	Liquid Addition Bottle	44
6.4.7	Autoclavable Bottle Holder.....	44
6.5	Sampling and Drain	45
6.5.1	Assembly Holder.....	45
6.5.2	Sample Pipe.....	45
6.5.3	Sample Systems.....	48
6.6	Heat Exchanger	49
6.7	Miscellaneous.....	49
6.7.1	Holdings for OD 8 mm Sensors	49
6.7.2	Holdings for OD 12 mm Sensors	49
6.7.3	Thermometer Pocket	50
6.7.4	Blind Stoppers	50
7	Sensors.....	51
8	Start-Up Kit	52

1 SAFETY

1.1 SAFETY SYMBOLS

The following symbols are used on the equipment and in this manual.

**WARNING**

Important issue concerning personnel health and device safety. Refer to this manual

**WARNING**

Risk of electrical shock hazard

**WARNING**

Hot surface.



Additional information



Disposal instructions

© 2021 Applikon Biotechnology, Delft.

All rights reserved. This set of documents, describing the functionality of the Hardware and Software of the *my*-Control, is protected by copyright law. It may not be reproduced, stored or made public in any form by any means without the prior written approval of Applikon Biotechnology B.V.

Applikon Biotechnology B.V.
Heertjeslaan 2
2629 JG Delft
The Netherlands

Tel. +31 (0)10 208 35 55
Fax. +31 (0)10 208 35 05
info.applikon@getinge.com
<http://www.getinge.com>

1.2 SAFETY WARNINGS



GENERAL

- This set of equipment has been designed in accordance with EN61010-1 "Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use", and has been supplied in a safe condition.
- The Hardware manual contains information and warnings, which have to be followed by the user to ensure safe installation, operation and to retain the equipment in safe condition. Carefully read this manual before putting the *my-Control* into operation.
- Before switching-on the equipment, make sure that it is set to the line voltage (for details, refer to [section 3.2](#)).
- This equipment has been designed for bioprocess control; it must not be used for other purposes!



WARNING

Risk of electrical shock hazard.

- The colored metal front panel (with any mounted pumps or micro valves) of the *my-Control* cabinet can be replaced by a panel with a different color. However, removing the metal panel will make hazardous parts accessible and must therefore be performed by qualified personnel. The *my-Control* must not be switched on or used when the colored metal front panel is not properly in place.
- Any interruption of the protective conductor inside or outside the *my-Control* or disconnection of the protective conductor terminal will make the device hazardous. Intentional interruption is prohibited.
- Capacitors inside the apparatus may still be charged, even if the apparatus has been disconnected from all voltage sources.
- It is not allowed to perform maintenance and/or repair on the opened device under voltage. Before removing the metal front panel or the rear panel, the power cord must be removed from the power entry socket of the *my-Control*.
- Make sure that only fuses with the required rated current and of the specified type (International Standard IEC 127) are used for replacement. The use of makeshift fuses and the short-circuiting of fuse holders are prohibited.
- It is not permitted to connect equipment to the *my-Control* or the bioreactor without the qualification of double isolation or without the SELV (Safety Extra Low Voltage) qualification.



WARNING

The rear of the *my-Control* cabinet must be accessible.

- The power switch of the *my-Control* is located at the rear of the cabinet. Make sure that the *my-Control* is installed in such a way that, in case of emergency, the power switch can be easily reached!



WARNING

Risk of overpressure in the glass bioreactor.

- The glass reactor may be damaged easily (scratches on the surface)! As a result, its overall strength is reduced. Therefore, do not apply a process pressure that exceeds 0.5 barg (7 psig). Do not obstruct the off-gas line! Make sure that the off-gas filter is not clogged.

**WARNING**

Risk of damaging the equipment.

- In most cases, one or more pumps are installed in the *my-Control*.
- Application of damaged tubes may result in fluid leaking into the pump drive.
- Verify the tube quality inside the pump head before every fermentation run.
- Do not use the tubing pump drives for other purposes than displacement of fluids (or gas).
- Advised pump tubing (pharmed) has its limitation in physical and chemical resistance. Make sure that the pump tubing and the selected reagent type are compatible.

**WARNING**

Hot surface.

- When the system is in operation, the stirrer motor will be running and may become hot. Take precautions to prevent burns!
- A Heating Blanket may be used around the bioreactor as an actuator for temperature control. During heating up the bioreactor, the outer surface of this Heating Blanket will be hot.

**WARNING**

Risk of electric shock hazard; risk of personal harm and damaging the equipment.

- In most cases, the bioreactor is equipped with a Stirrer Motor that drives the stirrer shaft and impellers. The *my-Control* must not be switched on until the motor cables are properly connected to both the controller and the stirrer motor.
- When the power of the *my-Control* has been switched on, the motor cables must not be disconnected. When the motor cables are disconnected, the power supply to the motor will be interrupted which may disrupt the internal operation of the Motor Controller inside the *my-Control*.
- If the M10 stirrer motor type is used, a disconnected control cable will freeze the stirrer speed. Refer to [section 5.2.2](#).

**WARNING**

Make sure to use a proper power cord.

- The *my-Control* comes with a detachable power cord with 3 x 1.0mm² wires (for the USA, the power cord complies with 18AWG which is equal to 3 x 0.82mm² wires).
- When the original power cord needs to be replaced by another one, make sure that the replacement cable has the same (or better) specifications than the original.

**WARNING**

Do not use flammable substances in the vicinity of the *my-Control* while in operation.

- The *my-Control* is an electr(on)ic control device that contains relays for switching power and actuator signals. These relays may generate sparks during operation. It is therefore not allowed to use flammable substances in the vicinity of the *my-Control* while this device is in operation.

**Additional information**

- Although the *my*-Control as a whole is not UL-certified, all used components have been selected based on conformance with the standard UL 60950 (Underwriters Laboratories Inc. Standard for Safety of Information Technology Equipment).

**Disposal instructions**

- This product must not be disposed of together with domestic waste.
- All users are obliged to hand in all electrical or electronic devices, regardless of whether or not they contain toxic substances, at a municipal or commercial collection point so that they can be disposed of in an environmentally acceptable manner.
- Consult your local authority or your supplier for information about disposal.

1.3 EU DECLARATION OF CONFORMITY

The company Applikon Biotechnology B.V., residing in Delft, The Netherlands, hereby certifies that the design of the instrument:

***my*-Control**
for
Autoclavable 2 and 3 Liter Bioreactors

meets the requirements of the following Directives of the European Union:

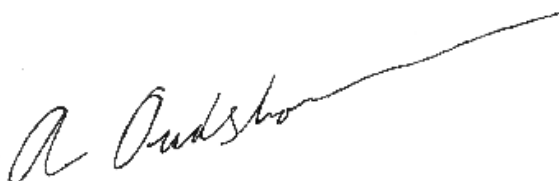
- ✓ Directive 2006/42/EC on Machinery
- ✓ Directive 2014/30/EU on Electromagnetic Compatibility (EMC)
- ✓ Directive 2011/65/EU and 2015/863/EU on Restriction of Hazardous Substances (RoHS)
- ✓ Regulation (EC) No 1907/2006 on Restriction of Chemicals (REACH)

The compliance of the *my*-Control has been based on the following harmonized standards:

Directive	Harmonized Standard
2006/42/EC (Machinery)	EN 60204-1:2006 / EN 12100:2010
2014/35/EU (Low Voltage)	EN 61010-1:2010 / EN 62311:2008
2014/30/EU (EMC)	EN 61326-1:2013 / EN 61000-3-2:2014 / EN 61000-3-3:2013

*For the *my*-Control, the Machinery Directive includes the requirements of the Low Voltage Directive.

ir A. Oudshoorn MBA
Managing Director



February 9th 2017

Applikon Biotechnology B.V. (Part of Getinge)
Heertjeslaan 2
2629 JG Delft
The Netherlands

Tel. +31 (0)10 208 35 55
Fax. +31 (0)10 208 35 05
info.applikon@getinge.com
<http://www.getinge.com>

2 GENERAL

2.1 INTRODUCTION

The *my*-Control with Applikon autoclavable Bioreactor Systems basically consist of the following parts:

- an autoclavable Bioreactor with the appropriate auxiliaries like a stirrer assembly, sensors, an aeration assembly, etc.
- a *my*-Control bio controller for measurement and control of process variables (like pH, temperature, dO₂, level and stirrer speed) with corresponding controller outputs in order to keep process conditions on setpoint.

The *my*-Control combines and supports actuators like pumps, mass flow controllers and valves in order to optimize the use of limited bench space.

Typical characteristics of the *my*-Control with the 2 and 3L Bioreactor Systems:

- Easy setup and operation
- Cultivate using a small amount of medium
- Generation of scalable results
- Easy data handling

2.2 THE USER INTERFACE

Through a network that is connected to the *my*-Control (TCP/IP communication), different kind of devices can be used as a User Interface (UI). Since the *my*-Control is addressed by using its IP address, the User Interface is also called the Web UI.

Examples:

Web UI Device Type	Connecting Network
PC	LAN / WAN or Peer-to-Peer
Tablet	Wireless connection with WIFI-Router
Smartphone	Wireless connection with WIFI-Router

The *my*-Control is addressed by using its IP-address.

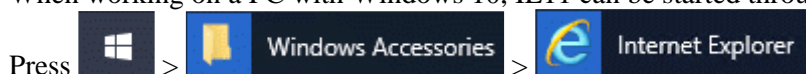
Start the Internet Browser at the WebUI-device and surf to the following address: http://IP-address*/. The *my*-Control WebUI will be displayed.

***The IP-address of the *my*-Control. The *my*-Control comes with a preset IP-address. This address can easily be customized. Refer to section 1.3 and Appendix A of the Software Reference Manual.**

Refer to Appendix D of the software manual in order to prevent instabilities in the network connection when the *my*-Control is the only controller directly connected to its controlling PC.



Internet Explorer IE11 and Google Chrome are supported as Internet browsers.
When working on a PC with Windows 10, IE11 can be started through the Accessories.

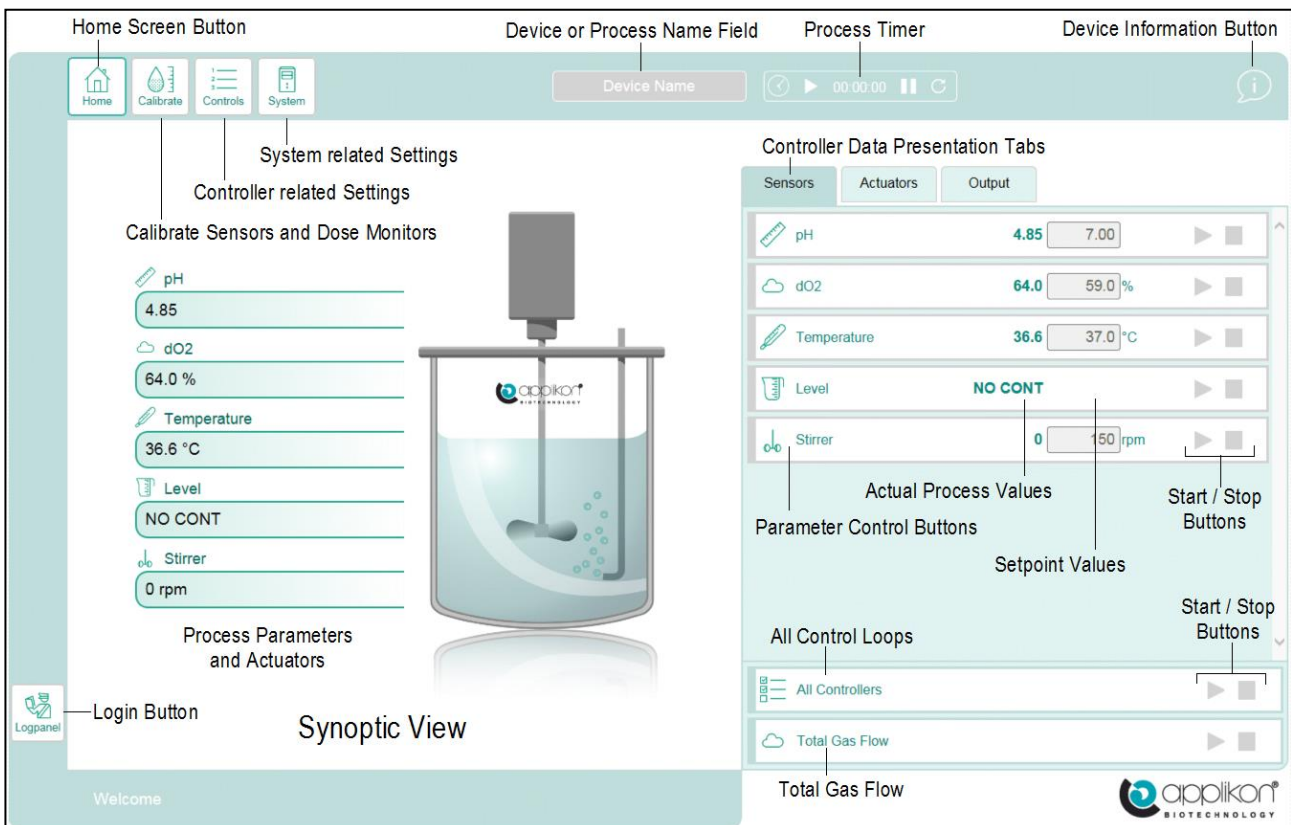


After switching on the power of the *my*-Control and invoking the Web Interface through the Internet browser on the PC, the *my*-Control displays its Home Screen (see next page).

In this Hardware Manual, it is assumed that a PC is used as Web UI (*my-Control* is operated with mouse-clicks).

After switching on the power of the *my-Control* and invoking the Web UI with the Internet browser, the *my-Control* displays its Home Screen.

Example of the Home Screen in View mode (no user is logged in, control loops are “Idle”):



Use the mouse pointer to press the virtual buttons at the Web UI of the *my-Control*.

2.3 RELATED MANUALS

Also refer to the following manuals:

- Software Reference Manual *my-Control* for Autoclavable and Single Use Bioreactors
- Operator Manual *my-Control* with Autoclavable Bioreactors 2 and 3L
- PID Control Manual
- Spare Part Manual for autoclavable Bioreactors 1 – 20L

3 THE *my*-CONTROL

The *my*-Control is a full-size biocontroller that is dedicated to the process in a bioreactor. It contains:

- Fixed and adaptive PID control for pH, dO₂ and Temperature
- Stirrer Speed control
- Foam and/or Level control
- Additional (freely configurable) measuring channels / PID control loops, such as:
 - (max. 4) Analog Inputs for sensors / measuring devices
 - (max. 4) Scales (USB) for Feed Control
 - Additional sensors for pH and dO₂ (USB)
 - Biomass Monitor (USB)

Inside the *my*-Control, the following actuators are supported:

- Variable speed tubing pumps (max. four mounting positions)
- Gas Solenoid Valves with Tuning Valve for aeration (max. four internal mounting positions)
- Three channel Mass Flow Controller for aeration (internal mounting)
- Power Supply for heating (Heating Blanket or Thermo-Electric element) and cooling (Thermo-Electric element or connection of external cooling valve)

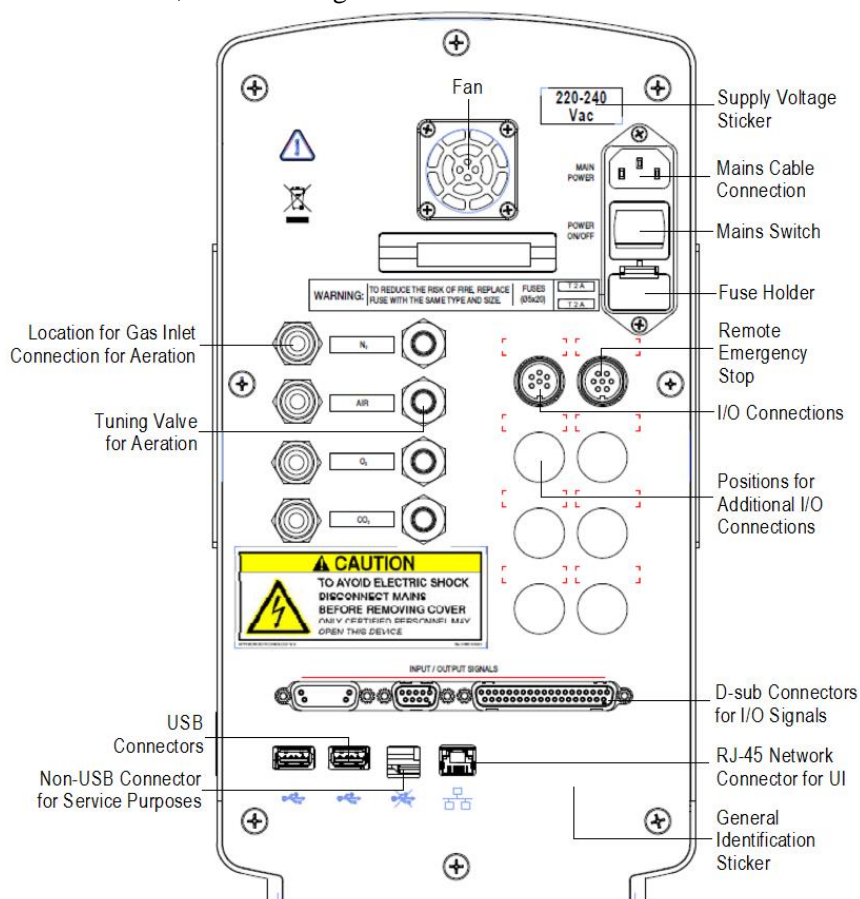
3.1 FRONT VIEW OF THE *my*-CONTROL



The rear view of the *my*-Control is presented at next page.

3.2 REAR VIEW OF THE *my*-CONTROL

At the rear of the control cabinet, the following connections can be found:



Power Supply section

The Power Supply Section of the *my*-Control contains:

- Mains Cable Connector for:
 - 220-240 VAC / 50 Hz or
 - 100-120 VAC / 60 Hz.
- Power Switch
- Fuse holders; fuses must comply with IEC 127:
 - 230 VAC: 2 x T 2A (5 x 20 mm)
 - 115 VAC: 2 x T 4A (5 x 20 mm)



The power switch is located at the rear side of cabinet. Make sure that the *my*-Control is installed in such a way, that the power switch can easily be reached in case of emergency!

Optional Remote E-Stop Connector

Optional connector for the external Emergency Stop circuit (button).

By default, this connection is internally jumpered. A connector for an external button is available as an option. Opening the external Emergency Stop circuit will power down all actuators. Resetting the Emergency Stop status is achieved by closing the circuit again. A "Normally Closed" relay can be used as an external Emergency Stop button.

Z310210200 Control Cable for Emergency Stop for My/In

Positions for Optional I/O Connections and Devices

- **Condenser Connection**
Connection for the condenser with Thermo-Electric cooler.
- **Connection for Temperature Control Actuators**
Actuator connection for heating and cooling: Thermo-Electric element or heating blanket and cooling valve.
- **Analog Inputs 0-10V**
The four analog inputs can be used as inputs for additional control loops.
A resistor of 500Ω (parallel with the input) can be used to convert a 0-20mA signal to 0-10V.
- **D-sub Connectors for I/O Signals**
For lay-out specification of the 37 pins D-sub connector, refer to [section 3.8](#) (Analog and Digital I/O Connections) of this Hardware Manual.

Gas Inlets for aeration

The gas inlets (carbon dioxide, oxygen, air and nitrogen) are Quick Connectors for tubing OD = 6 mm. For information and specifications of the available gas supply hardware, refer to [section 4.1](#) (Solenoid Valve with Tuning Valve) and [section 4.2](#) (Mass Flow Controllers).



Required inlet pressure for the gasses: 2 barg.
Required quality of the gasses: Instrument grade (dry and free of particles or oil).

USB-Connectors

Can be used to connect:

- A USB-memory stick, to be used for customizing the IP-address (refer to the Software Reference Manual, section 1.3) or to export / import data or configuration files (refer to the Software Reference Manual, section 3.3.3).
- External devices such as scales, biomass monitors, optical sensors, etc. In case more than 2 USB inputs need to be connected, a USB-Hub is required.

Non-USB-Connectors

A non-USB connector is used for service purposes.

Network Connector for the Web User Interface

The RJ-45 network connector is used for connection to the Web User Interface / SCADA-application.



In order to comply with the European EMC Standards for “emission” and “immunity”, the maximum length of the Ethernet cable is 30 meters!

3.3 MODULES TO BE MOUNTED INSIDE THE *my*-CONTROL

The following modules can be mounted inside the *my*-Control:

Part #	Description	Remarks
Z310211020*	Heating Control Module	Supply for Heating Blanket
Z310211050*	Cooling Valve Control Cable	Internal Cable for Cold Water Valve Control
Z310213010*	Stepper Stirrer Control Module	Supply for Stepper Stirrer Motor
Z310213020*	Stirrer Control Module P100	Supply for Stirrer Motor P100
Z310213030*	Stirrer Control Module M10	Supply for Brushless Motor M10
Z310216020*	Control Module for Pumps	Control Module for 2 Variable Speed Pumps
Z310217050*	Redox Control Module	Amplifier Board for a Redox Sensor

*Additional Modules must be installed by a certified Service Engineer.

3.4 COLORS OF THE FRONT PANEL

By default, the *my*-Control comes with a silver front panel. Other front panel colors are available on demand.



Ordering numbers of *my*-Controls with different colors:

Part #	Description	Part #	Description
Z310210130	Front Panel Silver V2	Z310210135	Front Panel Light Blue V2
Z310210131	Front Panel Yellow V2	Z310210136	Front Panel Green V2
Z310210132	Front Panel Orange V2	Z310210137	Front Panel Marine Blue V2
Z310210133	Front Panel Red V2	Z310210138	Front Panel Pink V2
Z310210134	Front Panel Purple V2		



WARNING

Risk of electrical shock hazard.

- The colored metal front panel (with any mounted pumps or micro valves) of the *my*-Control cabinet can be replaced by a panel with a different color. However, removing the metal panel will make hazardous parts accessible and must therefore be performed by qualified personnel. The *my*-Control must not be switched on or used when the colored metal front panel is not properly in place.

3.5 FRONT PANEL ILLUMINATION



The front panel of the *my*-Control is illuminated from the rear by LED-array.

The color of the LED's indicate the status of the *my*-Control.

Color LED-array	Status of the <i>my</i> -Control.
White	Booting
Blue	Ready (controllers are idle)
Green	Controller(s) are running (no alarms)
Red	Controllers are idle: System Alarm Controller(s) running: Process Alarm
Orange	Update available: - Web User Interface software, - Control software or - Licenses

3.6 ACTUATOR CONTROL

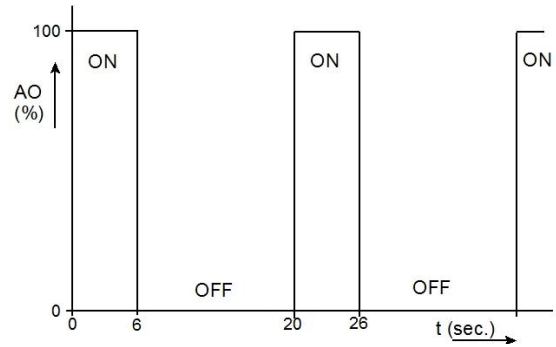
3.6.1 DIGITAL ACTUATORS VERSUS CONTINUOUS ACTUATORS

Discrete (digital) actuators like valves are controlled in a “Pulse-Width Modulated” manner (PWM):

- within a predefined “cycle time”, the output (Actuator) is switched on during the “On-time” and off during the rest of the cycle.

Example 1

If Cycle time = 20 sec. and
 Actuator Output = 30 %
 then On/Off Output will be repeatedly switched:
 on during 6 sec (30 % of 20 seconds).
 off during 14 sec.

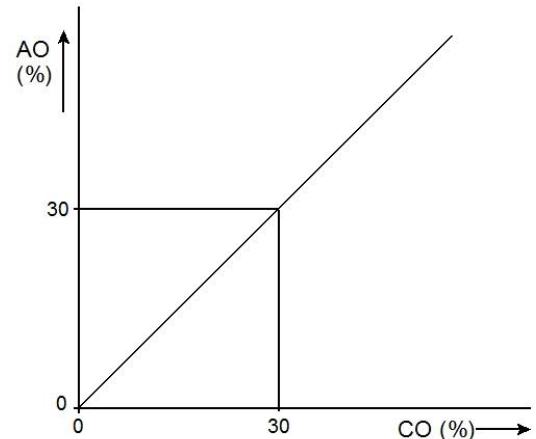


Continuous (analog) actuators like pumps, mass flow controllers and stirrers do not have a “cycle time” or an “on-time”.

Deviation from set-point results in a controller output that relates to the actuator output in a linear way.

Example 2

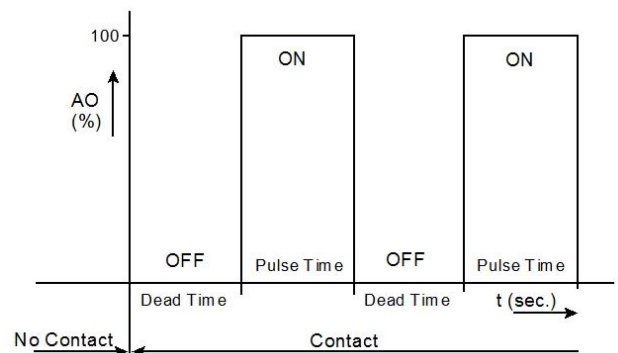
If Controller Output = 30 %
 Then Continuous output has an Actuator Output = 30 %.



3.6.2 ACTUATOR FOR LEVEL / FOAM CONTROL

The actuator for the level / anti-foam controller is either off (AO = 0 %) or on (AO = 100 %). In most cases the desired situation is “No Contact”.

When the status “No Contact” changes into “Contact”, first a “Dead Time” elapses after which the actuator is switched on during the “Pulse Time” interval. This sequence is repeated until the status changes into “No Contact” again.



- Values for Dead Time and Pulse Time and the parameters of the level/foam sensor can be edited by navigating to System > Settings > Controller Setup.
- Since a 200 rpm pump is used for antifoam agent, the upper limit of the pump speed can best be limited to 50% resulting in a maximum pump speed of 100 rpm.
 Refer to section 4.5.2 of the Software Reference Manual: Actuator Limits and Inhibit.

3.7 SENSOR INPUT SPECIFICATIONS

The applied sensor input amplifiers have the following specifications.

pH amplifier:	Range:	0 pH ... 14 pH
	Accuracy:	± 0.01 pH
	R _{in} :	$> 10^{15} \Omega$
	Resolution:	0.01 pH
Temperature amplifier:	Type:	Pt-100 (3-wire type)
	Range:	0 °C ... +150 °C
	Accuracy:	± 0.1 °C
	Resolution:	0.1 °C
dO ₂ amplifier:	Type:	Polarographic
	Range:	0 % - 100 % (when calibrated with oxygen) 0 % - 500 % (when calibrated with air)
	Accuracy:	± 0.1 %
	Resolution:	0.1 %
Level amplifier 1 and 2:	Type:	On/Off signal
	Sensitivity:	Software-selectable: High Sensitivity: Conductivity $\geq 26 \mu\text{S}$ equals "Contact" Low Sensitivity: Conductivity $\geq 200 \mu\text{S}$ equals "Contact" Refer to section 4.6.1 (Level / Foam Sensor Settings) of the Software Reference Manual.



The Redox Sensor can be used as an option (the Redox Amplifier Board is required; refer to [section 3.3](#)). It will be connected to the Level 2 sensor connection at the front of the my-Control cabinet. It in fact substitutes the Level 2 sensor.

Redox amplifier:	Range:	0 ± 2000 mV
	Accuracy:	± 1 mV
	Resolution:	1 mV

3.8 ANALOG AND DIGITAL I/O CONNECTIONS

The analog and digital I/O connections are located at the rear of the *my*-Control:

Analog Inputs

The (max. 4) analog input connectors contain four pins:

- Pin 1 = Analog input
- Pin 2 = Ground
- Pin 3 = Spare
- Pin 4 = Spare



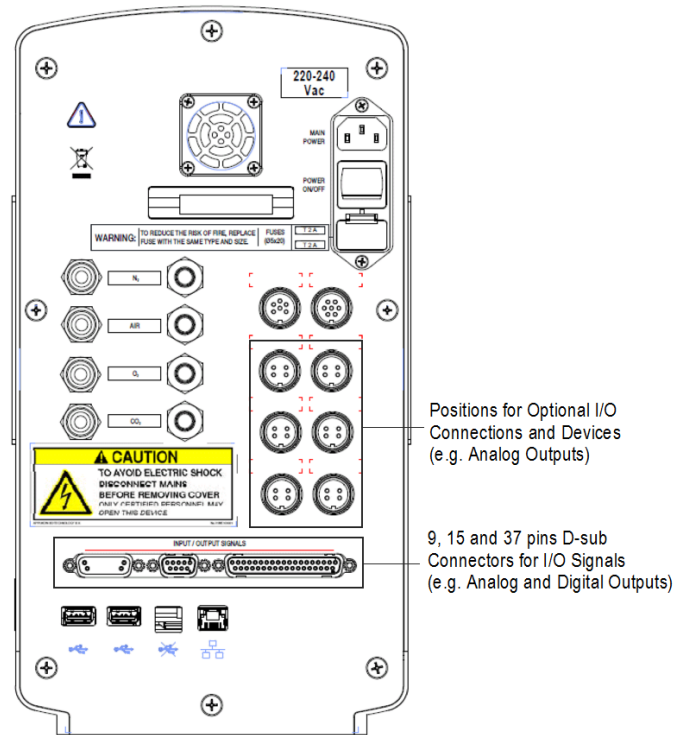
input connectors

Input range: 0 – 10 V
 Impedance: > 100 kΩ

Analog input for the *my*-Control including external cables and license:

Z310214010* Analog Input *my*-Control,

*The above mentioned part consists of one internal cable and two external cables: one for V-signals and one for mA signals (with a 500 Ohm resistor in its connector to convert the mA signal to a V-signal)). Additional Analog Inputs must be installed by a certified Service Engineer.



Analog and Digital Outputs (37 pins sub-connector):

Pin #	Description	Pin #	Description
1	DIGITAL OUTPUT 6+	17	ANALOG OUTPUT 3
2	DIGITAL OUTPUT 6-	18	ANALOG OUTPUT 1
3	DIGITAL OUTPUT 7+	19	ANALOG OUTPUT 2
4	DIGITAL OUTPUT 7-	20	ANALOG OUTPUT 4
5	DIGITAL OUTPUT 4+	21	GND
6	DIGITAL OUTPUT 4-	22	GND
7	DIGITAL OUTPUT 5+	23 / 24	SYSTEM ALARM OUTPUT (NO / COM)
8	DIGITAL OUTPUT 5-	25 / 26	DEVIATION ALARM OUTPUT (NO / COM)
9	DIGITAL OUTPUT 1+	27	24V for Digital I/O (max. 0.5A)
10	DIGITAL OUTPUT 1-	28	GND
11	DIGITAL OUTPUT 2+	30	GND
12	DIGITAL OUTPUT 2-	32	GND
13	DIGITAL OUTPUT 3+	34	GND
14	DIGITAL OUTPUT 3-	35	15Vext. (max. 0.1 A)
15	DIGITAL OUTPUT 8+	36	GND
16	DIGITAL OUTPUT 8-		

- Analog output 5 can be found at the 9 pins D-sub connector: pin 2 (+) and pin 6 (GND)!
- The System Alarm output (pin 23/24) indicates that the process cannot be supported anymore.
- The Deviation Alarm output (pin 25/26) indicates that a process value is out-of-limits.
- The ground (GND) pins are used in combination with the analog outputs.



Analog Outputs: 0/4 – 20 mA (software selectable)
Digital Outputs: 0/5 VDC, 100 mA each

3.9 ENVIRONMENTAL CONDITIONS

The *my*-Control for autoclavable Bioreactor Systems may be used at locations with the following environmental conditions:

- Use: indoor
- Altitude: up to 2000 m
- Temperature: 4 °C to 40 °C
- Relative humidity: maximum 80 % for temperatures up to 31 °C, decreasing linearly to 50 % relative humidity at 40 °C
- Mains supply voltage: 220 – 240 / 100 - 120 Vac, 50/60 Hz
- Transient over voltages: according to Installation category II
- Pollution: Pollution degree 2 in accordance with IEC 664
- Power consumption: P-max = 400 VA

3.10 STORAGE INSTRUCTIONS

When the *my*-Control, after being used, has to be stored for a longer time (> 1 month), follow the instructions below:

- Disconnect the sensor cables and stirrer motor cable(s) from the *my*-Control. Store the sensors according to the instructions in the User Manual that comes with the sensor. Store the Stirrer Motor in its original box.
- Remove the pump tubing from the Pumps of the *my*-Control. Drain and rinse the pump tubing and store it together with the feed bottles.
- Disconnect the gas supply lines from the gas inlets at the rear panel of the *my*-Control cabinet.
- Purge the gas supply lines (especially the O₂ and CO₂ lines) inside the *my*-Control with instrument air. Cover the gas inlets and outlets with blind caps.
- (if necessary) Clean the outside of the *my*-Control cabinet according to the instructions below.
- Pack the *my*-Control in its original packaging (plastic bag and box).
- Store it at altitude, temperature and humidity as specified in [section 3.9](#) (Environmental Conditions).
- Clean and dry the bioreactor with all its auxiliaries and store it, preferably in its original packaging.

3.11 CLEANING INSTRUCTIONS

The *my*-Control cabinet may be cleaned with a moist tissue in combination with a non-abrasive cleaner.

3.12 RELATED MANUALS

Also refer to the following Manuals:

- Software Reference Manual,
- Operator Manual,
- PID Control Manual,
- USB Sensor Manuals,
- Spare Part Manual for the autoclavable 1 – 20L bioreactors.

4 INTERNAL ACTUATORS

The *my*-Control may be equipped with internal actuators for aeration and liquid addition:

- Solenoid valve with tuning valve per gas inlet line (nitrogen, air, oxygen and carbon dioxide)
- 1-channel or 3-channel mass flow controller
- Tubing pump for liquid additions



Gasses that are used for aeration and pH control (CO₂) must comply with the following spec's:

- Required inlet pressure for the gasses: 2 barg.
- Required quality of the gasses: Instrument grade (dry and free of particles or oil).

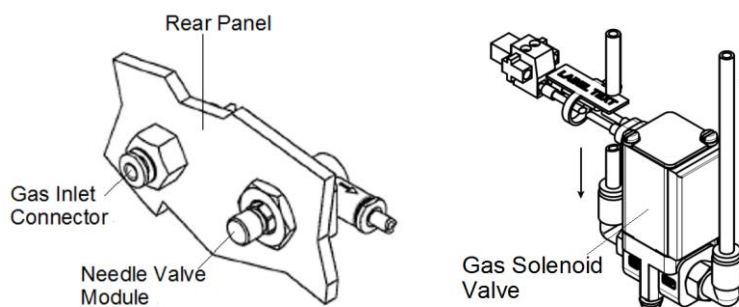
4.1 SOLENOID VALVE WITH TUNING VALVE

Per gas inlet line, inside the *my*-Control a solenoid valve may be installed. The individual gas flows can be manually tuned by a Needle Valve Module. The needle valve module includes a Non-Return valve that prevents back-flow of gas.



By default, the tuning valve is set to the required gas flow.

Changing the tuning valve setting must only be performed while using a flow meter.



Z310212012* Gas Solenoid Valve Assembly 24 VDC SMC

Z310212022* Needle Valve Module (including the Non-Return Valve)

*Additional (needle) valves must be installed by a certified Service Engineer.

For gas flows up to 500 ml/min, a precision metering valve is available for more accurate gas flow regulation:

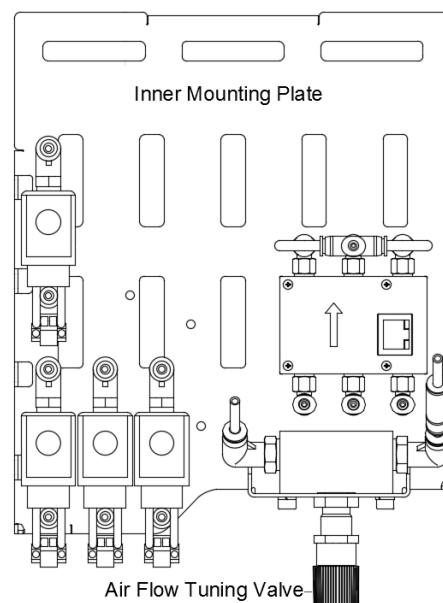
This metering valve is located inside the Control Console cabinet. Changing the default gas flow requires opening the cabinet and must only be performed by qualified personnel.

Top View image of the inner mounting plate with the precision air flow tuning valve(s) installed:

If two or more metering valves are installed, they are mounted on top of each other.

Z310212021* Precision Metering Valve Module
(including the Non-Return Valve)

*Additional Metering Valves must be installed by a certified Service Engineer.



4.2 MASS FLOW CONTROLLERS

Two types of mass flow controllers are used in the *my*-Control.

- 3-Channel Mass Flow Controller (for controlling the flow of three individual gasses)
- 1-Channel Mass Flow Controller (for controlling the flow of one gas only)

Both Mass Flow Controllers (MFC) are applied for bioreactor aeration.

The following gasses may be applied:

- Nitrogen
- Air
- Oxygen
- Carbon dioxide



3-Channel MFC



1-Channel MFC



Possible MFC configurations:

- If the flow of only one gas supply line needs to be controlled, the 1 Channel MFC is mounted,
- If the flow of two gas supply lines need to be controlled, two pieces of the 1 Channel MFC are mounted,
- If the flow of three gas supply lines need to be controlled, the 3 Channel MFC is mounted,
- If the flow of four gas supply lines need to be controlled, a 1 Channel MFC and a 3 Channel MFC are mounted,

MFC Specifications:

Aeration range: for N₂, air or O₂: up to 1,500 ml/min
for CO₂: up to 800 ml/min

Gas flow accuracy: $\pm 2\%$ full scale*

*The given accuracy is obtained under standard operating conditions (after at least 1 hour of operation):

Environmental temperature: 20 .. 25°C

Internal my-Control temperature: 35 .. 40°C

In case of different operating conditions, the accuracy may be less (theoretical temp. sensitivity for air, N₂ and O₂ = approx. 0.2%/°C, theoretical temp. sensitivity for CO₂ = approx. 0.6%/°C).

Gas Specifications:

Required gas inlet pressure: 2 barg

Required quality of the gasses: Instrument grade (dry and free of particles or oil).

Rule of Thumb for the Gas Flow Rates for Sparging and Overlay:

Gas	Cell Culture	Microbial Culture	Cell Culture	Microbial Culture
	Sparging		Overlay	
Air	Approx. 0.1 vvm	1 .. 2 vvm	Approx. 0.1 vvm	10% of sparger air flow
O ₂	10% of air flow	20 .. 30% of air flow	N.A.	N.A.
CO ₂	10 .. 25% of air flow	20 .. 30% of air flow	10% of sparger air flow	N.A.
N ₂	50 % of air flow	50 % of air flow	N.A.	N.A.

MFC Ordering Information:

Z310212120* 1-Channel MFC Assembly for *my-Control*

Z310212320* 3-Channel MFC Assembly for *my-Control*

Z310212110* Mounting Kit for 1-Channel MFC *my-Control*

Z310212310* Mounting Kit for 1-Channel MFC *my-Control*

When one or more MFCs must be added to an existing *my-Control*, one of the cables below must be ordered: VBL2080321* Cable Act. Board MFC (to connect the 1- or 3-channel MFC with the actuator board)

VBL2080351* Cable Act. Board MFC 2x (T-piece with extension cable to connect an additional MFX)

* Additional Mass Flow Controllers must be installed by a certified Service Engineer.

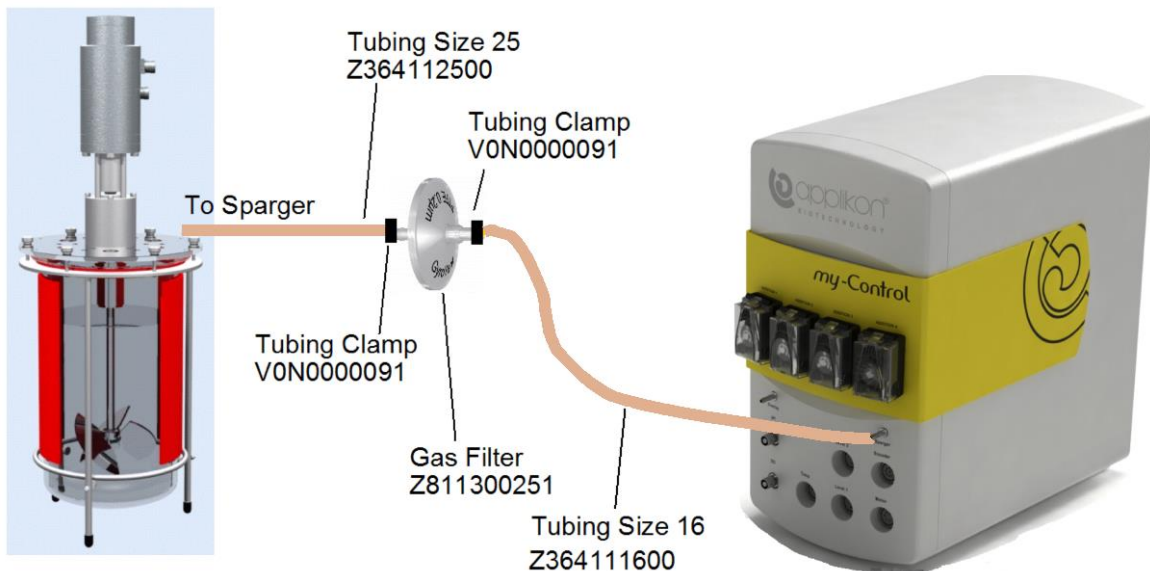
4.3 CONNECTION FOR SPARGING AND OVERLAY

At the front of the *my-Control* cabinet, an Aeration Outlet for Sparging is located. A second outlet for Overlay is optional.



- Z310212071 Gas Overlay Connection
- Z310212081 Gas Overlay Blind Plug

The connection between *my-Control* and autoclavable bioreactor can be realized according to the image below:



INTERNAL ACTUATORS

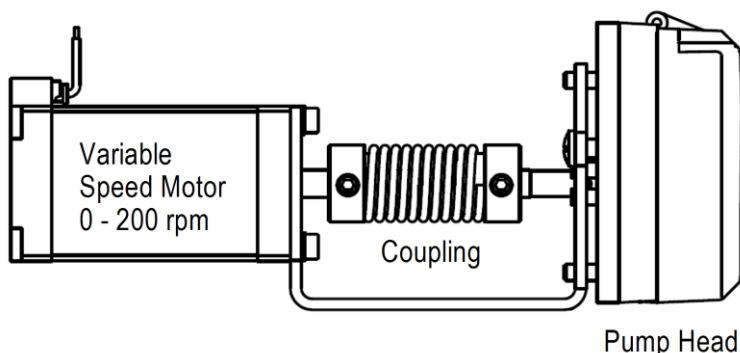
4.4 TUBING PUMP ASSEMBLY



WARNING

Risk of damaging the equipment.

- Application of damaged tubes may result in fluid leaking into the pump drive.
- Verify the tube quality inside the pump head before every new cultivation.
- Do not use the tubing pump drives for other purposes than displacement of fluids (or gas).



Microflex Pump Head with Closed and Open Cover

Total number of positions for tubing pump (and micro valves) at the front of the *my-Control* = 4.

The variable speed pump motor (0 – 200 rpm) drives a pump head.

Inside the pump head, Silicone or Pharmed tubing is applied.

Applicable tubing diameter:

- Microbore tubing size 48: ID = 2.79 mm

Tubing Type	Flow* at 200 rpm
Microbore tubing size 34	11 ml/min
Microbore tubing size 48	17 ml/min

*the nominal flow may vary $\pm 25\%$ due to tube tolerances and material characteristics (see remark below)!

When activated, the pump is rotating counterclockwise.

	<p>The loading procedure for new pump tubing is described on the next page.</p> <p>Due to stretching of the Pharmed tubing material, the liquid displacement of the tubing pump may show a decrease during the first few days after replacement of the tubing. When accurate dose monitoring is required, it is advisable to let the pump run continuously for approximately 24 hours before calibrating the Dose Monitor factor! Autoclaving may influence the liquid displacement as well!</p>
--	--

- Z310216011* Pump & Pump Head Variable Speed *my-Control* V2
- Z360762534 Silicone Tubing Microbore Size 34 (L = 15m)
- Z369580934 Pharmed Tubing Microbore Size 34 (L = 30m)
- Z360762548 Silicone Tubing Microbore Size 48 (L = 15m)
- Z369580948 Pharmed Tubing Microbore Size 48 (L = 30m)
- Z310216051 Blind Plate Pump Position *my-Control* V2

*Additional Pumps must be installed by a certified Service Engineer.

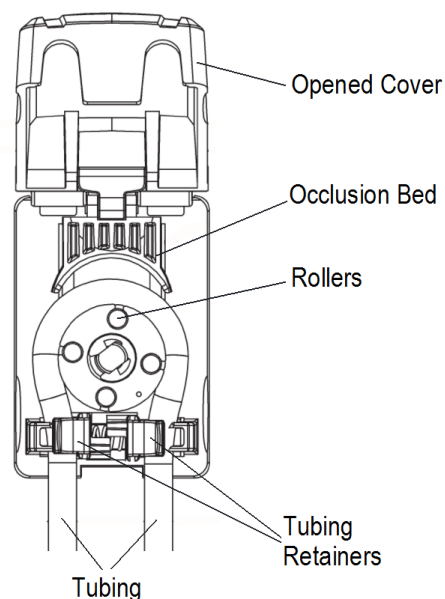
4.4.1 LOADING THE PUMP TUBING



WARNING:

Before loading tubing into the Pump Head, switch off the power of the my-Control. Fingers or loose clothing could be caught in the rollers.

1. When the cover is opened, the Occlusion Bed moves upward, away from the rollers.
2. Holding both ends of the tubing in one hand, form a loop and wrap the tubing around the Rollers, making sure that the tubing is centered on the rollers and keeping the free ends of the tubing outside of the Tubing Retainers.
3. Once the tubing is in place, close the Door and the Occlusion Bed will automatically align itself within the pump.
4. Insert the tubing into one of the Tubing Retainers by moving the retainer toward the center of the pump and placing the tubing in the v-notch of the retainer. Release the retainer so that the tubing is secured in place.
5. Repeat the previous step for the other tubing retainer.
6. The tubing should be stretched slightly around the rollers so that there is no excess tubing between the rollers and the retainers – any excess can be removed by pulling slightly on the tubing outside of the Pump Head.

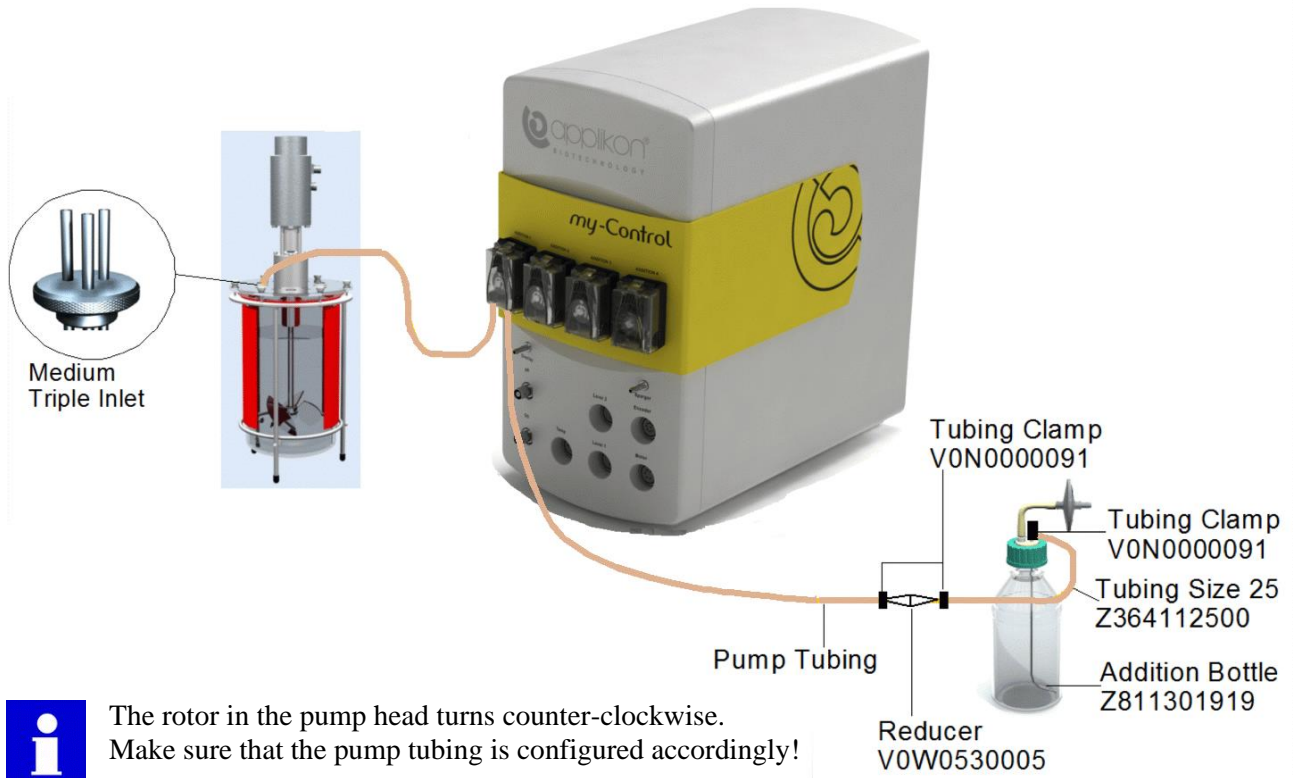


The Microbore Pump Tubing is now loaded in the Pump Head.

When activated, the pump will rotate counterclockwise.

4.4.2 PUMP TUBING CONNECTION

The liquid addition line between storage bottle and medium inlet triple can be realized according to the image below:



5 EXTERNAL ACTUATORS

External actuators are used for:

- Temperature control and
- Stirrer speed control.

The different actuator types are described in the sections below.

5.1 ACTUATORS FOR TEMPERATURE CONTROL

The reactor temperature can be controlled by

- A Heating Blanket for upward control (heating) and
- A Cold Water Valve for downward control (cooling).

In the sections below, both actuators are described.

5.1.1 HEATING BLANKETS

A heating blanket can be used to heat the bioreactor medium for unjacketed bioreactors. The maximum temperature of a heating blanket itself is at most around 80 °C, and the maximum medium temperature that can be reached by heating when a heating blanket is wrapped around the reactor, is about 70 °C (the actual temperature depends on the reactor size). The blankets are powered by a 48V DC source.



DO NOT disconnect the heating blanket without switching OFF the Temperature Control Loop!

Details on the power rating, dimensions, part numbers, and other attributes of the various heating blankets can be found in the heating blanket manual:

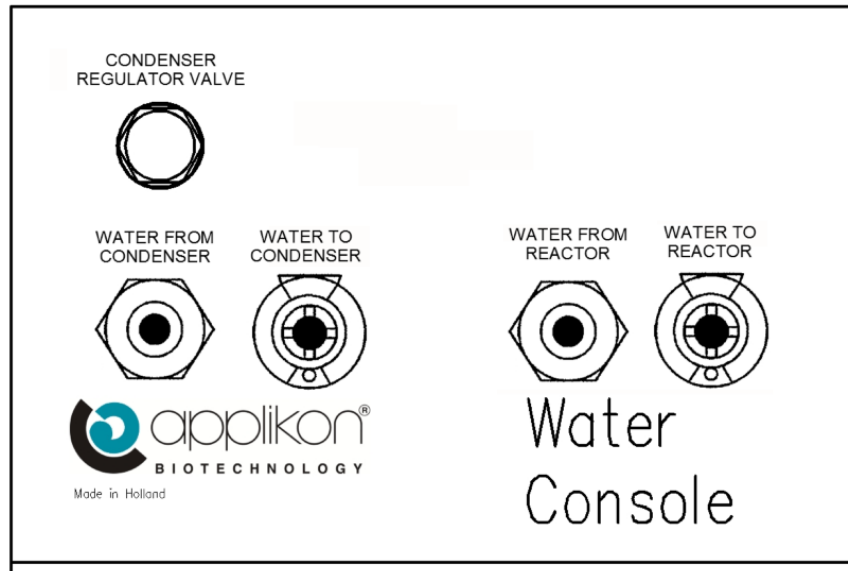
TRANSPARENT HEATING BLANKETS

For APPLIFLEX and AUTOCLAVABLE BIOREACTORS 250mL – 20L

which is separately provided along with this manual. By consulting this manual, you can determine the blanket size required for your bioreactor.

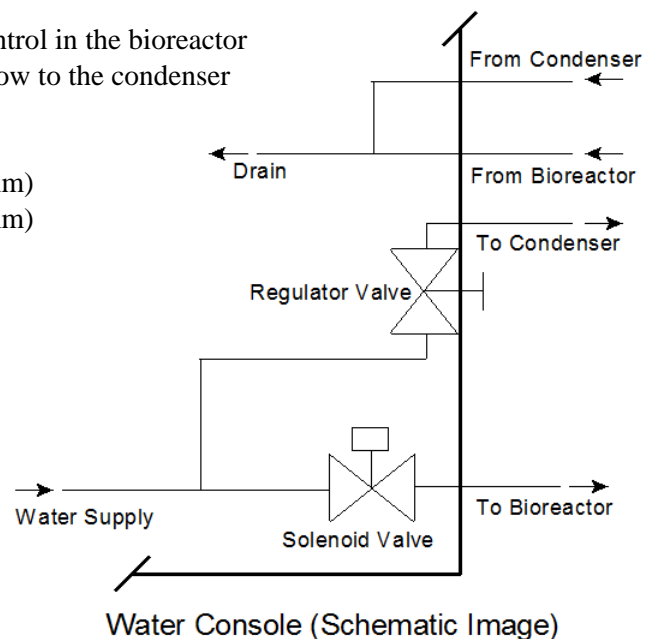
5.1.2 COLD WATER VALVE AND CONDENSER REGULATOR VALVE

The Cold Water Valve module and Condenser Regulator Valve are mounted in the External Cold Water / Condenser Assembly.



The Cold Water Valve module consists of:

- A Cold Water Solenoid Valve for Temperature control in the bioreactor
- A Regulator Valve that is used to tune the water flow to the condenser
- A water supply line connection
- A drain line connection
- Quick connectors to and from the bioreactor (10 mm)
- Quick connectors to and from the condenser (10 mm)



- Z311304010 Cold Water and Condenser Console Assembly
- Z311304020 Condenser Console Assembly



The external Cold Water Valve Module does not regulate the water pressure to the reactor! Ensure that the water supply pressure at the **Water to Reactor** inlet is maintained in the range 0.5-2 barg.

5.2 ACTUATORS FOR MIXING

Three different stirrer types can be used for mixing:

- The Stepper Stirrer Motor,
- The Brushless DC Motor M10 or
- The Brushed DC Motor P100.

The sections below describe the different options.



WARNING

- The stirrer motor is a machine with potential hazard (moving parts).
- In order to avoid dangerous situations, make sure that the stirrer motor is only operated when it is properly seated in the stirrer assembly of the bioreactor.
- The stirrer motor must only be used as part of a Bioprocess (bioreactor with control system).
- The stirrer motor must not be put into service until the machinery into which it is to be incorporated has been declared to conform to machinery directive 2006/42/EEC.
- When the stirrer motor has been put to operation, it will become hot. Take precautions to prevent personal injury.



The Stirrer Speed Controller contains a Current Limiter in order to prevent overheating of the motor. As a result, the maximum stirrer speed may be reduced in case of viscous media. In case the stirrer speed set-point cannot be reached, decrease the stirrer speed set-point or the number of impellers!

5.2.1 STEPPER STIRRER MOTOR

The Stepper Stirrer Motor can be used for cell culture applications. It is less powerful than the DC Stirrer Motors M10 and P100, but is suitable in the lower stirrer speed ranges.

The stepper stirrer motor is driven by the same controller as the stepper stirrer for the 250 and 500 ml MiniBio reactors.

If applicable, the my-Control may be switched as controller for the MiniBio reactors to the 2 and 3L reactors and vice versa.

Ordering numbers Stepper Stirrer Motor:

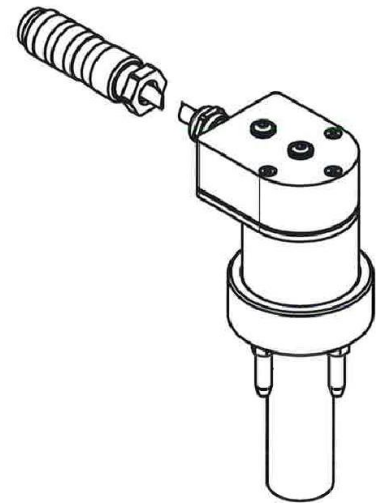
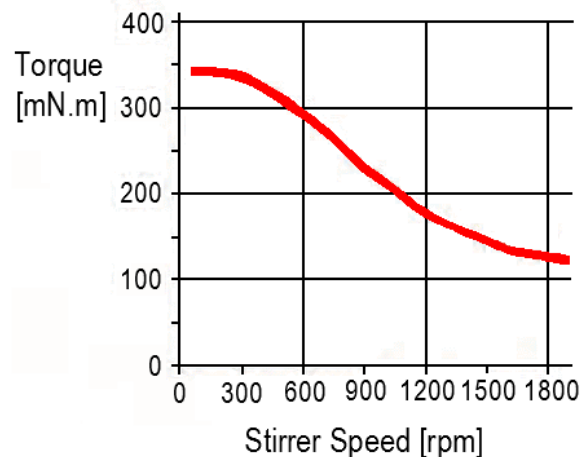
Z510002121 Stepper Stirrer Motor for 2 and 3L AC Cell Culture
(including motor studs and flexible coupling)
Z310213010 Stepper Stirrer Control Module

Maximum Torque of the Stepper Stirrer Motor:

The torque that can be supplied by the Stepper Stirrer Motor depends on the Stirrer Speed.

In general terms: the higher the stirrer speed, the lower the supplied torque.

The image shows the torque of the Stepper Stirrer Motor as a function of the stirrer speed:



5.2.2 BRUSHLESS DC STIRRER MOTOR M10

The DC Stirrer Motors are more powerful than the Stepper Motor and therefore very suitable for microbial applications where a high stirrer speed is required.

In addition to the stirrer power, the Brushless DC Motor has the advantage that it hardly requires maintenance (it does not have carbon brushes). Only the ball bearings need to be replaced every 20.000 operating hours (equivalent to almost 2.5 year of continuous operation).

The Brushless Stirrer Motor M10 is used in combination with the 2-7L range of glass autoclavable bioreactors.

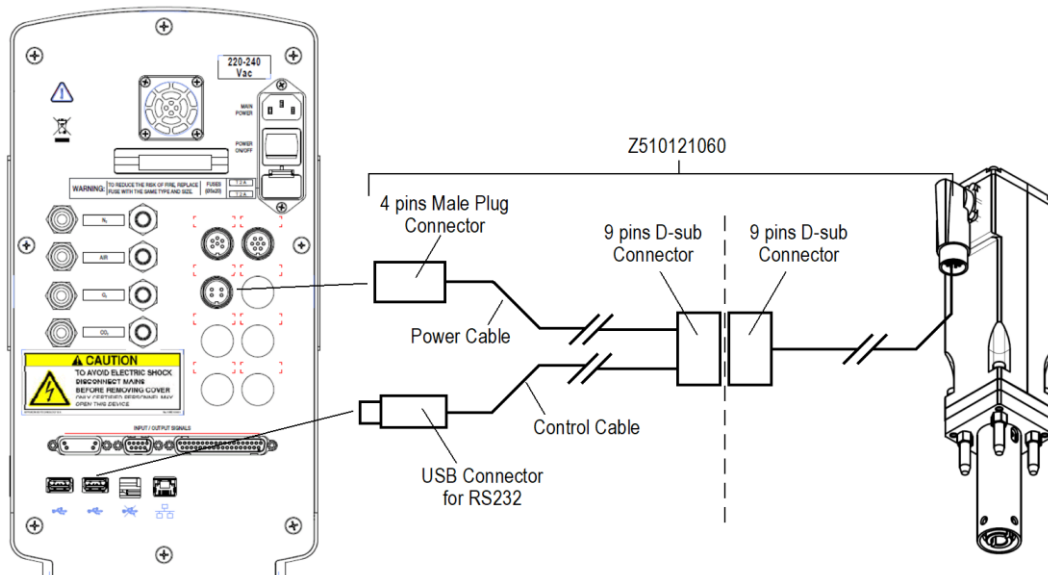
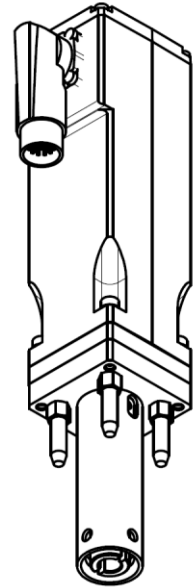
The motor comes with four motor studs to fit in the Top Stirrer Assemblies of the 2 – 7L range of bioreactors and a covered flexible fork coupling to avoid noise and vibrations during operation.

Maximum Stirrer Speed: 2000 rpm
 Maximum Torque: 0.24 Nm

Z510003010 Brushless Stirrer Motor M10

Cables between the my-Control and the M10 Motor:

A set of two cables is required to connect the M10 stirrer motor to the my-Control. This cable set (part Z510121060: Brushless Motor Cable via USB for my-Control and in-Control) is used as described in the image below.



Z510121060 Brushless Motor Cable via USB for my-Control and in-Control

Z310213030 Brushless Stirrer Control Module



WARNING: do not disconnect the USB Connector from the my-Control during operation.

When during operation the control cable USB Connector is disconnected from the my-Control, the stirrer motor cannot receive a new stirrer speed setpoint. As a result, the stirrer will continue to run at the same speed until the USB connector is reconnected or the my-Control power is switched

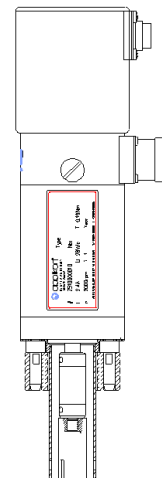
off.

EXTERNAL ACTUATORS

5.2.3 BRUSHED DC STIRRER MOTOR P100

The P100 is a brushed DC stirrer motor that can be used as an alternative for the M10 stirrer motor (see previous section).

An encoder, present in the motor, is used for stirrer speed feedback to *my*-Control. The stirrer motor is delivered with four motor studs to fit in the stirrer assembly and a covered (flexible) coupling fork to avoid noise and vibrations during operation. No tools are required to mount the stirrer motor on top of the stirrer assembly.



Maximum Stirrer Speed: 2000 rpm
Maximum Torque: 0.20 Nm

Z510000010 Brushed Stirrer Motor P100
Z510121015 Motor Cable for Stirrer P100 L = 0.7m
Z510121025 Encoder Cable for stirrer motors P100 L = 0.7m
Z310213020 Stirrer Control Module P100

Maintenance:

The stirrer motor is virtually maintenance-free. The only parts that require regular maintenance are:

- Carbon brushes: life span depends on operating conditions (normally approx. 10,000 operating hours).
Minimum length of the carbon brush: 9 mm.
- Ball bearings

**CAUTION**

- When carbon brushes need to be replaced, it is advised also to replace the ball bearings of the motor as well. Please return the stirrer motor to the Technical Support department of Applikon Biotechnology or its representative.
- Operating the stirrer motor with worn-out carbon brushes will cause irreversible damage!

Replacements:

V0R2001002 Cap for Carbon Brush (P100 motor)

6 REACTORS AND AUXILIARIES

This chapter describes the 2 and 3L autoclavable bioreactors with their auxiliaries.

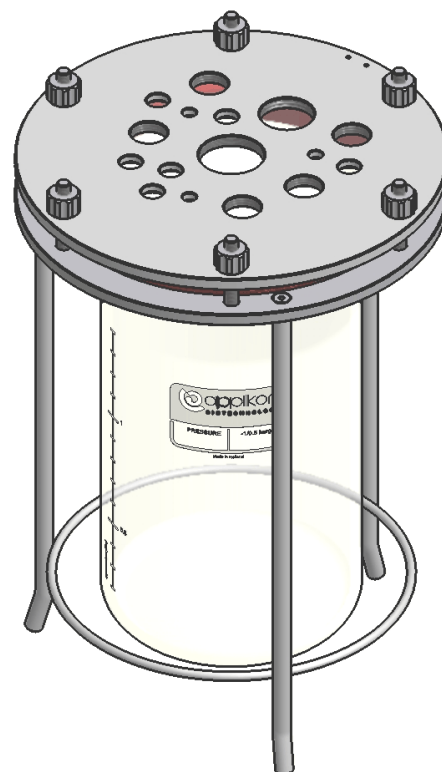
6.1 REACTOR TYPES

Materials in contact with the medium (all reactors):

- borosilicate glass
- stainless steel
- silicone rubber and FPM (lipseal)
- optional: viton or EPDM

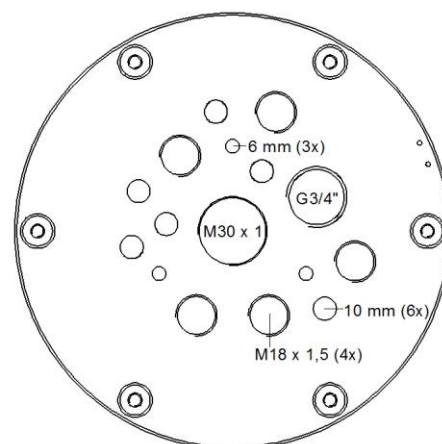
6.1.1 2 LITER DISHED BOTTOM REACTOR

Reactor type	2 liter, dished bottom
Inner diameter	105 mm
Inner height (maximum)	240 mm
Liquid height (working volume)	156 mm
Required autoclave space (H x D)	400 x 200 mm
Req. autocl. space with condenser	460 x 200 mm
Overall height reactor	290 mm
Total volume	2.2 liter
Working volume	1.7 liter
Minimum working volume	0.3 liter
H/D total	2.3
H/D working volume	1.9
Volume indication	Present
Minimum reactor pressure	-1 barg
Maximum reactor pressure	0.5 barg



Ports in the head plate:

Port	# of ports	Description
M30 x 1	1 x	Stirrer Port
M18 x 1.5	5 x	Auxiliaries such as sensors and condenser
G3/4	1 x	dO ₂ sensor holder
10 mm	6 x	Auxiliaries such as sample and overlay pipe
6 mm	3 x	Baffle ports



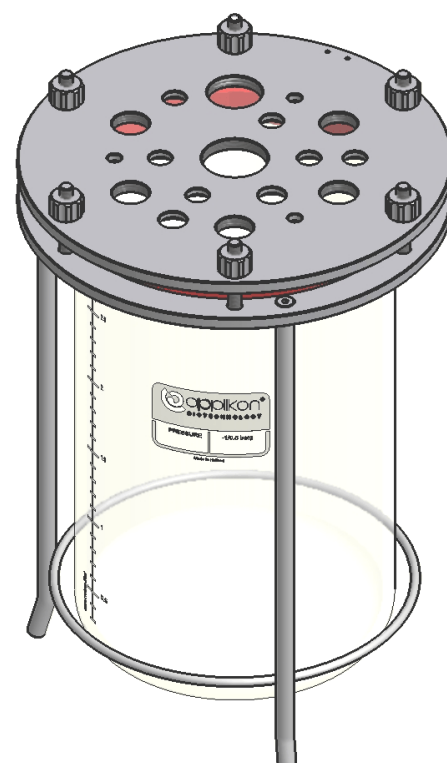
The head plate also contains two 2 mm holes for level sensor connection.

Z611000210 2 liter Dished-bottom Reactor

AUXILIARIES

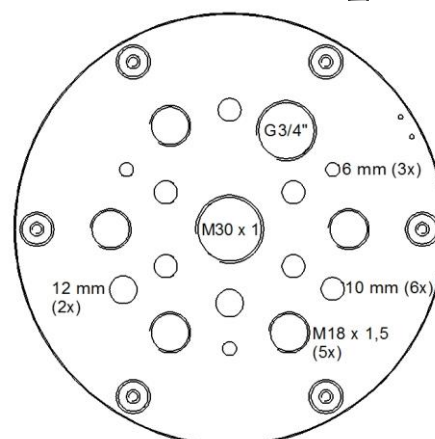
6.1.2 3 LITER DISHED BOTTOM REACTOR

Reactor type	3 liter, dished bottom
Inner diameter	130 mm
Inner height (maximum)	250 mm
Liquid height (working volume)	200 mm
Required autoclave space (H x D)	400 x 200 mm
Req. autocl. space with condenser	460 x 200 mm
Overall height reactor	290 mm
Total volume	3.1 liter
Working volume	2.4 liter
Minimum working volume	0.6 liter
H/D total	1.9
H/D working volume	1.5
Volume indication	present
Minimum reactor pressure	-1 barg
Maximum reactor pressure	0.5 barg



Ports in the head plate:

Port	# of ports	Description
M30 x 1	1 x	Stirrer Port
M18 x 1.5	5 x	Auxiliaries such as sensors and condenser
G3/4	1 x	dO ₂ sensor holder
12 mm	2 x	Auxiliaries such as sample and addition pipes
10 mm	6 x	Auxiliaries such as sparger and overlay pipes
6 mm	3 x	Baffle ports



The head plate also contains two 2 mm holes for level sensor connection.

Z611000310 3 liter Dished-bottom Reactor

6.2 STIRRER ASSEMBLIES

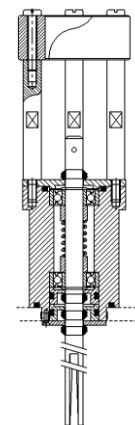
For agitation, stirrer assemblies, impellers and baffles can be applied. Use the formulas in [section 6.2.5](#) to determine which devices are optimal for your application.

6.2.1 TOP STIRRER ASSEMBLIES

All stirrer assemblies are mounted at the central stirrer port in the bioreactor head plate.

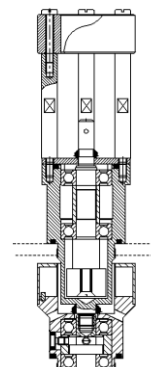
Lipseal Stirrer Assemblies:

Z81315R003 Lipseal Stirrer Assembly 2 and 3 liter



Magnetically Coupled Stirrer Assembly (shown without stirrer shaft):

Z81315MG03 MC Stirrer Assembly 2 and 3 liter



6.2.2 IMPELLERS

All impellers fit to the 8 mm shafts of the stirrer assemblies.

Turbine impellers

Mainly used for microbial applications.

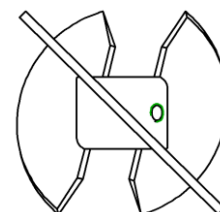
Z81313R602	Rushton impeller	6 blades	OD = 45 mm
Z81313R645	Rushton impeller	6 blades (vortex)	OD = 45 mm



Marine impellers

Mainly used for cell culture applications.

Z81314RC02	Marine impeller	vortex	OD = 45 mm
Z81314RC03	Marine impeller	scoping	OD = 45 mm



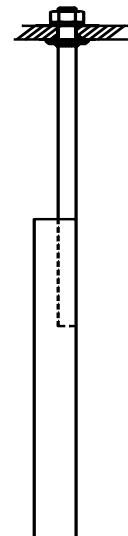
6.2.3 BAFFLES

Baffles are used to increase the mixing efficiency. Without baffles, the medium flow can become laminar, causing poor mixing efficiency and mass transfer. For optimal mixing performance, the baffles are mounted in the head plate, near the reactor wall.

Applicable number of baffles: 1 to 3.

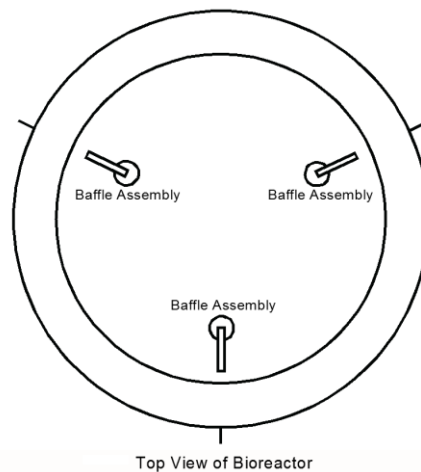
The baffle assembly consists of one baffle and mounting material.

Z81326KS03 Baffle Assembly 2 and 3 liter 6 mm port



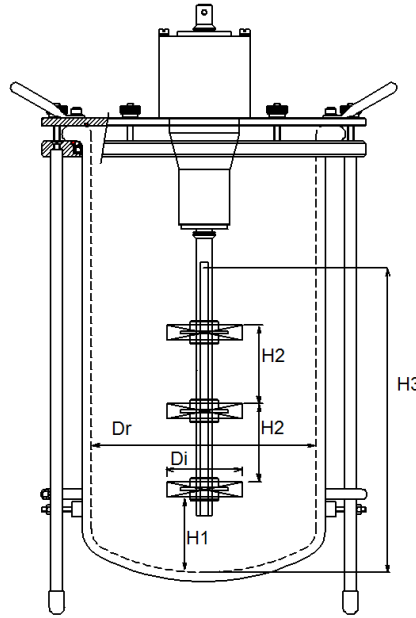
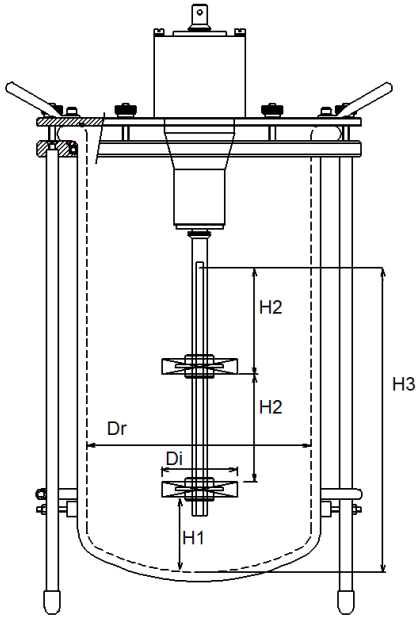
Advised baffle orientation:

aimed at the reactor wall;
 see image (top view of reactor):



6.2.4 OPTIMUM IMPELLER CONFIGURATION

The following images show the advised impeller configuration (position and diameter) for the glass autoclavable bioreactors (microbial and cell culture):



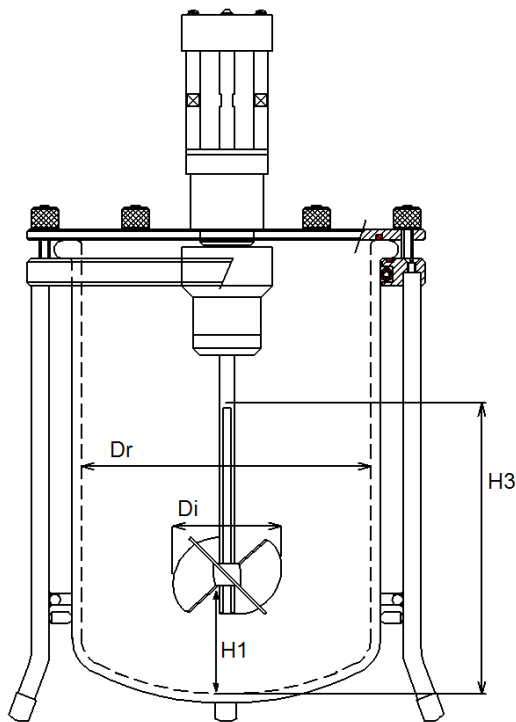
Microbial Culture

$Dr = 3 \times Di$

$Di = H1$

$H2 \sim 0.6 Dr$

$H3 = \text{liquid height Working Volume}$



Cell Culture

$Dr = 2.5 \times Di$

$Di = H1$

$H3 = \text{liquid height Working Volume}$

6.2.5 CALCULATIONS OF STIRRER POWER REQUIREMENTS

The power (Watt) of the stirrer motor that is required depends on the number, type and diameter of the impellers, density of the medium and the stirrer speed. The required power per impeller of a stirrer motor in **non-aerated** media is given by the equation:

$$P = \rho \times (N/60)^3 \times D^5 \times N_p$$

where:

P	Required Power of the Stirrer Motor (W)
ρ	Density of the Medium (kg/m ³)
N	Stirrer Speed (rpm)
D	Diameter of the Impeller (m)
N _p	Power Number of the Impeller*)

*) Rushton turbine impellers: N_p = 6
Applikon marine impellers: N_p = 1.5

When mounted according to the given configuration, a second or third impeller on a shaft requires only 90 % of the power of the first impeller. This means that the equation above is multiplied with the factor 1.9 for two impellers and with a factor 2.8 for three impellers.

Required Torque

The required torque of the stirrer motor is related to its power according to the following equation:

$$M = P \times 60 / (2 \pi N)$$

where:

M	Required Torque of the Stirrer Motor (Nm)
P	Required Power of the Stirrer Motor (W)
N	Stirrer Speed (rpm)

Impeller Tip Speed

The Tip Speed (m/s) of an impeller at a certain stirrer speed is given by the equation:

$$\text{Tip speed} = (N / 60) \times \pi \times D$$

Where:

N	Stirrer Speed (rpm)
D	Diameter of the Impeller (m)

Example

Required stirrer power, torque and corresponding tip speed for non-aerated media with a density of 1100 kg/m³ are calculated as follows:

2 or 3 liter reactor with two 6-bladed turbine impellers of 45 mm, at 1250 rpm:

required power: $P = 1100 \times (1250 / 60)^3 \times (0.045)^5 \times 6 \times 1.9 \approx 21 \text{ W}$
 required torque: $M = 21 \times 60 / (2 \times \pi \times 1250) \approx 0.16 \text{ Nm}$
 tip speed: $T = (1250 / 60) \times \pi \times 0.045 \approx 2.9 \text{ m/s}$

6.3 AERATION

6.3.1 GAS IN-/OUTLET FILTER

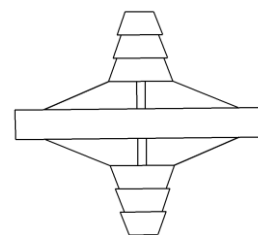
The bacterial air filter is an economical filter for sterile gas delivery and venting applications. The hydrophobic PTFE filter membrane excludes the risk of contamination. The filter is autoclavable.



For venting applications, a condenser must be applied in order to prevent the filter from becoming clogged with water.

Housing material: polypropylene
Pore size: 0.22 µm
Maximum temperature: 132 °C

Z811302030 Autoclavable air filter 0 – 40 L/min (Hose Barb 7 / 9.5 mm)
Z811300251 Autoclavable air filter 0 – 5 L/min (mini Hose Barb 3 mm)



6.3.2 SPARGERS

Spargers or gas inlet pipes are tubes that are immersed in the medium. Consequently gas that is added is sparged in the medium.

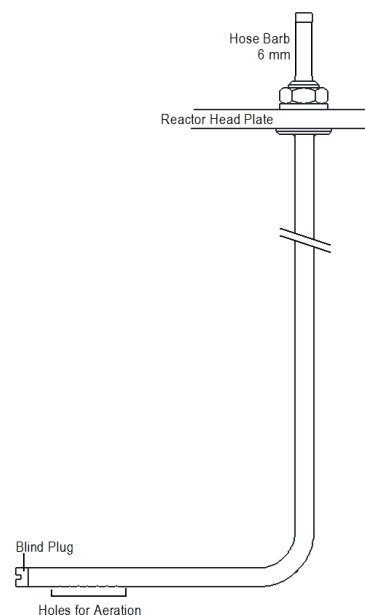
6.3.2.1 L-TYPE SPARGER

To meet the oxygen demand of a culture, a sterile gas stream can be sparged through the culture, using an air-inlet pipe. This pipe can be applied when high gas flow rates are required, since this pipe causes hardly any pressure drop.

The holes in this pipe are located at the bottom to make sure that medium will be driven out by the gas stream.

Hose barb size: 6 mm,
Hole diameter: 1 mm.

Z81318L002 Sparger L-type 2 liter 10 mm port
Z81318L003 Sparger L-type 3 liter 10 mm port

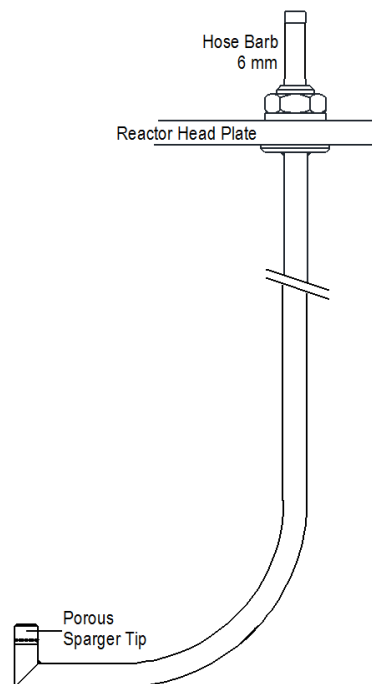


6.3.2.2 POROUS SPARGER

In cell culture cultivations, high gas flow will damage the cells due to shear forces. To meet the oxygen demand of the cells at lower gas flows the exchange surface must be high. This is achieved by using a porous sparger with a pore size of 15 µm. This sparger produces tiny gas bubbles for optimum gas distribution.

Porous Sparger with sintered Metal Tip:

Z81318L004	Sparger	Porous	2 liter	10 mm port
Z811303005	Sparger	Porous	3 liter	10 mm port
Z811303008	Sparger Tip for air-inlet pipe			

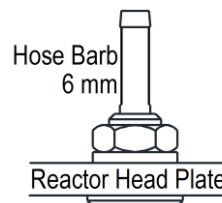


6.3.3 AIR OVERLAY ASSEMBLY

Air overlay means head space aeration (separate from, or in combination with, sparging gas through the culture).

This assembly can be used for either gas overlay or gas outlet.

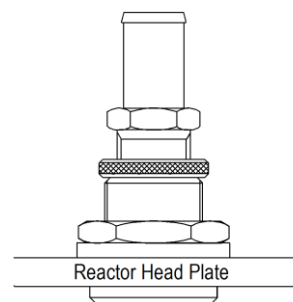
Z81308LU02	Air overlay assembly	2 and 3 liter	10 mm port
------------	----------------------	---------------	------------



6.3.4 PRESSURE RELIEF VALVE

It is advised to install a relief valve in the (glass) Applikon reactors. The relief valve opens at a pressure of 0.5 barg.

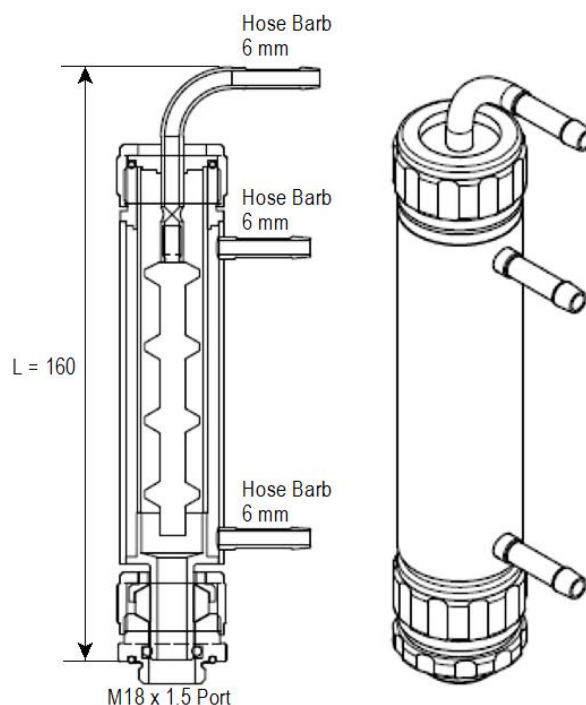
Z811302051	Pressure relief valve	M18 x 1.5 port
------------	-----------------------	----------------



6.3.5 AIR OUTLET CONDENSER

Working at elevated temperatures and using aeration of the culture might cause too much evaporation during fermentation, causing an increase of nutrient concentration and a decrease in volume. An air-outlet condenser can prevent this.

Air-outlet condenser (SS = Stainless Steel):



Z813080002 Baffled Condenser for M18 x 1.5 port, L = 160
To be used in the 2 and 3L reactors



If the reactor plus affixed condenser is too tall for the autoclave, a flexible coupling can be inserted between reactor and condenser. During the cultivation, the condenser is held upright by the condenser support. During autoclaving, the flexible coupling between reactor and condenser allows the condenser to be bent to a horizontal position.

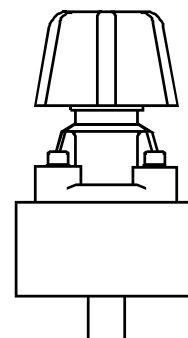
6.3.6 TUNING VALVE

The tuning valve can be installed on top of the stainless steel air outlet condenser in order to create a small over-pressure in the reactor. This has the following advantages:

- Risk of contamination is reduced.
- Oxygen transfer to the medium is increased.
- Sampling the culture is eased.



For safety reasons it is strongly advised to use this tuning valve in combination with the pressure relief valve.



Z811302020 Tuning valve

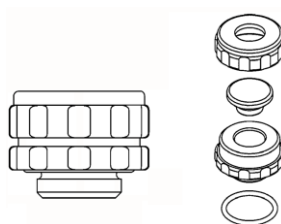
6.4 ADDITION

During preparation and while running a process, fluids will be added to the reactor for medium addition, inoculation, pH and level control, perfusion, etc.

6.4.1 SEPTUM HOLDER

The septum holder is equipped with a silicone rubber septum and can be used as a universal addition port by piercing it with one or more needles.

The needle can be used to add a fluid or gas to the culture.



Z813020002



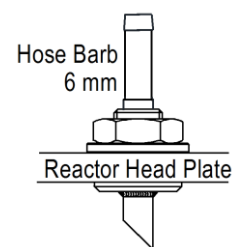
Z81309IN02

Z813020002	Septum Holder	2 and 3 liter	M18 x 1.5 port
Z81309IN02	Needle for septum		

6.4.2 ADDITION PIPE

The addition pipe can be used to add fluids (or gasses) to the 2 and 3L reactor.

Z81324MT02	Addition pipe	ID = 4 mm	10 mm port
Z81324MT05	Addition pipe	ID = 4 mm	12 mm port

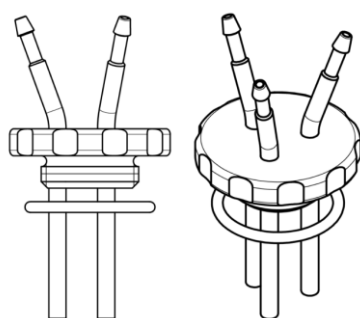


6.4.3 MEDIUM INLET TRIPLE

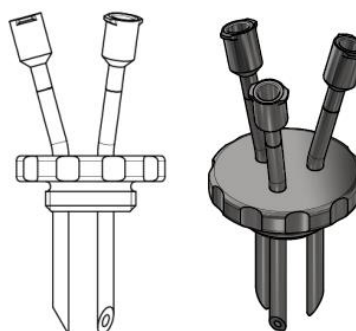
The medium inlet triple allows you to equip one head plate port with three additions (e.g. for acid, alkali and anti-foam addition). This device can be used to expand the number of entries beyond the number of ports in the head plate.

For the M18 x 1.5 ports in the head plate of the 2 and 3 liter reactors, the Medium Inlet Triple is available in two versions, with and without luer lock connectors.

Diameter of the inlet pipe hose barbs = 3 mm.



Z813240004



Z813240005

Z813240004 Medium Inlet triple (bent inlets), 2 to 7 liter reactors, M18 x 1.5 port

Z813240005 Medium Inlet triple (bent inlets) with luer lock connectors, 2 to 7 liter reactors, M18 x 1.5 port

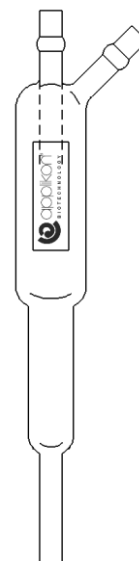
6.4.4 LIQUID ENTRY SYSTEM

When running a continuous culture, back growth of organisms into the medium container must be prevented.

The liquid entry system uses a sterile gas flow to transfer the fresh medium to the reactor. In this way, direct contact between the culture and the medium storage container does not exist.

The liquid entry system fits into the pH sensor nipple.

Z81309IN03 Liquid entry system 12 mm pH sensor nipple

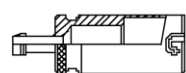


6.4.5 RAPI-LOK STERILE CONNECTOR

The autoclavable Rapi-Loks are a fast and reliable way to make or break tubing connections during a fermentation or cell culture process.

Materials: Body and blind caps: SS 316L
 O-rings: silicone

Z81324MT50	Rapi-Lok	male coupling	bore size (ID) 2 mm
Z81324MT51	Rapi-Lok	female coupling	bore size (ID) 2 mm
Z81324MT52	Rapi-Lok	male coupling	bore size (ID) 4 mm
Z81324MT53	Rapi-Lok	female coupling	bore size (ID) 4 mm
Z81324MT54	Rapi-Lok	male coupling	bore size (ID) 6 mm
Z81324MT55	Rapi-Lok	female coupling	bore size (ID) 6 mm
Z81324MT56	Rapi-Lok	blind cap	for male coupling
Z81324MT57	Rapi-Lok	blind cap	for female coupling



Female Coupling



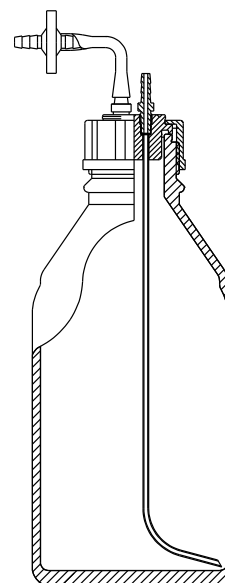
Blind Cap for Female Coupling



Blind Cap for Male Coupling



Male Coupling



6.4.6 LIQUID ADDITION BOTTLE

The liquid addition bottles are available in different sizes and come with an air-inlet filter.

Z811301918	Liquid Addition Bottle, 0.25 L, 1.5 barg
Z811301919	Liquid Addition Bottle, 0.5 L, 1.5 barg
Z811301920	Liquid Addition Bottle, 1 L, 1.5 barg
Z811301911	Liquid Addition Bottle, 2 L, 1.5 barg
Z811301912	Liquid Addition Bottle, 5 L, 1.5 barg

Z811302030 Autoclavable air filter 0 – 40 L/min (Hose Barb 7 / 9.5 mm)

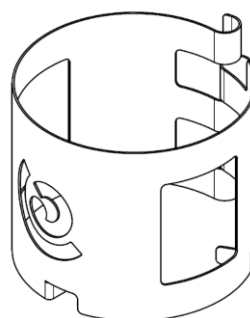
6.4.7 AUTOCLAVABLE BOTTLE HOLDER

For the 0.5L and 1L addition bottles, an autoclavable Bottle Holder is available that can be fixed to the Tripod of the Dished Bioreactor.

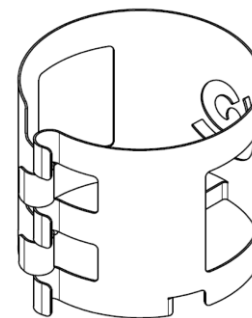
Squeeze the Bottle Holder and fit it on one of the vertical Tripod rods.

Place the bottle in the holder.

The Addition Bottle (including the connecting tubing) can be autoclaved together with the bioreactor.



Front View



Rear View

Z811301939	Autoclavable Bottle Holder for Tripod (0.5L bottle)
Z811301940	Autoclavable Bottle Holder for Tripod (1L bottle)

6.5.2.3 SAMPLE PIPE FOR SCREENS

If a sample screen is used at the end of this pipe, cell-free samples can be drawn from the culture. Sample screens are available in several pore sizes.

The sample pipe for screens has a very small dead volume. The height-adjustable sample pipe can be used with or without a sample screen. If it is used without sample screen, the small dead volume of the pipe guarantees samples from the culture that are representative for the reactor contents.

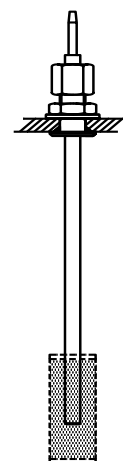
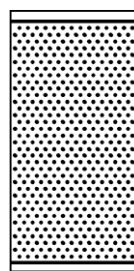
Z81319MB09 Sample Pipe 2 and 3 liter 10 mm port

Z811303010 Sample Screen pore size = 13 μm

Z811303014 Sample Screen pore size = 20 μm

Z811303012 Sample Screen pore size = 76 μm

Z811303013 Sample Screen pore size = 105 μm

6.5.2.4 NARROW SAMPLE PIPE

This sample pipe is designed for the sampling of small volumes.

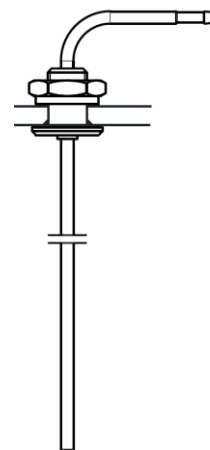
The small internal diameter of the pipe guarantees a minimum dead volume.

The sample pipe fits into a 6 mm (baffle) port or into a 10 mm port, depending on type number.

Diameter ID = 1.56 mm

Z81319MB13 Sample Pipe 2 and 3 liter 6 mm port

Z81319MB15 Sample Pipe 2 and 3 liter 10 mm port

6.5.2.5 WIDE SAMPLE PIPE

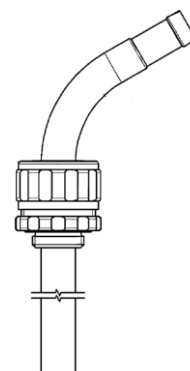
This sample pipe is designed for sampling cultures with flocculating organisms. In this case a sample pipe with a small diameter would ruin the flocks and the pipe would be clogged.

The shear forces inside this sample pipe are nearly negligible.

The sample pipe can be fitted in the pH sensor nipple (ID = 12 mm).

Diameter: ID = 10 mm

Z813190022 Sample Pipe 2 and 3 liter 12 mm pH sensor nipple



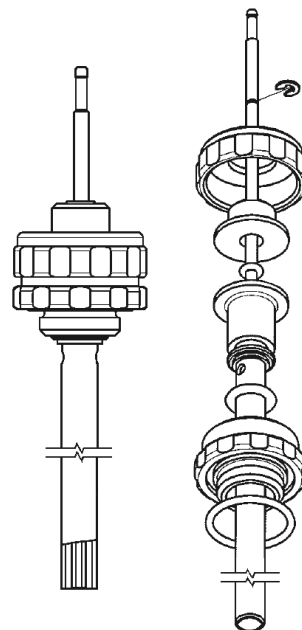
6.5.2.6 CHEMOSTAT TUBE

The chemostat tube is used in continuous fermentation.

This device is designed to achieve a constant volume level in the reactor. Liquid is taken out of the reactor through the height-adjustable inner tube. This inner tube is shielded from the reactor by an outer tube to avoid the influence of foam and surface irregularities on the liquid level.

Outer tube:	OD	= 8 mm
	ID	= 6 mm
Inner tube:	OD	= 3.18 mm
	ID	= 1.4 mm

Z813060002 Chemostat Tube L = 157 mm M18 x 1.5 port

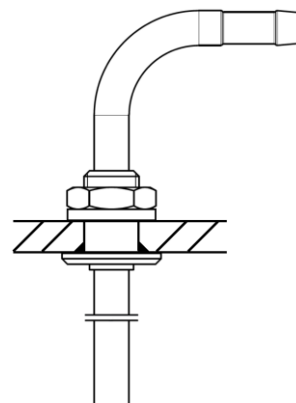


6.5.2.7 DRAIN TUBE

The drain tube is used to take relatively large samples from the culture and to drain the reactor after finishing the process.

Diameter:	OD	= 6.35 mm
	ID	= 4.53 mm

Z81319MB14 Drain Tube 2 and 3 liter 10 mm port

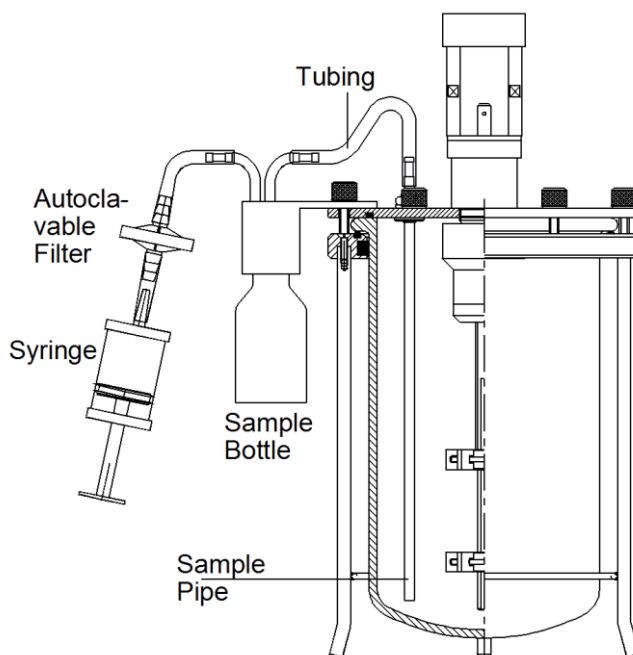


6.5.3 SAMPLE SYSTEMS

Reusable Sample system

The sample system with a 60 ml (or 30 ml) glass bottle can be mounted onto the head plate of the reactor.

This system, completed with a syringe and connected to a sample pipe (tubing), provides your reactor with an easily operated sampling device.



- Z81207SS02 Sample System for 2 and 3 liter reactors
- Z81207BT30 Sample bottle 30 ml
- Z81207BT60 Sample bottle 60 ml

Single Use Sample System

The single use sample system package includes 5 sample systems and 25 syringes of 10 ml. This system is mounted on the standard autoclavable sample pipe and is autoclaved with the bioreactor.

When a sample needs to be taken from the bioreactor, a syringe is placed on the filter to push air through the sample pipe in order to clear it.

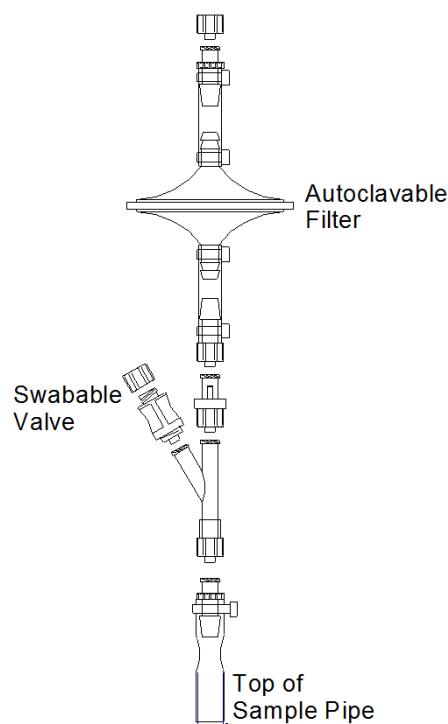
Next, a sterile syringe is placed on the swabable valve and a sample can be drawn into the syringe.



The swabable valve must be cleaned with 70% ethanol before and after sampling.

Using this sample system has the benefit that no sample bottles need to be autoclaved and no flames are required to maintain sterility. Since the swabable valve can only be used for 10 to 15 samples, the sample system should be replaced after each cultivation.

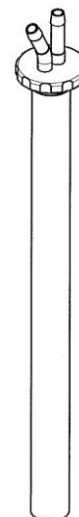
- Z850000010 Sample system single use for autoclavable reactors, 5 pieces



6.6 HEAT EXCHANGER



The 1 liter reactor comes with a heat exchanger that is fixed in the head plate.



Heat exchanger for the 2 and 3 liter reactors:

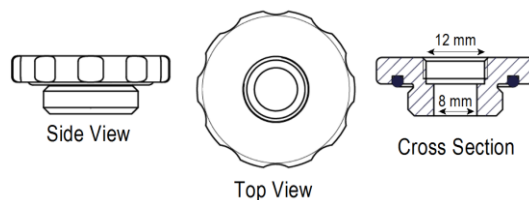
Z813170003 Heat Exchanger 2 and 3 liter M18 x 1.5 port

6.7 MISCELLANEOUS

6.7.1 HOLDERS FOR OD 8 MM SENSORS

M18 x 1.5 Ports

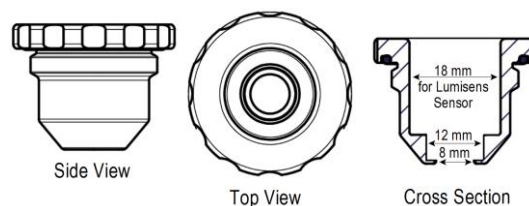
The holder for OD=8 mm sensors that fits in a M18 x 1.5 port is used to mount the sensors for the MiniBio reactors in the top plate of the 2 and 3L bioreactors.



Z813000040 Sensor Holder D=8mm M18 Port M12 Thread

G3/4" Ports

The holder for OD=8 mm sensors that fits in a G3/4" port is used to mount the Lumisens sensor in the top plate of the 2 and 3L bioreactors.



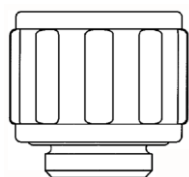
Z813000050 Sensor Holder D=8mm G3/4" Port M12 Thread

6.7.2 HOLDERS FOR OD 12 MM SENSORS

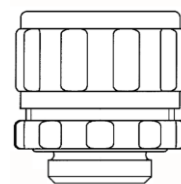
M18 x 1.5 Ports

The sensor holders ID = 12 mm for the M18 x 1.5 ports can accommodate:

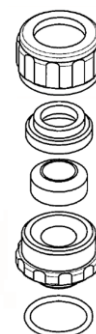
- sensors (pH, dO₂, etc.)
- liquid entry system
- glass condenser
- other 12 mm (OD) devices.



Z813000011



Z813000002



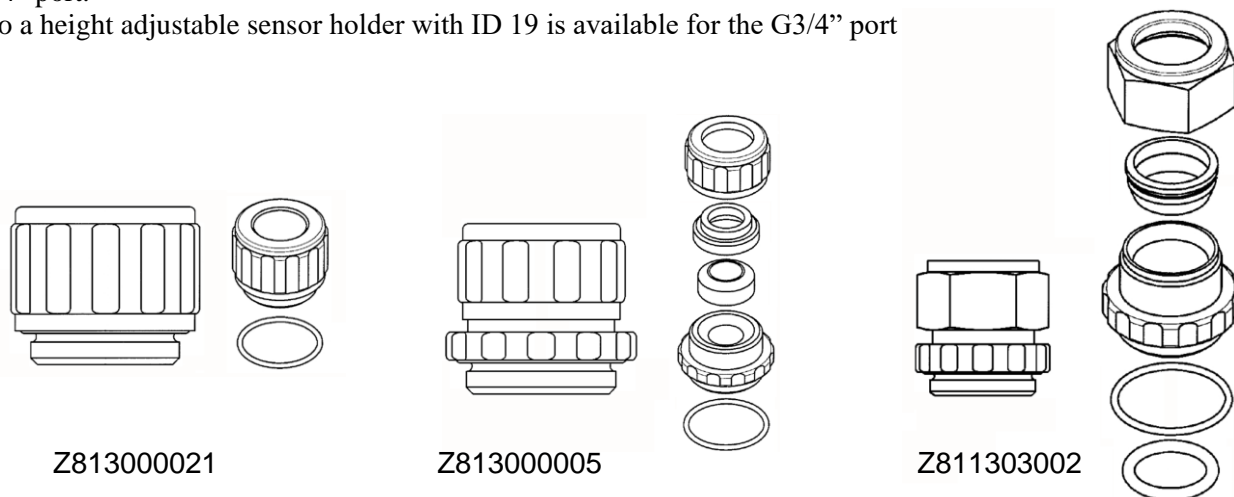
Z813000011 Sensor Holder ID = 12 mm, PG 13.5, M18 x 1.5 port

Z813000002 Sensor Holder height adjustable version ID = 12 mm, M18 x 1.5 port

G3/4" Ports

Two nipples are available to fit a sensor or other OD 12 mm device with a fixed or adjustable height to the G3/4" port.

Also a height adjustable sensor holder with ID 19 is available for the G3/4" port



- Z813000021 Sensor Holder ID = 12 mm, PG 13.5, G3/4" port
- Z813000005 Sensor Holder height adjustable version ID = 12 mm, G3/4" port
- Z811303002 Sensor Holder height adjustable version ID = 19 mm, G3/4" port

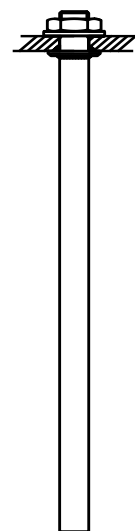
6.7.3 THERMOMETER POCKET

The thermometer pocket allows you to insert a temperature probe (Pt100) in the reactor.



Fill the thermometer pocket with water or silicone oil in order to improve thermal contact between the culture and the probe.

The 1 liter reactor comes with a thermometer pocket that is fixed in the head plate.

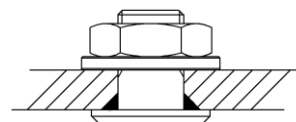


- Z81323TP03 Thermometer Pocket 2 and 3 liter 10 mm port

6.7.4 BLIND STOPPERS

Blind stoppers can be used to blind unused ports in the head plate.

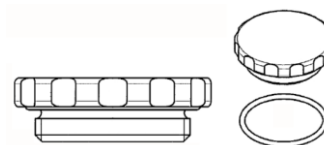
The assemblies for 6, 10, 12, and 27 mm ports are mounted into the head plate from the inside of the reactor, leaving only a flat surface in the reactor.



- Z81321BP03 Blind Stopper 2 and 3 liter 6 mm port
- Z81322BP03 Blind Stopper 2 and 3 liter 10 mm port
- Z81322BP08 Blind Stopper 2 and 3 liter 12 mm port

Blind stoppers for threaded ports are mounted from the topside of the head plate.

- Z813010004 Blind Stopper 2 and 3 liter G3/4" port
- Z813010003 Blind Stopper 2 and 3 liter M30 x 1 port
- Z813010002 Blind Stopper 2 and 3 liter M18 x 1.5 port



7 SENSORS

pH:

Z001023551	Sensor	pH+ (annular junction)	L = 235 mm	2 and 3 liter	PG 13.5
Z100065010	Cable	pH sensor	L = 0.65 m		
Z100200010	Cable	pH sensor	L = 2 m		

dO₂:

Z010023525	Sensor	dO ₂ (low drift, GMP)	L = 235 mm	2 and 3 liter	PG 13.5
Z100065012	Cable	dO ₂ sensor	L = 0.65 m		
Z100200012	Cable	dO ₂ sensor	L = 2 m		
Z110000425	Low Drift Membrane Module Kit (4 pieces)				



The diameter of the pH and dO₂ sensors is 12 mm.

Temperature:

Z034150010	Sensor	Temperature (Pt-100)	L = 150 cm		
------------	--------	----------------------	------------	--	--

Level / Foam:

Z711203001	Sensor	Level / Foam for 10 mm Port		2 and 3 liter	
Z103150010	Cable	Foam sensor	L = 1.5 m		



- At the sensor side, the Level sensor cable is equipped with two jacks. One jack needs to be inserted at the top side of the hollow sensor, the other jack fits in the 2 mm hole in the top plate of the bioreactor.

8 START-UP KIT

The Start-Up Kit for the 2 and 3L bioreactors is described below.

Z81100AK12 Start-Up Kit II for autoclavable reactors 2 and 3L

The table below lists the content of the Start-Up Kit:

Part Number	Part Description	Quantity Per Assembly
V3MA000031	CLAMPING RING FOR PH-NIPPLE VITON	2
V1S4ARP124	O-RING ID 31.42X2.62 SILICONE	2
V1S4ARP111	O-RING ID 10.77X2.62 SILICONE	4
V1S4ARP023	O-RING ID 26.70X1.78 SILICONE	2
V1S4135X40	O-RING ID135.00X4.00 SILICONE	2
V1S4085X25	O-RING ID 8.50X2.50 SILICONE	12
V1S4057X19	O-RING ID 5.70X1.90 SILICONE	6
V1S4026X19	O-RING ID 2.60X1.90 SILICONE	5
V1S4022X16	O-RING ID 2.20X1.60 SILICONE	2
V1S4020X20	O-RING ID 20.00X2.00 SILICONE	10
V1S400PDR3	RUBBER SEPTUM-SMALL SILICONE GREY	5
V1S4004X10	O-RING ID 4.00X1.00 SILICONE	5
V1S1302007	LIPSEAL FOR ST.ASS.V- 7S FPM BLACK - NON FDA	4
V1S1302001	LIPSEAL FOR ST.ASS.V-10A FPM - FDA COMPLIANT	2
V0W3300006	TWIST LOCK 22.9 - 25.4MM	10
V0W3300005	TWIST LOCK 14.0 - 16.5MM	10
V0W0700001	TUBING CLAMP	6
V0W0530005	REDUCER MALE-MALE 1/16"-3/16"	3
V0W0530004	REDUCER MALE-MALE 1/8"-3/16"	1
V0W0430002	T-CONNECTOR 1/8"-1/8"-1/8"	2
V0W0430001	T-CONNECTOR 3/16"-3/16"-3/16"	1
V0R9900101	ALLEN KEY 1.5 MM	1
V0R9900007	COMP. STORAGE BOX 312x238x51MM, 21 DIVIDERS	1
V0R1451010	CABLE TIE BLACK 92X2.3 MM	25
V0N0000093	KWIK CLAMP PA HOSE OD 9.1-11.0MM	12
V0N0000091	KWIK CLAMP PA HOSE OD 6.5-8.2MM	4
V0N0000090	KWIK CLAMP PA HOSE OD 5.5-6.8MM	6