

# Xcellerex™ XDR-10 Benchtop Bioreactor System

## Operating Instructions

Original instructions



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# 1 Introduction

## About this chapter

This chapter contains important user information and regulatory information about XDR-10 Benchtop Bioreactor System.

---

## In this chapter

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## 1.1 About this manual

### Purpose of this manual

The *Operating Instructions* provides operator, supervisor and administrator with the instructions needed to install, operate and maintain XDR-10 Benchtop Bioreactor System in a safe way.

---

### Typographical conventions

Software items are identified in the text by ***bold italic*** text. A colon separates menu levels, thus ***File:Open*** refers to the ***Open*** command in the ***File*** menu.

Hardware items are identified in the text by **bold** text (for example, **Power**).

---

## 1.2 Important user information

### Introduction

This section contains important information regarding XDR-10 Benchtop Bioreactor System and this manual.

---

### Read this before operating XDR-10 Benchtop Bioreactor System



**All users must read the entire *Operating Instructions* before installing, operating or maintaining XDR-10 Benchtop Bioreactor System.**

Always keep the *Operating Instructions* at hand when operating XDR-10 Benchtop Bioreactor System.

Do not operate XDR-10 Benchtop Bioreactor System in any other way than described in the user documentation. If you do, you may be exposed to hazards that can lead to personal injury and you may cause damage to the equipment.

---

### Intended use of XDR-10 Benchtop Bioreactor System

XDR-10 Benchtop Bioreactor System is a small-scale stirred-tank bioreactor intended for researching, developing and manufacturing of biologics or drugs.

XDR-10 Benchtop Bioreactor System is not a medical device and shall not be used in any clinical procedures, or for diagnostic purposes.

---

### Prerequisites

In order to operate XDR-10 Benchtop Bioreactor System in a safe way and according to its intended use, the following prerequisites must be fulfilled:

- You should be acquainted with the use of general laboratory equipment and with handling of biological materials.

## 1 Introduction

### 1.2 Important user information

- You must read and understand the *Safety instructions* chapter in this manual.
  - The system must be installed by a GE representative.
  - Supervisors and Administrators must be familiar with basic operations in Microsoft® Windows® operating system.
- 

## Safety notices

This user documentation contains safety notices (WARNING, CAUTION, and NOTICE) concerning the safe use of the product. See definitions below.



### WARNING

**WARNING** indicates a hazardous situation which, if not avoided, could result in death or serious injury. It is important not to proceed until all stated conditions are met and clearly understood.



### CAUTION

**CAUTION** indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. It is important not to proceed until all stated conditions are met and clearly understood.



### NOTICE

**NOTICE** indicates instructions that must be followed to avoid damage to the product or other equipment.

## Notes and tips

**Note:** A note is used to indicate information that is important for trouble-free and optimal use of the product.

**Tip:** A tip contains useful information that can improve or optimize your procedures.

---

## 1.3 Regulatory information

### Introduction

This section lists the directives and standards that are fulfilled by XDR-10 Benchtop Bioreactor System.

---

### Manufacturing information

The following table summarizes the required manufacturing information. For further information, see the the EC Declaration of Conformity document.

| Requirements                     | Content                                                                             |
|----------------------------------|-------------------------------------------------------------------------------------|
| Name and address of manufacturer | GE Healthcare Bio-Sciences Corp.<br>14 Walkup Drive<br>Westborough, MA 01581<br>USA |

### International standards

The standard requirements fulfilled by this product are summarized in the following table.

| Standard          | Description                                                                                                 | Notes                                                       |
|-------------------|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| EN 61326-1:2006   | Electrical Equipment for Measurement, Control, and Laboratory Use - EMC requirements.                       | EN standard is harmonized with EU directive 2006/42/EC.     |
| EN ISO 12100:2010 | Safety of machinery. Basic concepts, general principles for design. Part 1: Basic terminology, methodology. | EN ISO standard is harmonized with EU directive 2006/42/EC. |
| EN 60204-1:2006   | Safety of Machinery - Electrical equipment of machines. Part 1: General requirements.                       |                                                             |

Conformity with EU directives

This product complies with the European directives listed in the following table, by fulfilling the corresponding harmonized standards. A copy of the Declaration of Conformity is available on request.

| Directive    | Title                                                                                   |
|--------------|-----------------------------------------------------------------------------------------|
| 2004/108/EC  | Electromagnetic Compatibility Directive (EMC)                                           |
| 2006/42/EC   | Machinery Directive (MD)                                                                |
| 2002/96/EC   | Waste Electrical and Electronic Equipment (WEEE) Directive                              |
| 1907/2006/EC | Registration, Evaluation, Authorization and Restriction of CHemicals (REACH) Regulation |

CE marking



The CE marking and the corresponding EC Declaration of Conformity is valid for the instrument when it is:

- used as a stand-alone unit, or
- connected to other products recommended or described in the user documentation, and
- used in the same state as it was delivered from GE, except for alterations described in the user documentation.

Regulatory compliance of connected equipment

Any equipment connected to this product should meet the safety requirements of EN 60204-1:2006 or relevant harmonized standards. Within the European Union, connected equipment must be CE marked.



## 1.4 Abbreviations

The following terms and abbreviations are used in the user documentation for XDR-10 Benchtop Bioreactor System:

| Term/Abbreviation | Definition                               |
|-------------------|------------------------------------------|
| ACD               | aseptic connection device                |
| CV                | controlled variable                      |
| CVHL              | controlled variable high limit           |
| CVLL              | controlled variable low limit            |
| DB                | deadband                                 |
| DO                | dissolved oxygen                         |
| MFC               | mass flow controller                     |
| MV system         | multi-vessel system                      |
| OUR               | oxygen uptake rate                       |
| PID               | proportional integral derivative         |
| PLC               | programmable logic controller            |
| PV                | process variable                         |
| RTD               | resistance temperature detector          |
| SAT               | Site Acceptance Testing                  |
| SCADA             | supervisory control and data acquisition |
| SP                | setpoint                                 |
| SPHL              | setpoint high limit                      |
| SPLL              | setpoint low limit                       |
| SV system         | single-vessel system                     |
| UPS               | uninterruptible power supply             |
| XDR               | Xcellerex Disposable Reactor             |

# 2 Safety instructions

## About this chapter

This chapter describes safety precautions and emergency shutdown procedures for XDR-10 Benchtop Bioreactor System. The labels on the system, information regarding recycling and security levels are also described.

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## 2.1 Safety precautions

### Introduction

The safety precautions in this section are grouped in following categories:

- General precautions
  - Flammable liquids and explosive environment
  - Personal protection
  - Installing and moving
  - Power supply
  - System operation
  - Maintenance
- 

### General precautions



#### **WARNING**

**Awareness of all hazards.** Before installing, operating or maintaining XDR-10 Benchtop Bioreactor System, all users must read and understand the entire contents of this chapter to become aware of the hazards involved.

Failure to do this may cause human injury or death, or damage to the equipment.



#### **WARNING**

**Operate as described.** Do not operate XDR-10 Benchtop Bioreactor System in any other way than described in the instrument user documentation.

## 2 Safety instructions

### 2.1 Safety precautions



#### WARNING

**Qualification.** The customer must make sure that all installation, maintenance, operation and inspection is carried out by qualified personnel who are adequately trained, understand and adhere to local regulations and the operating instructions, and have a thorough knowledge of XDR-10 Benchtop Bioreactor System and the entire process.



#### WARNING

**Damaged system.** Do not use XDR-10 Benchtop Bioreactor System if it is not working properly, or if it has suffered any damage, for example:

- damage to the power cord or its plug
- damage caused by dropping the equipment
- damage caused by splashing liquid onto it.



#### CAUTION

**Moving parts.** Use caution close to moving parts, stored energy, pressurization, and electrical sources.

## Moving and unpacking



#### WARNING

**Squeezing or crushing injuries.** Be very careful to avoid any risk of injury, and especially squeezing or crushing injuries, when moving the system.

**WARNING**

**Properly balanced system.** Note that crates may not be marked

with a center of gravity symbol.



Make sure that the crates are properly balanced and centered over the forks of the lifting equipment so that they will not accidentally tip when moved.

**WARNING**

**Safety of personnel.** Packing crates shall only be moved by personnel with appropriate training, and in adherence with local regulations.

Even if the instructions in the *Operating Instructions* are followed, it is the responsibility of the customer to guarantee the safety of personnel while working with the system.

**WARNING**

**Use properly sized lifting system.** Lifting equipment must support both sides of the frame. The frame and lifting equipment must be balanced so that neither can tip over.

**WARNING**

**Risk of tipping.** Pay extra attention when moving the system to make sure that the system does not tip.

**CAUTION**

**Risk of damaging the instrument tower.** The instrument tower may be damaged if the polystyrene foam is removed before sliding the instrument tower onto the bench.

**CAUTION**

**Assistance when lifting the system.** It requires two persons to remove the instrument tower from the crate.

## 2 Safety instructions

### 2.1 Safety precautions



#### CAUTION

**Correct recycling of the crates.** Packing crates may have been exposed to pesticides, depending on the regulations of the country of delivery. Recycle packing crates according to local recommendations for pesticide-treated wood.



#### CAUTION

**Assistance when unpacking the system.** To avoid injury to yourself, or damage to the system components, have two or more assistants help you unpack the components from the crates.



#### NOTICE

The design of a crate is subject to change by the manufacturer. Use the unpacking instructions only as guidelines for unpacking the crates.



#### NOTICE

XDR-10 Benchtop Bioreactor System is designed for indoor use only.



#### NOTICE

Perform all assembly and handling of material on clean, non-ferritic surfaces.

## Flammable liquids and explosive environment



### WARNING

**Fire and explosive hazard.** Follow the instructions below to avoid a fire or explosion when using oxygen:

- Monitor oxygen flow rates displayed on the user interface.
- Check for leaks, poor connections, or damages to the equipment prior to use.
- Use proper ventilation when operating the bioreactor using oxygen.
- Do NOT expel oxygen into an enclosed space.



### WARNING

**Use correct tubing.** Only the gas tubing specified by GE must be used. Using other gas tubing may result in a possible gas leak.



### WARNING

**Gas shut-off valves.** Gas shut-off valves that can be physically locked out for servicing must be installed on the facility gas supplies.



### WARNING

**Do not work in an explosive atmosphere.** XDR-10 Benchtop Bioreactor System is not designed to handle flammable fluids. XDR-10 Benchtop Bioreactor System is not approved for work in a potentially explosive atmosphere, in areas classified as Zone 0 to Zone 2 according to IEC 60079-10 2002.

#### Personal protection



##### WARNING

**Slipping hazard.** Remove any spillage on the floor immediately to minimize the risk for slipping accidents.



##### WARNING

**Hazardous substances.** When using hazardous chemical and biological agents, take all suitable protective measures, such as wearing protective glasses and gloves resistant to the substances used. Follow local and/or national regulations for safe operation and maintenance of the system.



##### WARNING

**Pinch hazard.** Keep fingers clear of the space between the agitator base and the agitator drive head. Strong magnets will pull these two pieces together.



##### WARNING

**STRONG magnets.** Magnets may interfere with functioning of pacemakers or implanted heart defibrillators and cause DEATH or SERIOUS INJURY. Magnets are located on the bottom of XDR-10 Benchtop Bioreactor System, and in the impeller assembly of the disposable bags.

- OBSERVE and follow instructions for installation, operation, and maintenance of XDR-10 Benchtop Bioreactor System.
- KEEP a safety distance of 25 cm or more from the magnets to avoid exposure of magnetic field greater than 0.5 mT (5 G).
- Warn other people who wear pacemakers or implanted heart defibrillators from getting too close to the magnets.





**WARNING**

**Personal protective equipment.** Whenever packing, unpacking, transporting or moving the system, wear personal protective equipment.



**WARNING**

**Personal protective equipment.** For personal safety during the transportation, installation, operation and maintenance of the system, always use protective glasses and other personal protective equipment appropriate for the current application. The following personal protective equipment should always be available:

- Protective glasses
- Working gloves to protect against sharp edges
- Protective footwear
- Disposable gloves

Always use clean disposable gloves when manually handling parts.

## Installing and moving



**WARNING**

**Installation.** Installation and relocation of the instrument must be performed by a GE representative.



**WARNING**

**Access to power switch.** The power switch must always be easy to access.



**WARNING**

**Access to power cord.** The power cord must always be easy to disconnect.

## 2 Safety instructions

### 2.1 Safety precautions



#### WARNING

**Access to power supply circuit breaker.** The power supply circuit breaker must always be easy to access.



#### CAUTION

**Tripping hazard.** Make sure that all tubing, hoses and cables are placed so that the risk for tripping accidents is minimized.



#### CAUTION

**Indoor use only.** The bioreactor is designed for indoor use only.



#### CAUTION

**Dusty and damp atmosphere.** Do not use this instrument in a dusty atmosphere or close to spraying water.



#### CAUTION

**Inspect cables.** Cables need to be inspected for wear and damage. Replace before re-powering system.

## Power supply



#### WARNING

**High voltage.** It is essential for the safety of personnel working in or around electrically powered equipment to follow a company policy and procedure for Lock-Out / Tag-Out (LOTO).



#### WARNING

**High voltage.** XDR-10 Benchtop Bioreactor System must always be connected to a grounded power outlet.



#### WARNING

**Qualification.** Make sure that replacement of fuses is carried out by qualified personnel who are adequately trained, understand, adhere to local regulations and XDR-10 Benchtop Bioreactor System *Operating Instructions*, and have a thorough knowledge of the XDR-10 Benchtop Bioreactor System.



#### WARNING

**Installation.** All electrical installation must be performed by authorized personnel only.

## System operation



#### WARNING

**Gas leakage hazard.** Make sure that the gas connections are tight in order to avoid gas leakage.



#### WARNING

**Gas leakage hazard.** To prevent any gas leakage, always switch off all gas supplies when the system is not in use.



#### CAUTION

**Quality of gases.** The gases supplied to the system should be clean, filtered, and pharmaceutical quality. Failure to use pharmaceutical quality filtered gases could result in malfunction of flow control valves and gas supply solenoids.



#### CAUTION

**Magnetic components.** Use caution when handling magnetic components. There is a strong magnetic attraction between the impeller and the motor drive coupling.

## 2 Safety instructions

### 2.1 Safety precautions



#### CAUTION

**Safe operation of software.** To safely operate the bioreactor, knowledge of how to use system operating software is required.



#### CAUTION

**Pinch hazard.** Do not operate the pumps without the covers in place.



#### CAUTION

**Tuning PID control loops.** Make sure that personnel tuning PID control loops are qualified to perform this task. Incorrectly tuned PID loops could cause injury to personnel and damage the instrument.



#### CAUTION

**Changing split range setup.** Only qualified personnel should change the split range percentage. Incorrectly set up split range could cause injury to personnel and damage the instrument.



#### CAUTION

**Inspect cables.** Cables need to be inspected for wear and damage. Replace damaged cables before connecting power to the system.

## Maintenance



#### WARNING

**Trained personnel.** Maintenance of the instrument must be performed by properly trained personnel only.



#### WARNING

**Electric shock hazard.** All repairs should be done by service personnel authorized by GE. Do not open any covers or replace parts unless specifically stated in the user documentation.



#### WARNING

**Turn off equipment.** Turn off XDR-10 Benchtop Bioreactor System and Lock-Out / Tag-Out (LOTO) any equipment before doing electrical maintenance.



#### WARNING

**Cleaning.** Always clean the equipment in a well ventilated area. Never immerse any part of the equipment in liquid or spray liquid on the equipment. Always make sure that the equipment is completely dry before plugging it in. Always follow all environmental, health, and safety guidelines pertaining to the materials used.



#### WARNING

**Spare parts.** Only spare parts that are approved or supplied by GE may be used for maintaining or servicing the system.



#### CAUTION

**Contamination hazard.** Before performing any service work on the instrument, make sure that the system has been properly decontaminated.

## 2.2 Labels

### Introduction

This section describes the various labels on XDR-10 Benchtop Bioreactor System and their meaning.

---

### System label

The system label is located on the back of the instrument tower or Mini X-Station, depending on your instrument model. The image below shows the location of the label.



The illustration below shows an example of a system label.

**Note:** The specific label below is only an example without values. Actual data printed on the system label is specific for each individual system and may vary from system to system.

|                                                                                   |                                                                                   |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|
|  |  |
|                                                                                   | GE Healthcare Bio-Sciences Corp.<br>14 Walkup Drive Westborough, MA 01581         |
| Serial No                                                                         |                                                                                   |
| Model                                                                             |                                                                                   |
| Year of Mfg                                                                       |                                                                                   |
| Voltage/Phase/<br>Frequency                                                       |                                                                                   |
| Full Load<br>Amps                                                                 |                                                                                   |
| Largest Motor                                                                     |                                                                                   |
| Max Power                                                                         |                                                                                   |
| SCCR                                                                              |                                                                                   |
| Pneumatic<br>Supply                                                               |                                                                                   |
| Protection<br>Class                                                               |                                                                                   |
| Diagram                                                                           |                                                                                   |
| Made in USA                                                                       |                                                                                   |

The system label information is explained in the table below.

| Label text/image        | Description                                                      |
|-------------------------|------------------------------------------------------------------|
| Serial No               | Serial number of the system.                                     |
| Model                   | Model number of the system.                                      |
| Year of Mfg             | The year the system was built.                                   |
| Voltage/Phase/Frequency | Electrical power requirements in Volts (V)/Phase/Frequency (Hz). |
| Full Load Amps          | Maximum amount of current the system draws (A).                  |
| Largest Motor           | Horsepower rating of the motor (hp).                             |
| Max Power               | Maximum power the system could draw (kVA).                       |
| SCCR                    | Short circuit current rating (A).                                |
| Pneumatic Supply        | Gas input pressure (bar or psi).                                 |
| Protection Class        | Instrument tower ingress protection.                             |
| Diagram                 | Electrical schematic of AC distribution.                         |



## Regulatory label

Regulatory label is located below the system label on the XDR-10 Benchtop Bioreactor System.

The illustration below shows an example of a regulatory label.



The regulatory label information is explained in the following table.

| Label image                                                                         | Description                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <b>Warning!</b> Do not use XDR-10 Benchtop Bioreactor System before reading the XDR-10 Benchtop Bioreactor System <i>Operating Instructions</i> . Do not open any covers or replace parts unless specifically stated in the user documentation.                                   |
|    | This symbol indicates that the product contains hazardous materials in excess of the limits established by the Chinese standards SJ/T11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in Electronics.                                            |
|  | This symbol indicates that electrical and electronic equipment must not be disposed of as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of equipment. |
|  | The system complies with applicable European directives.                                                                                                                                                                                                                          |

Safety labels

The table below describes the various safety labels that are located on the parts of XDR-10 Benchtop Bioreactor System.

| Safety label                                                                        | Description                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <b>Warning! Burn Hazard/Hot Surface.</b> The heaters should be allowed to cool before being serviced.                                                                                                                                                                                    |
|    | <b>Warning! Rotating Parts/Cutting of Fingers.</b> Motor magnetic shaft should be completely stopped prior to servicing instrument.                                                                                                                                                      |
|    | <b>Warning! High Pressure.</b> The gases operate under high pressure. Do not open gas lines. Servicing gas lines is reserved for authorized service engineers. Wear protective glasses and read service manual prior to servicing gas lines. Maximal allowed pressure 5.4 bar (80 psig). |
|   | <b>Warning! Heavy Object.</b> Use proper lifting techniques when removing or replacing the I/O Cabinet.                                                                                                                                                                                  |
|  | <b>Warning! Hazardous voltage.</b> Disconnect power before servicing or cleaning.                                                                                                                                                                                                        |
|  | <b>Warning! Hazardous voltage will cause severe injury or death.</b> Turn off power and lock out before service.                                                                                                                                                                         |
|  | <b>Warning! High Voltage.</b> Turn off power and lock out before service.                                                                                                                                                                                                                |

| Safety label                                                                                                                                                                                                                                                                                                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                | <p><b>Warning! Fire or explosion hazard when using oxygen.</b> Follow the instructions below to avoid a fire or explosion when using oxygen.</p> <ul style="list-style-type: none"> <li>• Monitor oxygen flow rates displayed on the user interface.</li> <li>• Check for leaks, poor connections, or damages to the equipment prior to use.</li> <li>• Use proper ventilation when operating XDR-10 Benchtop Bioreactor System with oxygen.</li> <li>• Do NOT expel oxygen into an enclosed space.</li> </ul>                                                                                                                                                                                                             |
|  <div> <p><b>⚠ WARNING</b><br/> MAGNETIC FIELDS<br/> LOCATED IN THIS AREA.<br/> Can be harmful to<br/> pacemakers and other<br/> sensitive equipment.</p> </div>  | <p><b>Warning! STRONG magnets.</b> Magnets may interfere with functioning of pacemakers or implanted heart defibrillators and cause DEATH or SERIOUS INJURY. Magnets are located on the bottom of the XDR-10 Benchtop Bioreactor System, and in the impeller assembly of the bags.</p> <ul style="list-style-type: none"> <li>• OBSERVE and follow instructions for installation, operation, and maintenance of XDR-10 Benchtop Bioreactor System.</li> <li>• KEEP a safety distance of 25 cm or more from the magnets to avoid exposure of magnetic field greater than 0.5 mT (5 G).</li> <li>• Warn other people who wear pacemakers or implanted heart defibrillators from getting too close to the magnets.</li> </ul> |

## 2.3 Emergency procedures

### Introduction

This section describes how to do an emergency shutdown of XDR-10 Benchtop Bioreactor System, what happens as the result of power failure, and the procedure for restarting XDR-10 Benchtop Bioreactor System.

### Emergency shutdown of instrument tower

| Step | Action                                                                                                                                                                                                                | Result                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Press the <b>EMERGENCY STOP</b> button.</p>   | <ul style="list-style-type: none"><li>• <b>E-Stop Active</b> will be displayed in the <i>Reactor Display</i> window.</li></ul>  <ul style="list-style-type: none"><li>• All control loops are forced into manual mode with the CVs set to a safe value.</li><li>• All MFCs and pumps stop.</li><li>• Data logging continues.</li></ul> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Result                                                 |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
| 2    | <p>If required:</p> <ul style="list-style-type: none"><li>Switch off the mains power supply on the switch located on the back of the instrument tower to the 0-position.</li></ul> <div>The image shows the back of a grey instrument tower. At the top is a black rectangular panel. Below it, on the left, is a white label with technical specifications and safety warnings. To the right of the label is a black power switch with a white 'I' and 'O' indicator. Below the switch is a power cord connection point. A yellow callout box highlights the power switch and the connection point. The switch is currently in the 'I' position.</div> <ul style="list-style-type: none"><li>Disconnect the power cord.</li><li>Switch off the fixed power supply circuit breaker.</li></ul> <p><b>Note:</b><br/><i>The circuit breaker is provided by the user. The location of the circuit breaker varies.</i></p> | <p>All power is removed from the instrument tower.</p> |

Emergency shutdown of Mini X-Station

| Step | Action                                                                                                                                       | Result                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Press the <b>EMERGENCY STOP</b> button.</p> <div></div> | <ul style="list-style-type: none"><li>• <b>E-Stop Active</b> will be displayed in the <i>Reactor Display</i> window.</li></ul> <div></div> <ul style="list-style-type: none"><li>• All control loops are forced into manual mode with the CVs set to a safe value.</li><li>• All MFCs and pumps stop.</li><li>• Data logging continues.</li></ul> |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Result                                               |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|
| 2    | <p>If required:</p> <ul style="list-style-type: none"><li>Switch off the mains power supply on the switch located on the back of the Mini X-Station to the <b>0</b>-position.</li></ul>  <ul style="list-style-type: none"><li>Disconnect the power cord.</li><li>Switch off the fixed power supply circuit breaker.</li></ul> <p><b>Note:</b><br/><i>The circuit breaker is provided by the user. The location of the circuit breaker varies.</i></p> | <p>All power is removed from the Mini X-Station.</p> |

Power interruption

The consequences of power interruption to XDR-10 Benchtop Bioreactor System is described in the table below.

| Equipment        | Backup power                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Instrument tower | <p><b>Reactor Summary</b> window will show that the connectivity is lost. The following X-symbol will be displayed on the computer screen for each input that cannot be collected:</p> <div></div> <p>The instrument tower does not contain backup power system.<br/>Backup power will be dependent on site backup power.<br/>The instrument tower will power off and data will not be collected. Data that has already been collected will not be lost.<br/>A running batch will be placed in a held state.</p> |
| Laptop           | <p>The laptop has battery backup power.</p> <p>The process will continue to run as normal and data will continue to be collected until the battery power runs out. The time frame depends on number of applications running.</p> <p>When the battery power is exhausted, the laptop will shut down automatically and and data will no longer be collected.</p>                                                                                                                                                                                                                                    |
| XDR vessel       | <p>The XDR vessel gets power from the instrument tower. See information above.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |



## Restart after emergency shutdown

Follow the instructions below to restart XDR-10 Benchtop Bioreactor System after emergency shutdown or power failure.

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Make sure that the condition that caused the emergency shutdown is corrected.                                                                                                                                                                                                                                                                                                                                                                   |
| 2    | <p>Disengage the <b>EMERGENCY STOP</b> by following the instructions below:</p> <ol style="list-style-type: none"> <li>1 Turn the <b>EMERGENCY STOP</b> clockwise.</li> </ol>  <ol style="list-style-type: none"> <li>2 Pull the <b>EMERGENCY STOP</b> outwards.</li> </ol>  |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>Press the <b>ENABLE</b> button that is located under the <b>EMERGENCY STOP</b> button.</p> <div><br/></div> <p><i>Result: <b>E-stop Active</b> will no longer be displayed on the <b>Reactor Display</b> window. Control and data logging will resume.</i></p> |
| 4    | <p>Verify the status of all PID control loops and setpoints. For more information see the Wonderware™ manufacturer's documentation.</p>                                                                                                                                                                                                                                                                                              |

**Note:** *It may take up to 10 minutes for the computer system to boot. While the laptop is booting and starting up background applications, no process will run and data is not collected or saved.*

2.4 Interlocks

| If...                                                                                 | Then...                                              |
|---------------------------------------------------------------------------------------|------------------------------------------------------|
| bag pressure exceeds 0.048 bar (0.7 psig)                                             | interlocks shut off mass flow controllers and pumps. |
| the system has a balance and the vessel is empty                                      | there is no interlock.                               |
| the system has a balance and vessel weight exceeds 110% of the nominal working volume | interlocks shut off mass flow controllers and pumps. |

## 2.5 Security levels

### Introduction

This section contains important information regarding XDR-10 Benchtop Bioreactor System software modes and security levels.

---

### Overview

The XDR-10 Benchtop Bioreactor System software has two modes:

- View only
- Operation

All users can access the view only mode.

The operation mode has three security levels:

- Operator
- Supervisor
- Administrator

**Note:** *The roles of operator, supervisor and administrator are appointed by the customer.*

---

### View only mode

All users can access the view only mode by logging out. This mode enables you to navigate and view the status conditions and alarms. The list below shows which functions of XDR-10 Benchtop Bioreactor System are accessible in view only mode. See [Appendix B User interface description, on page 283](#) and [Chapter 7 Operation, on page 139](#) for description of the various functions described below.

- Access and view the windows from the header toolbar
- Open, view and configure trends
- Open and view PID faceplate dialog boxes
- Start and shut down the viewer software

**Note:** *Shutting down the viewer software does not change any setpoints or current control values of the system.*

---

## Operation mode

The operation mode enables you to modify functions of the XDR-10 Benchtop Bioreactor System. The table below shows access levels for individual system functions. See [Appendix B User interface description, on page 283](#) for description of system functions that are described in the table below.

**Note:** The security level clearance (✓/✗) applies to all entries in respective columns.

| System functions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Security level |            |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------|---------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Operator       | Supervisor | Administrator |
| <ul style="list-style-type: none"><li>• Acknowledge alarms</li><li>• Adjust setpoints (SP)</li><li>• Adjust controlled variables (CV)</li><li>• Calibrate (change offsets for):<ul style="list-style-type: none"><li>- DO probe</li><li>- Exhaust filter temperature</li><li>- pH probe</li><li>- Vessel temperature</li></ul></li><li>• Calibrate the pumps</li><li>• Change current user password</li><li>• Change PID control loop modes (<b>Remote/Local</b> and <b>Auto/Manual</b>)</li><li>• Configure setpoint tables</li><li>• Edit gas flow paths</li><li>• Enable and disable agitator</li><li>• Map and unmap PID control loops</li><li>• Measure oxygen uptake rate</li><li>• Operate MFC totalizer</li><li>• Operate pump totalizer</li><li>• Start, stop, abort, reset batches</li><li>• Switch between probe channels (A/B)</li><li>• Tare bag pressure</li><li>• Tare vessel weight</li></ul> | ✓              | ✓          | ✓             |

| System functions                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Security level                                                                      |                                                                                     |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Operator                                                                            | Supervisor                                                                          | Administrator                                                                         |
| <ul style="list-style-type: none"> <li>Adjust alarm settings</li> <li>Adjust range defining parameters CVHL, CVLL, SPHL, SPL for: <ul style="list-style-type: none"> <li>- Agitator</li> <li>- Auxiliary inputs</li> <li>- Dissolved oxygen</li> <li>- Exhaust filter temperature</li> <li>- Mass flow controllers</li> <li>- pH</li> <li>- Pumps</li> <li>- Vessel temperature</li> <li>- Vessel weight</li> </ul> </li> <li>Enable and disable alarms</li> <li>Exit software</li> </ul> |    |    |    |
| <ul style="list-style-type: none"> <li>Add, disable and remove user accounts</li> <li>Adjust PID control loop tuning parameters (P, I, D, DB) for: <ul style="list-style-type: none"> <li>- Auxiliary inputs</li> <li>- Dissolved oxygen</li> <li>- pH</li> <li>- Vessel weight</li> </ul> </li> </ul>                                                                                                                                                                                    |  |  |  |

## 2.6 Recycling information

### Introduction

This section contains information about the decommissioning of XDR-10 Benchtop Bioreactor System.

---

### Decontamination

The instrument shall be decontaminated before decommissioning and all local regulations shall be followed with regard to scrapping of the equipment.

---

### Disposal

When taking the bioreactor system out of service, the different materials must be separated and recycled according to national and local environmental regulations.

---

### Recycling of hazardous substances

The instrument contains hazardous substances. Detailed information is available from your GE representative.

---

### Disposal of electrical components



Waste electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of the equipment.

---



## Instructions for disposal

Follow the instructions below for disposal of XDR vessel and control unit:

| Step | Action                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Separate all electronic components (terminal strips, power supplies, transmitters, pumps, probes / sensors, etc.) from the control unit and XDR vessel.                                                                                                                                        |
| 2    | Decontaminate the XDR vessel and the instrument tower following appropriate procedures dependent on what type of environment the unit was located in. Contact the local processing facility or government official for specific disposal requirements for the vessel and the instrument tower. |
| 3    | Decontaminate the probes and sensors that have come into contact with the process fluid. Dispose of the fluid by following the disposal of hazard materials according to the facility the unit is located in.                                                                                  |
| 4    | Dispose of electronic components as specified by local guidelines depending on material used in the construction of the components. Contact the local processing facility or government official for specific disposal requirements.                                                           |

## 2.7 Declaration of Hazardous Substances (DoHS)

### Introduction

The following product pollution control information is provided according to SJ/T11364-2006 Marking for Control of Pollution caused by Electronic Information Products.

根据SJ/T11364-2006《电子信息产品污染控制标识要求》特提供如下有关污染控制方面的信息

### Symbols used in pollution control label

#### 电子信息产品污染控制标志说明

| Label                                                                             | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>This symbol indicates the product contains hazardous materials in excess of the limits established by the Chinese standard SJ/T11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Products. The number in the symbol is the Environment-friendly Use Period (EFUP), which indicates the period during which the toxic or hazardous substances or elements contained in electronic information products will not leak or mutate under normal operating conditions so that the use of such electronic information products will not result in any severe environmental pollution, any bodily injury or damage to any assets. The unit of the period is "Year".</p> <p>In order to maintain the declared EFUP, the product shall be operated normally according to the instructions and environmental conditions as defined in the product manual, and periodic maintenance schedules specified in Product Maintenance Procedures shall be followed strictly.</p> <p>Consumables or certain parts may have their own label with an EFUP value less than the product. Periodic replacement of those consumables or parts to maintain the declared EFUP shall be done in accordance with the Product Maintenance Procedures.</p> <p>This product must not be disposed of as unsorted municipal waste, and must be collected separately and handled properly after decommissioning.</p> |

| Label                                                                             | Meaning                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | <p>该标志表明本产品含有超过SJ/T11363-2006《电子信息产品中有毒有害物质的限量要求》中限量的有毒有害物质。标志中的数字为本产品的环保使用期，表明本产品在正常使用的条件下，有毒有害物质不会发生外泄或突变，用户使用本产品不会对环境造成严重污染或对其人身、财产造成严重损害的期限。单位为年。</p> <p>为保证所声明的环保使用期限，应按产品手册中所规定的环境条件和方法进行正常使用，并严格遵守产品维修手册中规定的期维修和保养要求。</p> <p>产品中的消耗件和某些零部件可能有其单独的环保使用期限标志，并且其环保使用期限有可能比整个产品本身的环保使用期限短。应到期按产品维修程序更换那些消耗件和零部件，以保证所声明的整个产品的环保使用期限。</p> <p>本产品在使用寿命结束时不可作为普通生活垃圾处理，应被单独收集妥善处理</p> |

## List of hazardous substances and their concentrations

产品中有毒有害物质或元素的名称及含量

Indication for each major part if substance exceeds limit

| Value | Meaning                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| O     | <p>Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.</p> <p>表示该有毒有害物质在该部件所有均质材料中的含量均在SJ/T11363-2006 标准规定的限量要求以下</p>                                                                                                                                                                                                                                  |
| X     | <p>Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.</p> <ul style="list-style-type: none"> <li>Data listed in the table represents best information available at the time of publication</li> </ul> <p>表示该有毒有害物质至少在该部件的某一均质材料中的含量超出SJ/T11363-2006 标准规定的限量要求</p> <ul style="list-style-type: none"> <li>此表所列数据为发布时所能获得的最佳信息</li> </ul> |

List of hazardous substances

| Component name <sup>1</sup><br>部件名称                            | Hazardous substance<br>有毒有害物质或元素 |         |         |             |             |               |
|----------------------------------------------------------------|----------------------------------|---------|---------|-------------|-------------|---------------|
|                                                                | Pb<br>铅                          | Hg<br>汞 | Cd<br>镉 | Cr6+<br>六价铬 | PBB<br>多溴联苯 | PBDE<br>多溴二苯醚 |
| XDR vessel (plastic supported by stainless steel rods, heater) | X                                | O       | O       | O           | O           | O             |
| Instrument tower                                               | X                                | O       | O       | O           | O           | O             |
| Laptop                                                         | X                                | O       | O       | O           | O           | O             |
| Balance                                                        | X                                | O       | O       | O           | O           | O             |
| Cables                                                         | X                                | O       | O       | O           | O           | O             |

<sup>1</sup> The product has not been tested as per the Chinese standard SJ/T11363-2006 *Requirements for Concentration Limits for Certain Hazardous Substances in Electronic Information Product*.

# 3 System description

## About this chapter

This chapter provides a description of XDR-10 Benchtop Bioreactor System and an overview of its components.

---

## In this chapter

| Section                     | See page |
|-----------------------------|----------|
| 3.1 Safety system           | 50       |
| 3.2 System overview         | 52       |
| 3.3 XDR vessel              | 54       |
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| 3.8 Auxiliary inputs        | 76       |
| 3.9 System connectivity     | 78       |

---

## 3.1 Safety system

### Introduction

XDR-10 Benchtop Bioreactor System is provided with several safety systems to guarantee the safety of personnel, equipment, and product.

---

### Emergency stop

The system is equipped with an emergency stop functionality. The purpose of the emergency stop is to halt the system in an emergency situation, such as an accident or a sudden unexpected release of the cell culture from the disposable bag. The emergency stop button is labeled **EMERGENCY STOP** and is located on the instrument tower or on the Mini X-Station, depending on your system.

The following illustration shows the location of the **EMERGENCY STOP** button on the instrument tower.



The following illustration shows the location of the **EMERGENCY STOP** button on Mini X-Station.



The **EMERGENCY STOP** is engaged by being pushed. See [Section 2.3 Emergency procedures, on page 32](#) for more detailed description.

---

## System labeling

The system is labeled to make operators aware of the hazards associated with system operation. These labels show important information which should be available to the user at all times during operation. All labels used on the system are described in this manual.

---

## Breakers and fuses

Each subcomponent in the XDR-10 Benchtop Bioreactor System is individually fused. This design protects the system from being completely disabled by a short circuit in a subcomponent. The fuses installed in the system are specified based on the expected quantity of electrical current consumed by each subcomponent, and by the type of load (inductive or non-inductive).

---

## 3.2 System overview

### Introduction

The following physical components are included in XDR-10 Benchtop Bioreactor System:

| Part                              | Function                                                                                                                               |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| XDR vessel                        | The XDR vessel is a plastic and stainless steel, cylindrically shaped container. It has the capacity to support a 10 L disposable bag. |
| Computer system                   | The computer system provides a software controlled environment for XDR-10 Benchtop Bioreactor System.                                  |
| Instrument tower (Mini X-Station) | The instrument tower connects the computer to the XDR vessel and provides control and measurement.                                     |
| Balance (optional)                | The balance is a weighing platform which measures the weight of the contents of the disposable bag.                                    |

### Single-vessel and multi-vessel systems

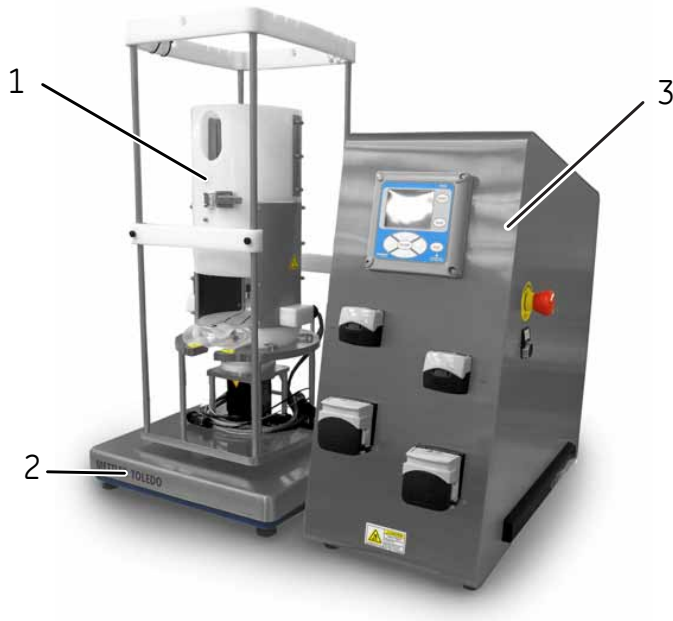
XDR-10 Benchtop Bioreactor System comes in two types, described in the table below.

| Part                      | Description                                                                                                                                                                           |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Single-vessel (SV) system | Includes: <ul style="list-style-type: none"><li>• 1 XDR Vessel</li><li>• 1 instrument tower</li><li>• 1 computer system (laptop; or may be installed in the Mini X-Station)</li></ul> |
| Multi-vessel (MV) system  | Includes: <ul style="list-style-type: none"><li>• 2-4 XDR vessels</li><li>• 2-4 instrument towers</li><li>• 1 computer system (laptop only)</li></ul>                                 |



## Illustration of the system

The following illustration shows an example of a single-vessel system. The computer system is free-standing (a laptop) and is not shown in this illustration.



| Part | Function         |
|------|------------------|
| 1    | XDR vessel       |
| 2    | Balance          |
| 3    | Instrument tower |

## 3.3 XDR vessel

### Description

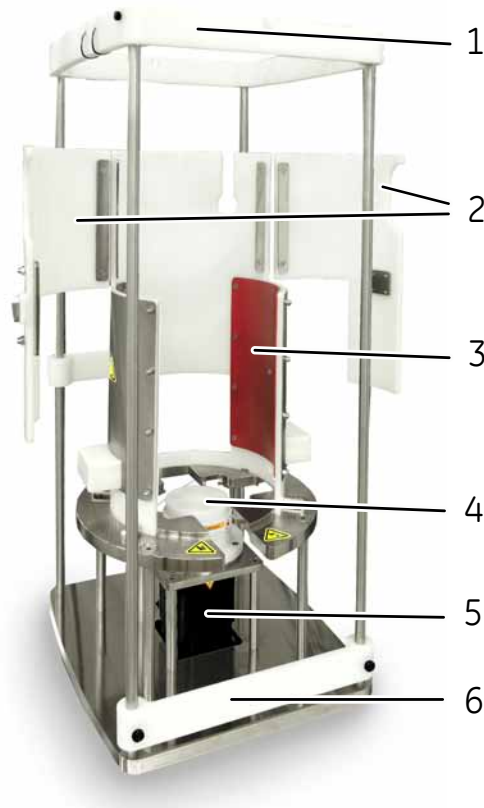
The XDR vessel is a plastic and stainless steel, cylindrically shaped container. It has the capacity to support a 10 L disposable bag. It comprises a single bag holder with built-in agitation assembly and heating blankets to provide temperature control of the process fluid within the disposable bag.

The environment within the disposable bag is monitored via an instrument tower or Mini X-Station, depending on product version. The XDR vessel also has integrated tubing manager and adjustable probe support bar, and the exhaust filter heater assembly.

The XDR vessel has double loading doors that provide access to the disposable bag during installation and removal of the bag. The doors are held closed by a clasp on the front of the XDR vessel.

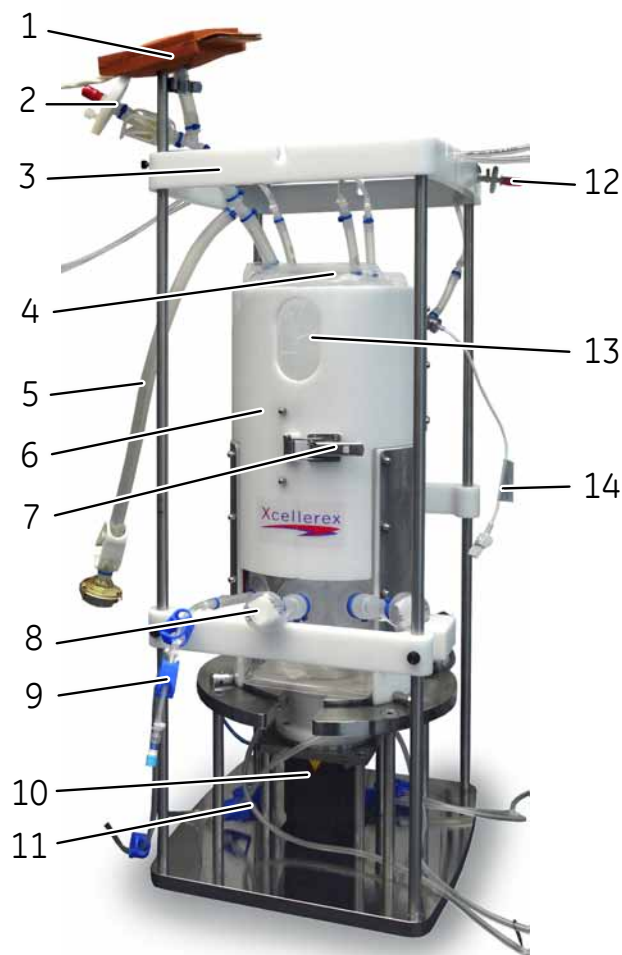
---

## Illustration of empty XDR vessel



| Part | Description                    |
|------|--------------------------------|
| 1    | Tubing manager                 |
| 2    | Vessel doors (open)            |
| 3    | Heating blankets               |
| 4    | Agitator drive head            |
| 5    | Agitator motor                 |
| 6    | Probe support bar (adjustable) |

Illustration of loaded XDR vessel



| Part | Description              |
|------|--------------------------|
| 1    | Exhaust filter heater    |
| 2    | Exhaust filter           |
| 3    | Tubing manager           |
| 4    | Disposable bag           |
| 5    | Feed port with tubing    |
| 6    | Plastic vessel container |

| Part | Description                          |
|------|--------------------------------------|
| 7    | Door clasp                           |
| 8    | pH/DO probe port                     |
| 9    | Sample port with tubing              |
| 10   | Agitator assembly                    |
| 11   | Sparge tubing                        |
| 12   | Headsweep (overlay) inlet gas filter |
| 13   | Viewing window                       |
| 14   | Bag pressure sensor                  |

## Heating blanket

The heating blankets are positioned in the lower part of the disposable bag holder. They are designed to maintain and control temperature in the disposable bag during operation. The heating blankets are behind an anodized aluminium plate, which helps to apply heat evenly.

---

## 3.4 Instrument tower

### Introduction

The instrument tower physically and logically connects the XDR vessel to the controller computer. It contains instrumentation for the measurement and control of pH and DO.

---

### Master instrument tower

The master instrument tower is the measurement and control system that includes field devices (for example transmitter, peristaltic pumps, mass flow controllers), a PLC and associated automation components.

---

### Slave instrument tower

The slave instrument tower is the measurement and control system that includes field devices (for example transmitter, peristaltic pumps, mass flow controllers) and associated automation components. The slave instrument tower does not contain a PLC.

---

### Programmable logic controller (PLC)

The programmable logic controller (PLC) is contained in the master instrument tower and controls and monitors the functions associated with the system, and communicates with devices and analyzers attached to the instrument tower.

---

### Computer

The computer uses an operator interface based on Wonderware software running on a Microsoft Windows computer. The Wonderware software also provides historical data collection.

Following tasks are performed by the server computer:

- Sends and receives data from the PLC.
- Stores history data.
- Performs data trending.
- Performs process control.
- Views data.

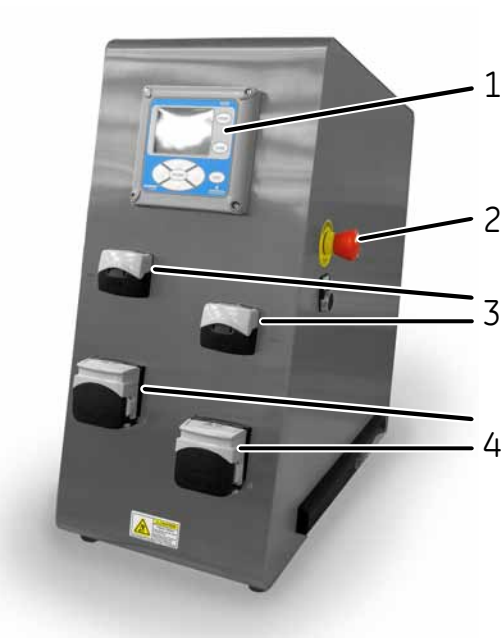
- Manages user credentials.

XDR-10 Benchtop Bioreactor System utilizes either a built-in computer system, a laptop or FlexFactory™ Automation System control for the server computer. These systems are described in the table below.

| Computer system                       | Description                                                                                                                                                                                                                                                                                          |
|---------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Laptop                                | The laptop utilizes Transmission Control Protocol/Internet Protocol (TCP/IP) to connect to the XDR-10 Benchtop Bioreactor System instrument tower. It controls one to four XDR vessels via the TCP/IP.                                                                                               |
| Built-in computer (Mini X-Station)    | An industrial computer is mounted in the Mini X-Station. The built-in computer incorporates a touchscreen panel PC into a control cabinet. The Mini X-Station can control up to one XDR vessel.                                                                                                      |
| FlexFactory Automation System control | If XDR-10 Benchtop Bioreactor System is part of the FlexFactory, the historian function and interaction with users are performed by FlexFactory Automation System. Viewing nodes, called Mobile Workstations, allow users in a manufacturing environment to control and view data about the process. |

Illustration of the instrument  
tower front

The following illustration shows an example of the instrument tower of a system with a free-standing laptop (not shown).



| Part | Description                                |
|------|--------------------------------------------|
| 1    | pH/DO transmitter                          |
| 2    | <b>EMERGENCY STOP</b> button               |
| 3    | Watson-Marlow™ peristaltic pumps model 114 |
| 4    | Watson-Marlow peristaltic pumps model 313  |



Illustration of the instrument  
tower back

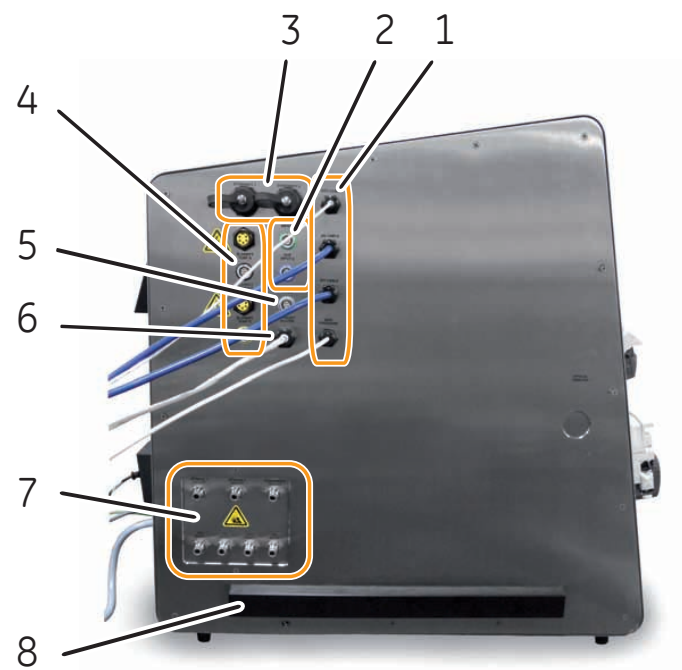
The following illustration shows an example of the instrument tower back side.



| Part | Description              |
|------|--------------------------|
| 1    | Ventilation hood         |
| 2    | System label             |
| 3    | Main power input         |
| 4    | <b>AGITATOR FEEDBACK</b> |
| 5    | <b>AGITATOR POWER</b>    |

Illustration of the instrument tower side

The following illustration shows an example of the instrument tower side.



| Part | Description                                                 |
|------|-------------------------------------------------------------|
| 1    | Sensor connection ports (temperature, pH, DO, bag pressure) |
| 2    | Auxiliary input connection ports                            |
| 3    | Ethernet connection ports                                   |
| 4    | Heating blanket connection ports                            |
| 5    | Balance (optional) connection port ( <b>SCALE</b> )         |
| 6    | <b>EXHAUST HEATER</b> connection port                       |
| 7    | Gas inlets and outlets                                      |
| 8    | Ventilation hood                                            |

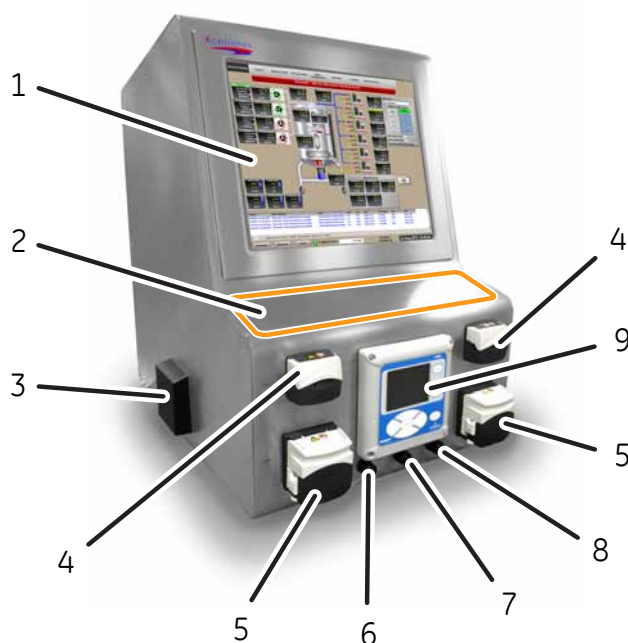
## Mini X-Station

The Mini X-Station is intended for use where a laptop might not be suitable, for example in a cleanroom area. It utilizes an industrial touchscreen computer built into the control cabinet instead of a separate laptop.

The Mini X-Station can contain an integrated keyboard and mouse.

## Illustration of the Mini X-Station

The following illustration shows an example of a Mini X-Station without an integrated keyboard and mouse.



| Part | Description                          |
|------|--------------------------------------|
| 1    | Touchscreen                          |
| 2    | Area for built-in keyboard and mouse |
| 3    | Ventilation hood                     |
| 4    | 114 series pump                      |
| 5    | 313 series pump                      |

| Part | Description         |
|------|---------------------|
| 6    | RTD connection port |
| 7    | pH connection port  |
| 8    | DO connection port  |
| 9    | pH/DO transmitter   |

Software

The user interface is based on Wonderware software.

---

## 3.5 Bioreactor components

### Introduction

This section provides information about the components of the bioreactor.

---

### In this section

| Section                              | See page |
|--------------------------------------|----------|
| 3.5.1 Agitator                       | 66       |
| 3.5.2 Balance                        | 67       |
| 3.5.3 Exhaust filter heater assembly | 68       |
| 3.5.4 Pumps                          | 70       |

## 3.5.1 Agitator

### Description

Control of the XDR-10 Benchtop Bioreactor System agitator motor is accomplished with a servo motor and drive. The system utilizes feedback for accurate speed control of the plastic agitator assembly (see image below), which is part of the disposable bag. The agitator motor does not require alignment on XDR-10 Benchtop Bioreactor System.

---

### Illustration of the agitator



## 3.5.2 Balance

### Description

A balance is used to measure the weight of the XDR vessel and the vessel contents. The balance is a Mettler-Toledo™ precision single cell load weighing platform. The balance is tared prior to filling the XDR vessel and all subsequent readings will reflect the weight of the XDR vessel contents. The balance is connected to the instrument tower via an industry standard connector.

The balance is an optional component.

---

### Illustration of the balance

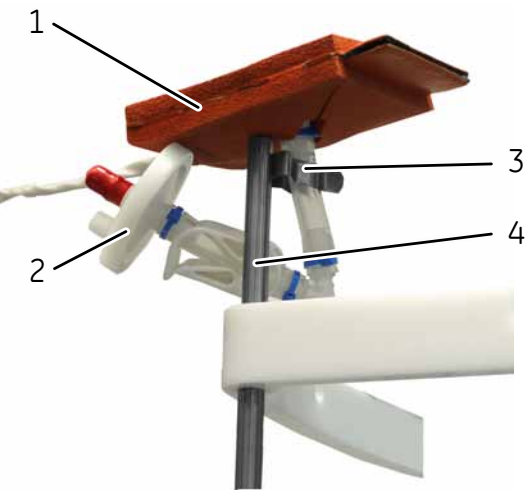


### 3.5.3 Exhaust filter heater assembly

#### Description

The exhaust filter heater assembly is intended to prevent the condensation of water in the exhaust filter, which could cause an overpressure event for the disposable bag. The exhaust filter heater is permanently connected to the instrument tower or Mini X-Station.

#### Illustration of the exhaust filter heater assembly

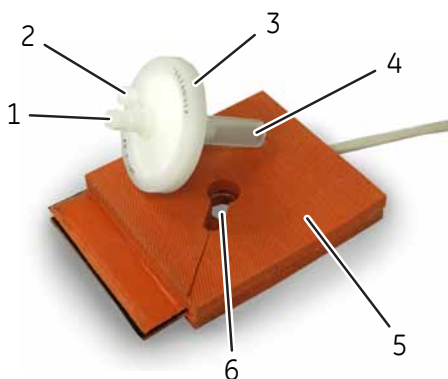


| Part | Function              |
|------|-----------------------|
| 1    | Exhaust filter heater |
| 2    | Exhaust filter        |
| 3    | Retention clip        |
| 3    | Filter heater stand   |



## Illustration of the exhaust filter heater and exhaust filter

The illustration below shows the exhaust filter and the exhaust filter heater which form the filter heater assembly.



| Part | Function       |
|------|----------------|
| 1    | Outlet         |
| 2    | Vent port      |
| 3    | Filter         |
| 4    | Inlet          |
| 5    | Filter heater  |
| 6    | Mounting holes |

### 3.5.4 Pumps

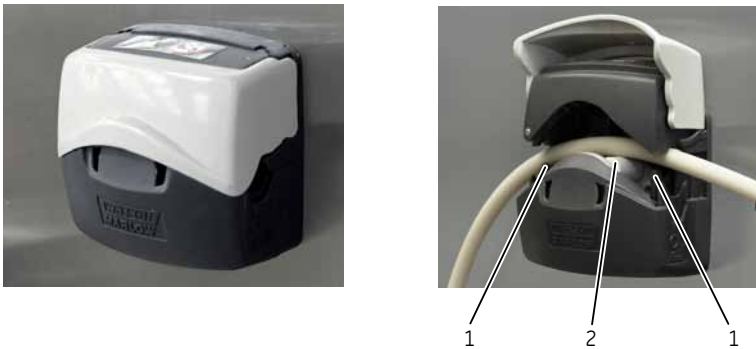
#### Introduction

The pumps are used for adding liquids to the XDR vessel, removing liquids from the XDR vessel, and controlling pH.

#### Pump types used

Watson-Marlow peristaltic pump models 114 and 313 are used. A standard system has three pumps, two model 114 pumps and one 313 pump. A fourth pump (model 313) is optional.

#### Illustration of a 114 series pump



| Part | Description     |
|------|-----------------|
| 1    | Biting elements |
| 2    | Roller          |

## Illustration of a 313 series pump



| Part | Description                    |
|------|--------------------------------|
| 1    | Adjustment for biting elements |
| 2    | Roller                         |

## Pump operating modes

Watson-Marlow pump model 114 pumps are on/off pumps which operate at a fixed speed. Changing the controlled variable (CV) changes the time which the pumps run from 0% to 100% of the time. The pumps will switch on and off to achieve control.

Watson-Marlow 313 pumps operate at variable speeds. Varying the CV between 0% and 100% increases the speed linearly over the range. The pumps will cycle on and off at pre-defined intervals to achieve control.

## 3.6 Disposable bag assembly

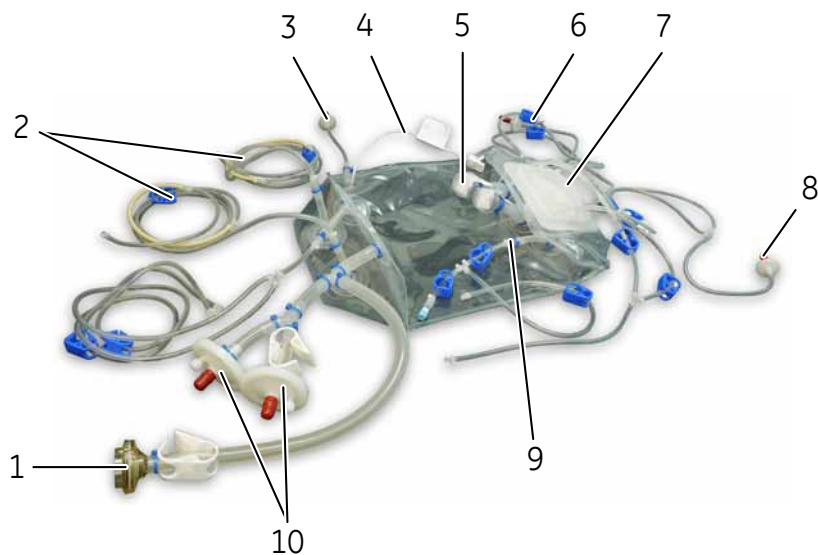
### Description

The disposable bag assembly is a gamma-irradiated disposable bioreactor bag, designed for mammalian cell culture processes.

The disposable bag assembly comprises tubing sets, aseptic connectors, clamps, filters, a thermowell and an agitator assembly. The agitator assembly is welded onto the bottom of the disposable bag and also houses sparge discs to provide gases for cell growth. The thermowell is on the back of the bag.

### Illustration of the unpacked disposable bag

The image below shows the unpacked disposable bag with its tubing.



| Part | Function                    |
|------|-----------------------------|
| 1    | GE Readymate™ Connector     |
| 2    | Bag tubing                  |
| 3    | Headspace inlet with filter |
| 4    | Pressure sensor             |

| Part | Function                   |
|------|----------------------------|
| 5    | Probe ports                |
| 6    | Sparge 1 filter and tubing |
| 7    | Agitator base plate        |
| 8    | Sparge 2 filter and tubing |
| 9    | Sample tubing              |
| 10   | Exhaust filters            |

## Storage of the disposable bag assembly

The disposable bag assembly should be stored in the original packaging at ambient conditions.

---

## 3.7 Probe sheath assembly

### Description

The probe sheath is an accessory to the disposable bag that will provide aseptic connection of a probe with the cell culture inside the disposable bag. The probe sheath with the inserted probe constitutes the probe sheath assembly, which is inserted into the bag assembly probe port.

The probe sheath assembly is provided as a single assembled unit and includes an aseptic connection device (ACD). The probe sheath is compatible with the following 12 × 225 mm probes:

- Dissolved oxygen (DO) probe
- pH probe

The probe sheath utilizes a PG 13.5 thread type connector.

The probe sheath assembly has to be autoclaved before it is connected to a probe port of the bag assembly.

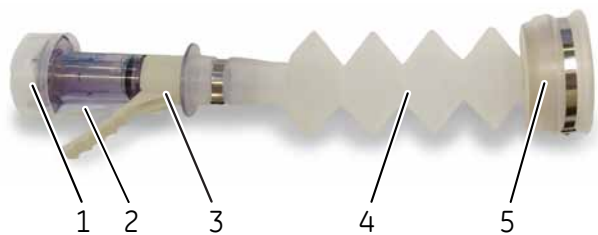
### Illustration of the probe sheath assembly

The following illustration shows a pH probe.



| Part | Description             |
|------|-------------------------|
| 1    | Threaded connector plug |
| 2    | O-rings                 |
| 3    | pH sensor               |

The following illustration shows a probe sheath.



| Part | Description                          |
|------|--------------------------------------|
| 1    | Aseptic connection device (male end) |
| 2    | Sterile membrane                     |
| 3    | Anti-actuation ring                  |
| 4    | Bellows                              |
| 5    | End plug                             |

Illustration of the probe sheath  
with inserted probe

The following illustration shows a probe sheath assembly with the inserted probe.



## 3.8 Auxiliary inputs

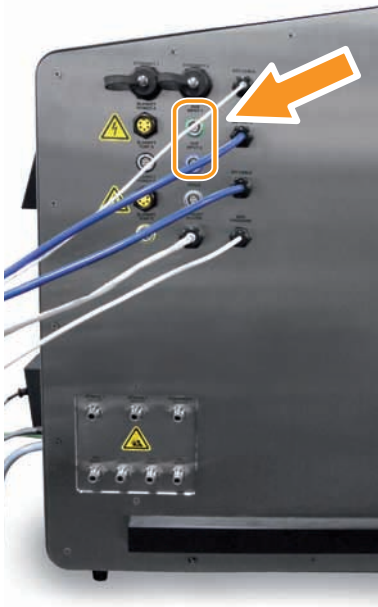
### Introduction

XDR-10 Benchtop Bioreactor System is provided with two auxiliary inputs. The auxiliary inputs are designed to provide connectivity to defined accessories and user supplied instrumentation, such as redox or cell density monitors. The auxiliary inputs can be used for any measuring equipment with a 4 to 20 mA analog output.

---

### Location of the auxiliary inputs

Auxiliary inputs are located on the side panel of the instrument tower.



The auxiliary input socket and plug are shown in the following illustrations.





## Description

In addition to the 4 to 20 mA input, connections are available to provide 24 VDC control loop power to external devices that require it. See the electrical drawing package for additional information.

The auxiliary inputs accept an industry standard 8-pin connector. Wiring details for the auxiliary inputs are provided in the electrical drawings, contained in the instrument Turnover Package.

---

## Auxiliary inputs

The auxiliary inputs are designed to accept a standard 4 to 20 mA signal. The auxiliary inputs can be mapped within the automation, for use in various measurement and control applications. Examples of auxiliary inputs:

- CO<sub>2</sub> sensors
- Disposable bag exhaust gas sensors

Please consult the system electrical drawing for connection details.

**Note:** *Some options may require customized cables, bags, and/or other accessories. Contact your local GE representative for assistance.*

---

## 3.9 System connectivity

### Introduction

The instrument tower is connected to the laptop via an industrial Ethernet network. Industry standard cables and connectors are used for these connections.

---

### Connections for the system with two or more XDR vessels

When two or more XDR vessels are configured for use with one laptop, an Ethernet switch located in the instrument tower is used to connect the instrument tower of each XDR vessel in a daisy-chain configuration.

The connector on the instrument tower is compatible with NEMA 4X Ethernet cabling. This permits locating the cable and the XDR vessel in a clean environment.

---

### Connection to site network

Utilizing an additional wireless or USB networking adapter, the laptop may be connected to a site network. A connection to a site network is not required.

---

### Connection to legacy systems

An OPC server can be included in XDR-10 Benchtop Bioreactor System for connectivity with legacy systems. Please contact your GE representative for additional information.

---

# 4 User interface overview

## About this chapter

This chapter provides general information about XDR-10 Benchtop Bioreactor System software user interface. For more detailed information see [Appendix B User interface description, on page 283](#).

---

## In this chapter

| Section                            | See page |
|------------------------------------|----------|
| 4.1 Software architecture          | 80       |
| 4.2 Wonderware windows             | 81       |
| 4.3 Startup view                   | 83       |
| 4.4 Process control and monitoring | 85       |

# 4.1 Software architecture

## Wonderware structure

XDR-10 Benchtop Bioreactor System is managed by using Wonderware software, running under Microsoft Windows operating system.

The user interacts with instrument display and control functions through a touchscreen and a keyboard. The user interface is presented in nine windows:

- *Reactor Display*
- *Control*
- *Setpoint Table*
- *PID Face Plate*
- *Alarm Configuration*
- *Alarm Summary*
- *Alarm History*
- *Trending*
- *Platform Status*

These windows provide access to dialog boxes that are used to view and regulate different aspects of the process.

## Navigation

Tap on the touchscreen or use the mouse to select buttons and objects.

## Header toolbar

The header toolbar is located at the top of the screen and is available from all application interfaces. All windows are accessible from this toolbar.

The following illustration shows the header toolbar for a stand-alone bioreactor.



To access a window, select the appropriate button from the header toolbar. If several options exist for this item, a drop-down menu with additional choices will be available.

**Alarm Summary** and **Alarm History** windows are found in a drop-down menu after clicking on **Alarming** option on the header toolbar.

## 4.2 Wonderware windows

### Introduction

The user interface comprises nine different windows altogether. All windows are accessed from the header toolbar.

### Description of the windows

The following table gives an overview of all windows in Wonderware software.

| Window                                 | Description                                                                                                                                                                                                                                                                                        |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Reactor Display</b>                 | Default window at login. Provides a detailed graphical display of the bioreactor system layout. Graphic objects give the user the access to process control parameters.                                                                                                                            |
| <b>Control</b>                         | Displays input and output devices and intermediate control elements. Allows the user to configure the interaction of units that are part of the bioreactor control system.                                                                                                                         |
| <b>Setpoint Table</b>                  | Displays an overview of all individual PID control loop setpoint tables. Provides access to each individual setpoint table. Allows the user to define automatic changes to PID control loop setpoints according to selectable criteria.                                                            |
| <b>PID Face Plate<sup>1</sup></b>      | Displays an overview of all individual PID control loop faceplates. Each faceplate provides access to a PID control loop and allows the user to adjust PID control loop tuning parameters.                                                                                                         |
| <b>Alarm Configuration<sup>1</sup></b> | Displays an overview of alarm configuration dialog boxes for all available process variables. Each dialog box allows the user to activate the alarms and define the limits for deviation of a variable from a setpoint.                                                                            |
| <b>Alarm Summary</b>                   | This window is accessed by choosing <b>Alarming:Summary</b> . This window presents all currently active alarms in a table format. Detailed information about each alarm is shown. The user can select and acknowledge individual alarms.                                                           |
| <b>Alarm History</b>                   | This window is accessed by choosing <b>Alarming:History</b> . This window presents all alarms and events that are associated with the current process, both active alarms and acknowledged alarms. All information contained in this window is saved in the database.                              |
| <b>Trending</b>                        | Selecting this option from the header toolbar opens an independent Wonderware application. The <b>Trending</b> window displays historical and real-time data as graphs. <b>Trending</b> application records all process parameters while the computer is on and connected to the instrument tower. |

| Window                 | Description                                                                        |
|------------------------|------------------------------------------------------------------------------------|
| <b>Platform Status</b> | Displays information about the status of the bioreactor automation control system. |

<sup>1</sup> This window may be displayed in two or more pages.

## 4.3 Startup view

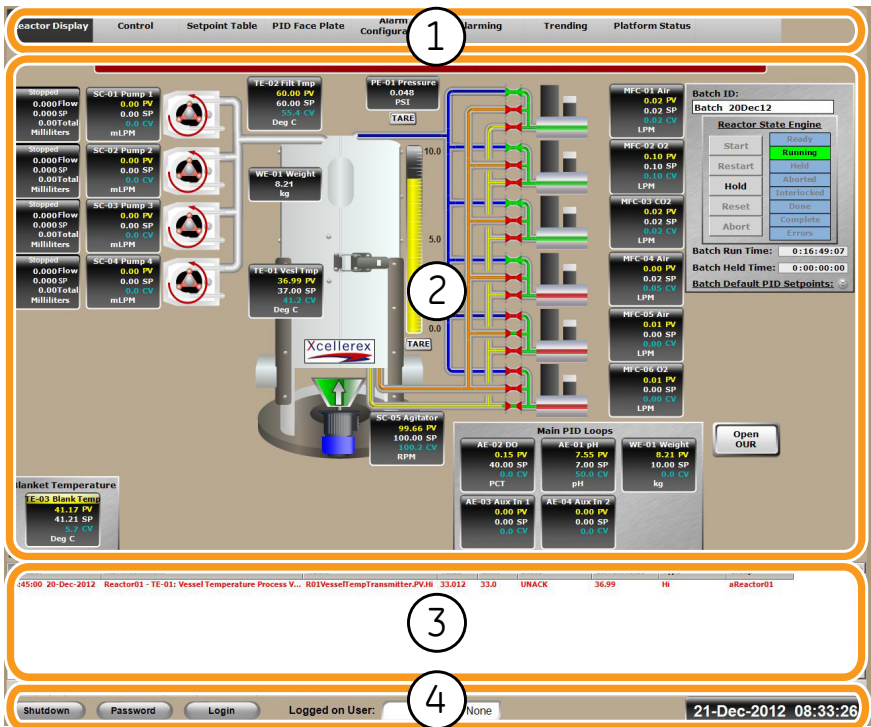
### Introduction

The default view after logging in to the software is **Reactor Display** window. This window consists of four main parts and provides a detailed graphical display of bioreactor system layout.

---

Illustration of the startup view

The following illustration shows the overview of *Reactor Display* window.



| Part | Name               | Description                                                                                                          |
|------|--------------------|----------------------------------------------------------------------------------------------------------------------|
| 1    | Header toolbar     | Provides access to all windows in Wonderware software.                                                               |
| 2    | Main pane          | Contains graphic objects that display process data and give the user access to process control parameters.           |
| 3    | Alarm summary pane | Presents the current alarms with a date and time stamp.                                                              |
| 4    | Footer toolbar     | Displays the current user, allows shutdown of Wonderware application, changing user password, and changing the user. |



## 4.4 Process control and monitoring

### Access to parameters

The bioreactor control system provides continuous control and monitoring of the process. All process parameters can be accessed for viewing or modification through Wonderware windows. The windows contain two types of objects:

- Display objects, which do not allow modification of the displayed values,
- Active objects, which open a dialog box when clicked on, and let the user to access and modify the state of the process.

The automated process control is achieved by connecting the input signal from a transmitter unit to a final control element. This process of setting up the connections between units is called control loop mapping.

For detailed information on Wonderware windows, window elements, and control loop mapping see [Appendix B User interface description, on page 283](#).

---

# 5 Installation

## About this chapter

For unpacking instructions, see separate XDR-10 Benchtop Bioreactor System *Unpacking Instructions* manual.

Installation and relocation of XDR-10 Benchtop Bioreactor System must be performed by a GE representative. This chapter describes pre-installation tasks that the customer can perform without GE support. Components not covered in this manual must not be installed by the customer.



**NOTICE**

For ease of future transport, retain the shipping crates in which XDR-10 Benchtop Bioreactor System parts were delivered.

## In this chapter

| Section                                   | See page |
|-------------------------------------------|----------|
| 5.1 General safety precautions            | 87       |
| 5.2 Site requirements                     | 90       |
| 5.3 Materials for Site Acceptance Testing | 93       |
| 5.4 Installation of the system            | 94       |

## 5.1 General safety precautions



### WARNING

**Fire and explosion hazard.** Follow the instructions below to avoid a fire or explosion when using oxygen:

- Monitor oxygen flow rates displayed on the user interface.
- Check for leaks, poor connections, or damages to the equipment prior to use.
- Use proper ventilation when operating the bioreactor using oxygen.
- Do NOT expel oxygen into an enclosed space.



### WARNING

**STRONG magnets.** Magnets may interfere with functioning of pacemakers or implanted heart defibrillators and cause DEATH or SERIOUS INJURY. Magnets are located on the bottom of XDR-10 Benchtop Bioreactor System, and in the impeller assembly of the disposable bags.

- OBSERVE and follow instructions for installation, operation, and maintenance of XDR-10 Benchtop Bioreactor System.
- KEEP a safe distance of 25 cm or more from the magnets to avoid exposure of magnetic field greater than 0.5 mT (5 G).
- Warn other people who wear pacemakers or implanted heart defibrillators from getting too close to the magnets.



### WARNING

**Gas shut-off valves.** Gas shut-off valves that can be physically locked out for servicing must be installed on the facility gas supplies.



### WARNING

**Installation.** Installation and relocation of the instrument must be performed by a GE representative.

## 5 Installation

### 5.1 General safety precautions



#### **WARNING**

**Access to power switch.** The power switch must always be easy to access.



#### **WARNING**

**Access to power supply circuit breaker.** The power supply circuit breaker must always be easy to access.



#### **WARNING**

**High voltage.** It is essential for the safety of personnel working in or around electrically powered equipment to follow a company policy and procedure for Lock-Out / Tag-Out (LOTO).



#### **WARNING**

**Gas leakage hazard.** Make sure that the gas connections are tight in order to avoid gas leakage.



#### **CAUTION**

**Tripping hazard.** Make sure that all tubing, hoses and cables are placed so that the risk for tripping accidents is minimized.



#### **CAUTION**

**Indoor use only.** The product is designed for indoor use only.



#### **CAUTION**

**Dusty and damp atmosphere.** Do not use the instrument in a dusty atmosphere or close to spraying water.



**CAUTION**

**Inspect cables.** Cables need to be inspected for wear and damage. Replace damaged cables before connecting power to the system.

## 5.2 Site requirements

### Space and floor

For space and floor requirements, see [Section 10.1 System specifications, on page 268](#) for dimensions and weights of XDR-10 Benchtop Bioreactor System.

### Bench

Make sure that the bench can handle the weight of XDR-10 Benchtop Bioreactor System at fully loaded conditions. The data in the following table refer to a single-vessel system.

| Property                   | Value                    |
|----------------------------|--------------------------|
| Minimum bench size (W × D) | 183 × 92 cm (72 × 36 in) |
| Weight capacity            | 120 kg                   |



**NOTICE**

In order to allow convenient working conditions during the use, sufficient space should be provided on all sides of XDR-10 Benchtop Bioreactor System when installed at the intended production location.

### Ambient environment

The following should be avoided:

- Direct sunlight
- Strong magnetic or electric fields
- Vibrations
- Corrosive gas
- Dust
- Condensing humidity, more than 60%
- Temperatures outside the following recommended operating range:  
5°C to 30°C

## Electrical power

| Parameter                       | Requirement                                                                             |
|---------------------------------|-----------------------------------------------------------------------------------------|
| Power                           | 110 VAC $\pm$ 10%, 1 phase, 50/60 Hz, 7.9 A                                             |
|                                 | 220 VAC $\pm$ 10%, 1 phase, 50/60 Hz, 3.8 A                                             |
| Instrument tower                | IEC style power cord attached with a US plug or an EU plug.                             |
| Number of power plugs           | One                                                                                     |
| Recommended backup power supply | Uninterruptible power supply (UPS)                                                      |
| Laptop                          | 100 to -240 VAC, 1 phase, 50/60 Hz, 2.5 Amps<br>Power cord attached with a US plug only |

## Computer

An external computer is not required. XDR-10 Benchtop Bioreactor System is either provided with a free-standing laptop that is connected to the instrument tower, or has a built-in industrial computer inside the Mini X-Station.

## Gas supply

Customer should supply semi-rigid polyethylene or flexible polyvinyl chloride tubing to run from room gas drop to the instrument tower and connect into quick disconnect fittings. Nitrogen is not the required for many processes but is recommended for dissolved oxygen (DO) calibration.

The table below describes the requirements regarding gas supply.

| Parameter         | Requirement                                                                                                                                            |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gas supply tubing | Customer to supply tubing: <ul style="list-style-type: none"> <li>o.d. ¼"</li> <li>Flexible polypropylene, pressure rated 10 bar (150 psig)</li> </ul> |
| Gas pressure      | 1.7 bar (25 psig) at at regulator on each gas                                                                                                          |

| Parameter   | Requirement                                                                                                                                                                                                                                                                                                                                                                               |
|-------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Gas inlets  | <p>Four gas inlets with o.d. ¼":</p> <ul style="list-style-type: none"><li>• <b>AIR/PILOT INLET</b></li><li>• <b>O<sub>2</sub> INLET</b></li><li>• <b>CO<sub>2</sub> INLET</b></li><li>• <b>N<sub>2</sub> INLET</b></li></ul> <p><b>Note:</b><br/><i>Unused gas inlets should be plugged.</i></p>                                                                                         |
| Gas outlets | <p>Three gas outlets with o.d. ¼":</p> <ul style="list-style-type: none"><li>• <b>SPARGE 1 OUTLET</b></li><li>• <b>SPARGE 2 OUTLET</b></li><li>• <b>HEADSPACE OUTLET</b></li><li>• <b>AIR/PILOT OUTLET</b> (optional). Designed for switching exhaust filters.</li></ul> <p><b>Note:</b><br/><i>If the external valve is not used, the <b>AIR/PILOT OUTLET</b> should be plugged.</i></p> |



**WARNING**

**Use correct tubing.** Only the gas tubing specified by GE must be used. Using other gas tubing may result in a possible gas leak.



**WARNING**

**Gas shut-off valves.** Gas shut-off valves that can be physically locked out for servicing must be installed on the facility gas supplies.



## 5.3 Materials for Site Acceptance Testing

### Personnel

Site Acceptance Testing (SAT) is performed by a GE representative, by the owner or the owner's designee.

---

### Chemicals

The following chemicals are required for SAT:

- pH standard solution of pH 4 for probe calibration, 50 mL.
  - pH standard solution of pH 7 for probe calibration, 50 mL.
  - pH standard solution of pH 10 for probe calibration, 50 mL.
-

## 5.4 Installation of the system



**WARNING**  
**Installation.** Installation and relocation of XDR-10 Benchtop Bioreactor System must be performed by a GE representative.

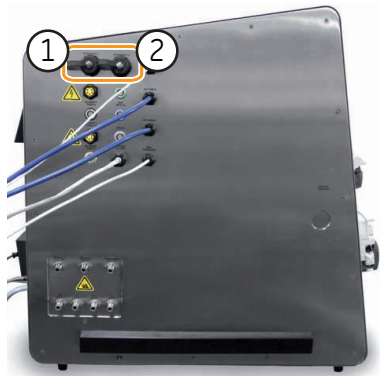
### Unpacking and installation

See separate *Unpacking Instructions* for information on how to unpack the instrument. Installation and relocation of XDR-10 Benchtop Bioreactor System must be performed by a GE representative.

### Connect a multi-vessel system

To connect two instrument towers to one laptop, follow the instructions below.

| Step | Action                                                                          |
|------|---------------------------------------------------------------------------------|
| 1    | Plug in an Ethernet cable to the Ethernet port of the laptop.                   |
| 2    | Connect the cable to <b>ETHERNET 1</b> port (1) of the master instrument tower. |



|   |                                                                                                |
|---|------------------------------------------------------------------------------------------------|
| 3 | Plug a second Ethernet cable to the <b>ETHERNET 2</b> port (2) of the master instrument tower. |
| 4 | Connect the second Ethernet cable to <b>ETHERNET 1</b> port of the slave instrument tower.     |

# 6 Preparation

## About this chapter

This chapter provides required information to prepare XDR-10 Benchtop Bioreactor System for operation.

---

## In this chapter

| Section                                | See page |
|----------------------------------------|----------|
| 6.1 General safety precautions         | 96       |
| 6.2 Unpack the disposable bag assembly | 98       |
| 6.3 Calibrate the pH probe             | 101      |
| 6.4 Autoclave probe sheath assembly    | 104      |
| 6.5 Prepare disposable bag             | 107      |
| 6.6 Calibrate the pump                 | 136      |

---

## 6.1 General safety precautions



### WARNING

**STRONG magnets.** Magnets may interfere with functioning of pacemakers or implanted heart defibrillators and cause DEATH or SERIOUS INJURY. Magnets are located on the bottom of XDR-10 Benchtop Bioreactor System, and in the impeller assembly of the disposable bags.

- OBSERVE and follow instructions for installation, operation, and maintenance of XDR-10 Benchtop Bioreactor System.
- KEEP a safe distance of 25 cm or more from the magnets to avoid exposure of magnetic field greater than 0.5 mT (5 G).
- Warn other people who wear pacemakers or implanted heart defibrillators from getting too close to the magnets.



### WARNING

**Personal protective equipment.** Whenever packing, unpacking, transporting or moving the product, wear personal protective equipment.



### WARNING

**Fire and explosion hazard.** Follow the instructions below to avoid a fire or explosion when using oxygen:

- Monitor oxygen flow rates displayed on the user interface.
- Check for leaks, poor connections, or damages to the equipment prior to use.
- Use proper ventilation when operating the bioreactor using oxygen.
- Do NOT expel oxygen into an enclosed space.



### WARNING

**High voltage.** It is essential for the safety of personnel working in or around electrically powered equipment to follow a company policy and procedure for Lock-Out / Tag-Out (LOTO).



**WARNING**

**Gas leakage hazard.** Make sure that the gas connections are tight in order to avoid gas leakage.



**CAUTION**

**Inspect cables.** Cables need to be inspected for wear and damage. Replace damaged cables before connecting power to the system.



**CAUTION**

**Quality of gases.** The gases supplied to the system should be clean, filtered, and pharmaceutical quality. Failure to use pharmaceutical quality filtered gases could result in malfunction of flow control valves and gas supply solenoids.



**CAUTION**

**Pinch hazard.** Do not operate the pumps without the covers in place.



**CAUTION**

**Magnetic components.** Use caution when handling magnetic components. There is a strong magnetic attraction between the impeller and the motor drive coupling.



**CAUTION**

**Moving parts.** Use caution close to moving parts, stored energy, pressurization, and electrical sources.

## 6.2 Unpack the disposable bag assembly

### Unpack the bag assembly



**WARNING**

**STRONG magnets.** Magnets may interfere with functioning of pacemakers or implanted heart defibrillators and cause DEATH or SERIOUS INJURY. Magnets are located on the bottom of XDR-10 Benchtop Bioreactor System, and in the impeller assembly of the bags.

- OBSERVE and follow instructions for installation, operation, and maintenance of XDR-10 Benchtop Bioreactor System.
- KEEP a safety distance of 25 cm or more from the magnets to avoid exposure of magnetic field greater than 0.5 mT (5 G).
- Warn other people who wear pacemakers or implanted heart defibrillators from getting too close to the magnets.



**NOTICE**

Before opening the box, clear the inspection area of sharp objects. All personnel who will be handling the disposable bag assembly should remove watches, rings, and any items with sharp edges or points that could damage the disposable bag.

Prepare an inspection table before unpacking the disposable bag.  
Follow the instructions below to unpack the disposable bag assembly.

| Step | Action                                           |
|------|--------------------------------------------------|
| 1    | Remove the disposable bag from the box.          |
| 2    | Place the disposable bag on an inspection table. |
| 3    | Remove the outside protective bag.               |

| Step | Action                                                                                   |
|------|------------------------------------------------------------------------------------------|
| 4    | Verify that the gamma irradiation dot is red, indicating successful gamma sterilization. |



- 5 Remove the inside protective bag.
- 6 Place the exposed disposable bag on the inspection table.
- 7 Verify that the disposable bag has no tears or openings.

**Note:**

*Light scratches and creases may be present on the bag due to handling. These and similar flaws do not indicate failed bag integrity.*

## 6 Preparation

### 6.2 Unpack the disposable bag assembly

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                                                                                                                                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8 | <p>Remove following from the tubing and probe ports:</p> <ul style="list-style-type: none"><li>• All bubble wrap</li><li>• The zip tie that is inserted into the thermowell</li><li>• The zip ties around the tubing from the headspace</li><li>• The zip ties around the tubing for acid and base tubes</li><li>• The zip ties around the sparge lines</li></ul> |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



#### CAUTION

**Do not remove plastic bags.** Do not remove the plastic bags from the Kleenpak™ connectors where the pH and DO probes are inserted into the bag or from the aseptic seal on the ReadyMate connector. Removing the plastic bags from these parts may damage the equipment.

An unpacked disposable bag assembly is shown in [Illustration of the unpacked disposable bag, on page 72](#).



## 6.3 Calibrate the pH probe

### Preparation

**Note:** *If XDR-10 Benchtop Bioreactor System is used in a GMP regulated environment, the pH probe is a GMP critical component.*

Before calibrating the pH probe, prepare the following:

- 30 mL pH standard solution of pH 4 in a 50 mL conical tube.
- 30 mL pH standard solution of pH 7 in a 50 mL conical tube.
- 30 mL de-ionized water in a 50 mL conical tube.

### Prepare the pH probe for calibration

Prepare the pH probe as follows:

| Step | Action                                                                               |
|------|--------------------------------------------------------------------------------------|
| 1    | Take a pH probe out of the packaging.                                                |
| 2    | Rinse the sensor end of the pH probe with de-ionized water.                          |
| 3    | Connect the pH probe with the probe cable so that no thread is visible on the probe. |



**NOTICE**

Do not cross-thread the probe cable.

### Calibrate the pH probe

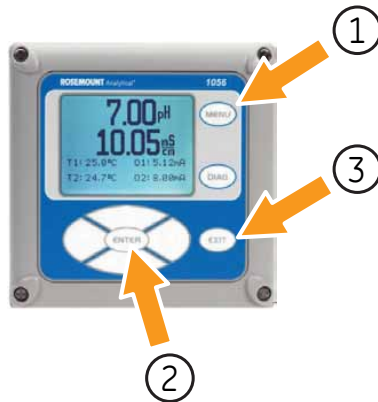
Calibrate the pH probe as follows:

| Step | Action                                                                    |
|------|---------------------------------------------------------------------------|
| 1    | Place the pH probe in the pH 4 solution and stir approximately ten times. |

## 6 Preparation

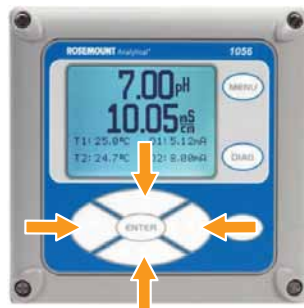
### 6.3 Calibrate the pH probe

| Step | Action                                                                                          |
|------|-------------------------------------------------------------------------------------------------|
| 2    | Locate the pH/DO transmitter display on the instrument tower. Press the <b>MENU</b> (1) button. |



*Result:* A menu is displayed on the transmitter screen.

|   |                                                         |
|---|---------------------------------------------------------|
| 3 | Use the arrow keys to move the selection on the screen. |
|---|---------------------------------------------------------|



- 1 Select **Calibrate** and press **ENTER** (2).
- 2 Select **Sensor 1** and press **ENTER**.
- 3 Select **pH** and press **ENTER**.
- 4 Select **Buffer Cal** and press **ENTER**.
- 5 Select **AUTO** and press **ENTER**.
- 6 The system will automatically detect the pH and display the applicable buffers. Select the appropriate buffer from the list and press **ENTER**.

*Result:* The pH probe has been standardized to pH 4.

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | Place the pH probe in the pH 7 solution and stir approximately ten times.                                                                                                                                                                                                                                                                                                                                                                                       |
| 5    | <p>The system will automatically detect the pH and display the applicable buffers. Select the appropriate buffer from the list and press <b>ENTER</b>.</p> <p><i>Result:</i> The pH probe has been standardized to pH 7. The display of the pH transmitter will show the slope from standardization. The displayed value should be around 57 mV/pH.</p> <p><b>Tip:</b><br/><i>Consult the probe manufacturer's manual for acceptable slope value range.</i></p> |

If the calibration fails, determine the cause of the failure using the transmitter and sensor user manuals.

If duplicate probes will be used, label the probe that was just calibrated as pH-1. Then repeat the steps described above to calibrate the second pH probe and label it as pH-2. After sterilization the probes need to be connected to pH/DO transmitters **pH/DO-1** and **pH/DO-2**, respectively.

When the calibration of the pH probes is complete, press **EXIT** (3) repeatedly until you reach the main screen.

## 6.4 Autoclave probe sheath assembly

### Conditions

The probe sheath assembly with inserted probe has to be autoclaved.

The recommended conditions for autoclaving are as follows:

- Temperature > 121°C
- Time 60 min (minimum time 30 min)
- Liquid cycle



**NOTICE**

The autoclaving temperature must not exceed 130°C.



**NOTICE**

Do not autoclave ratchet clamps.

### Autoclave probe sheath assembly

Before autoclaving the probe sheath assembly, prepare the following:

- Syringe
- Deionized water

Follow the instructions below to prepare the probe sheath for autoclaving:

| Step | Action                                                    |
|------|-----------------------------------------------------------|
| 1    | Draw 1 to 2 ml deionized water into a disposable pipette. |

- | Step | Action                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------|
| 2    | Insert the pipette into the probe sheath assembly through the threaded hole in the probe sheath assembly end plug. |



- |   |                                                                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Inject the water into the probe sheath assembly.<br><b>Note:</b><br><i>The inserted water will provide the steam inside the probe sheath assembly during autoclaving.</i> |
| 4 | Remove the pipette.                                                                                                                                                       |
| 5 | Verify that the O-rings are present on the probe.                                                                                                                         |



- |   |                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------|
| 6 | Insert the probe into the probe sheath assembly through the threaded hole in the probe sheath assembly end plug. |
|---|------------------------------------------------------------------------------------------------------------------|



## 6 Preparation

### 6.4 Autoclave probe sheath assembly

| Step | Action                                                                                                        |
|------|---------------------------------------------------------------------------------------------------------------|
| 7    | Hand-tighten the probe into the probe sheath assembly end plug by turning the probe in a clockwise direction. |



- 8 Check that the probe sheath assembly bellows are extended enough so that the sensory tip of the probe is not pressing hard against the sterile paper membrane at the end of the ACD connector (1).  
The following illustration shows probe sheath assembly with correctly inserted probe.



**Result:** The probe sheath assembly is now ready to be placed in the autoclave.

- 9 Place the probe sheath assembly into the autoclave. The paper membrane end of the probe sheath assembly (1) should be lower than the plug end of the assembly.

**Tip:**

Use a probe assembly holder (optional) to position the probe sheath assembly correctly during autoclaving. Contact your GE representative for more information.

- 10 Start the autoclave. See [Conditions, on page 104](#) for sterilization conditions.

## 6.5 Prepare disposable bag

### Precautions



#### WARNING

**STRONG magnets.** Magnets may interfere with functioning of pacemakers or implanted heart defibrillators and cause DEATH or SERIOUS INJURY. Magnets are located on the bottom of XDR-10 Benchtop Bioreactor System, and in the impeller assembly of the bags.

- OBSERVE and follow instructions for installation, operation, and maintenance of XDR-10 Benchtop Bioreactor System.
- KEEP a safety distance of 25 cm or more from the magnets to avoid exposure of magnetic field greater than 0.5 mT (5 G).
- Warn other people who wear pacemakers or implanted heart defibrillators from getting too close to the magnets.



#### WARNING

**Personal protective equipment.** Whenever packing, unpacking, transporting or moving the system, wear personal protective equipment.



#### WARNING

**High voltage.** It is essential for the safety of personnel working in or around electrically powered equipment to follow a company policy and procedure for Lock Out / Tag Out (LOTO).



#### CAUTION

**High voltage.** Cables need to be inspected for wear and damage. Replace before re-powering system.

Install the disposable bag in the XDR vessel

Before placing the disposable bag in the XDR vessel, wipe clean and dry the XDR vessel wall, as water can be mistaken for a bag leakage.



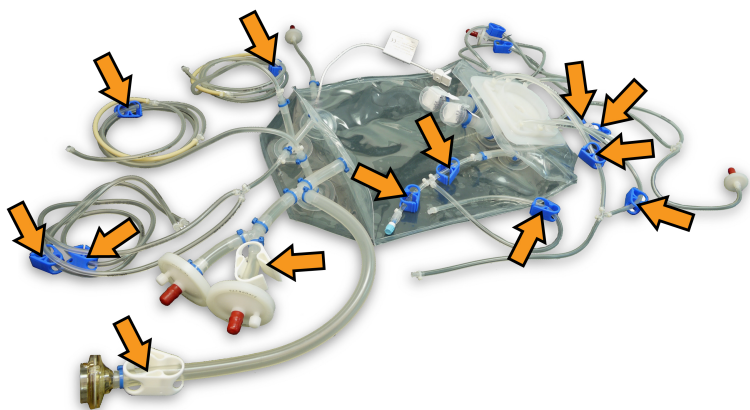
NOTICE

Make sure that the inner vessel wall is free of debris or sharp edges, and completely dry.

Install the disposable bag in the XDR vessel as described below.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                               |
|---|---------------------------------------------------------------|
| 1 | Close all tubing clamps except for the sparge 1 tubing clamp. |
|---|---------------------------------------------------------------|





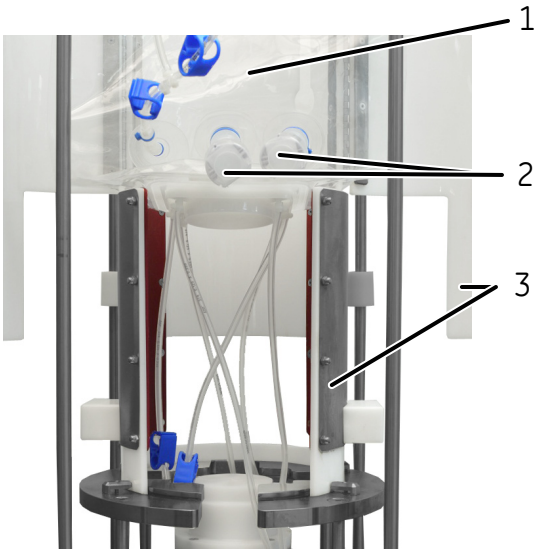
| Step | Action                                                                      |
|------|-----------------------------------------------------------------------------|
| 2    | Unlatch the clasp on the front of the XDR vessel and open the vessel doors. |



6 Preparation

6.5 Prepare disposable bag

| Step | Action                                                                                                 |
|------|--------------------------------------------------------------------------------------------------------|
| 3    | Position the disposable bag so that the Kleenpak connector at the bottom of the bag is facing forward. |

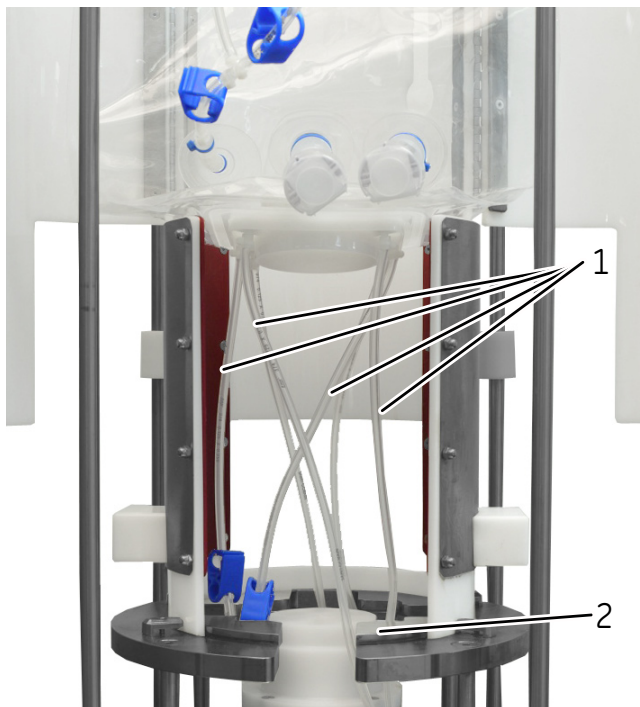


| Part | Function               |
|------|------------------------|
| 1    | Disposable bag         |
| 2    | Probe ports            |
| 3    | Vessel (open position) |

- |   |                                                                |
|---|----------------------------------------------------------------|
| 4 | Carefully place the disposable bag into the XDR vessel.        |
| 5 | Inspect the disposable bag for wrinkles. Smooth out if needed. |
| 6 | Align the tubing so that it will not be pinched.               |

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                    |
|---|------------------------------------------------------------------------------------|
| 7 | Gently pull the sparge tubing inside the mating plate at the bottom of the vessel. |
|---|------------------------------------------------------------------------------------|



| Part | Function      |
|------|---------------|
| 1    | Sparge tubing |
| 2    | Mating plate  |

- |   |                                                     |
|---|-----------------------------------------------------|
| 8 | Make sure that the tubing is not pinched or kinked. |
|---|-----------------------------------------------------|

6 Preparation

6.5 Prepare disposable bag

| Step | Action                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Gently push the agitator assembly downwards in the disposable bag until the agitator assembly is in contact with the agitator drive head. |



**WARNING**

**Pinch hazard.** Keep fingers clear of the space between the agitator base and the agitator drive head. Strong magnets will pull these two pieces together.



| Step | Action |
|------|--------|
|------|--------|

|  |                                                                                                               |
|--|---------------------------------------------------------------------------------------------------------------|
|  | <p><i>Result:</i> The agitator assembly is in contact with the agitator drive head as in the image below.</p> |
|--|---------------------------------------------------------------------------------------------------------------|



If the impeller baseplate is not positioned as indicated in step 9 above, the agitation does not work correctly. During agitation the agitator emits a loud clicking noise and the agitator motor is detached from the impeller baseplate. To correct the problem follow the instructions below.

- 1 Lift the impeller baseplate up to detach the agitator motor.
- 2 Arrange the impeller baseplate correctly, as shown in step 9 above.

## Prepare probe sheath assembly

All types of analytical probes are installed using the same procedure.

The probe sheath assembly should be autoclaved before installation. See [Section 6.4 Autoclave probe sheath assembly, on page 104](#) for instructions.

## 6 Preparation

### 6.5 Prepare disposable bag

The instructions below involve handling of ratchet clamps. Carefully read through the notice below before starting to insert the probe sheath assembly into the disposable bag.



#### NOTICE

- Ratchet clamps may break if they are overtightened.
- A ratchet clamp can be released from its tightened state by sliding the interlocked clamp fingers sideways with respect to each other.
- If ratchet clamp fingers cannot be released, the ratchet clamp has to be cut open. Side cutters pliers (similar to the ones used to remove a cable tie) can be used for the purpose.

Follow the instructions below to prepare for installation of the probe sheath assembly into the disposable bag.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                                                                                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Install two ratchet clamps over the section of tubing between the bag assembly probe port (welded into the disposable bag) and the female aseptic connection device (ACD) connector attached to the probe port of the disposable bag, at the location shown in the following illustration. |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



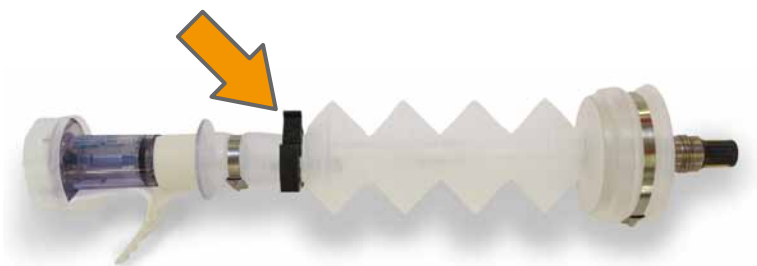
- | Step | Action                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Using your fingers, loosely tighten the ratchet clamps until the teeth on the clamp are engaged enough to hold the clamp in position (2 to 3 teeth engaged). |



**NOTICE**

Do not overly tighten the clamps at this time, otherwise they will interfere with the insertion of the probe into the disposable bag.

- 3 Install one ratchet clamp at the section of the probe sheath assembly between the male ACD connector and the bellows section of the probe sheath assembly, as shown in the following illustration.



| Step                                                                                                                                                                                                                                                             | Action                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4                                                                                                                                                                                                                                                                | Using your fingers, loosely tighten the ratchet clamp until the teeth of the clamp are engaged enough to hold the clamp in position (2 to 3 teeth engaged). |
| <div><div><b>NOTICE</b><p>Do not overly tighten the clamps at this time, otherwise they will interfere with the insertion of the probe into the disposable bag.</p></div></div> |                                                                                                                                                             |

## Install probe sheath assembly

Before inserting the probe sheath assembly into the disposable bag, make sure you have a clamp tightening tool accessible.



**Tip:** A ratchet clamp tightening tool is shipped with each bioreactor. You can also use a pair of medium sized multigrip pliers with parallel jaws.

Follow the instructions below to install the probe sheath assembly:

| Step | Action                                                                           |
|------|----------------------------------------------------------------------------------|
| 1    | Verify that the bag agitator plate is aligned with the agitator hole.            |
| 2    | Verify that the probe Kleenpak connectors are aligned with the XDR vessel mouth. |



| Step | Action |
|------|--------|
|------|--------|

- |   |                                                      |
|---|------------------------------------------------------|
| 3 | Remove the protective caps from both ACD connectors. |
|---|------------------------------------------------------|



- |   |                                                                                                                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | Hold the male ACD connector (part of the probe sheath assembly) and align it with the female connector (part of the probe port on the disposable bag), so that the white membrane strips are facing each other as they exit the flat sides of the connectors. |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



- |   |                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | Press the two ACD connectors together until they snap to closed position. A double-click sound indicates that the connectors have been closed and the ACD are fully engaged. |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

6 Preparation

6.5 Prepare disposable bag

| Step | Action                                                                                                                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Holding the bodies of both connectors with one hand, grip both the white membrane strips with the other hand and pull them (perpendicular to the connectors) simultaneously away from the bodies of the connectors in one smooth continuous motion. |



**NOTICE**

If only one membrane strip is removed or if a membrane strip breaks and only part of it is removed, the connection would not be considered aseptic.

Immediately clamp off this probe sheath assembly on the short section of silicone tubing between the disposable bag and the female ACD connector.



| Step | Action                                                                                                                           |
|------|----------------------------------------------------------------------------------------------------------------------------------|
| 7    | Remove the anti-actuation ring, which prevents unintentional engagement before the ACD connectors have been correctly connected. |



- 8 Push the thumb rest of the male connector down towards the base of the body of the connector until the thumb rest meets the body.
- Result:* A ratchet sound is heard from the male ACD connector during this motion. The present state of the connector is shown in the illustration below.



6 Preparation

6.5 Prepare disposable bag

| Step | Action                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------|
| 9    | Perform a visual inspection of the mated connection to confirm that the sealing O-rings are in place and that they are not distorted. |



**NOTICE**

If there is any indication that the connection might not be aseptic, immediately clamp off this probe sheath assembly on the short section of silicone tubing between the disposable bag and the female ACD connector.



| Step | Action                                                                                                                                                                                      |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10   | Hold the mated connectors with one hand and push the end plug of the probe sheath assembly inwards toward the disposable bag, compressing the bellows section of the probe sheath assembly. |



*Result:* The bellows section of the probe sheath assembly will be fully compressed, as shown below.



| Step | Action                                                                                                                                                      |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | Hold the probe sheath assembly in its fully compressed state in one hand and tighten the three ratchet clamps with a tool, until 7 clamp teeth are engaged. |



**NOTICE**

If the ratchet clamps are excessively tightened, they can break. Previous experience has shown that even if a ratchet clamp breaks, the probe itself would not be damaged, even if it is a pH probe with a glass body.

*Result:* The tip of the probe extends above the surface at the inside of the disposable bag for about 8 mm. The probe is now ready to be connected to the appropriate cable.

The illustration below shows a compressed probe sheath assembly in place.



To connect the next probe, repeat steps 1 to 11 above.

## Completed probe sheath installation

When the primary and secondary seals are in place and properly tightened, the entire probe sheath assembly will be maintained in its compressed condition even against the internal pressure in the disposable bag without the need of external fixtures. No additional measures are needed to prevent the probe from sliding out of the disposable bag, the probe will maintain its configuration during the whole cell culture run.

---

## Complete the bag installation

Complete the bag installation by following the instructions below.

| Step | Action                                                                    |
|------|---------------------------------------------------------------------------|
| 1    | Clamp off any unused probe port connections, for example with a hemostat. |



6 Preparation

6.5 Prepare disposable bag

| Step | Action                                                                    |
|------|---------------------------------------------------------------------------|
| 2    | Insert the temperature probe to thermowell at the back at the XDR vessel. |

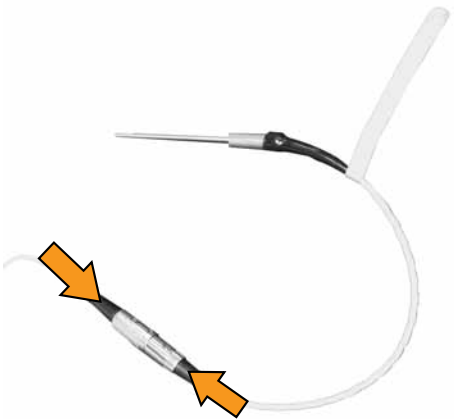


**NOTICE**

Before inserting the probe, verify that the zip tie is removed from the thermowell.



|   |                                                                                   |
|---|-----------------------------------------------------------------------------------|
| 3 | Connect the temperature probe to the appropriate cable from the instrument tower. |
|---|-----------------------------------------------------------------------------------|





| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------|
| 4 | Verify that the connections between the XDR vessel and the instrument tower are as shown in the image below. |
|---|--------------------------------------------------------------------------------------------------------------|

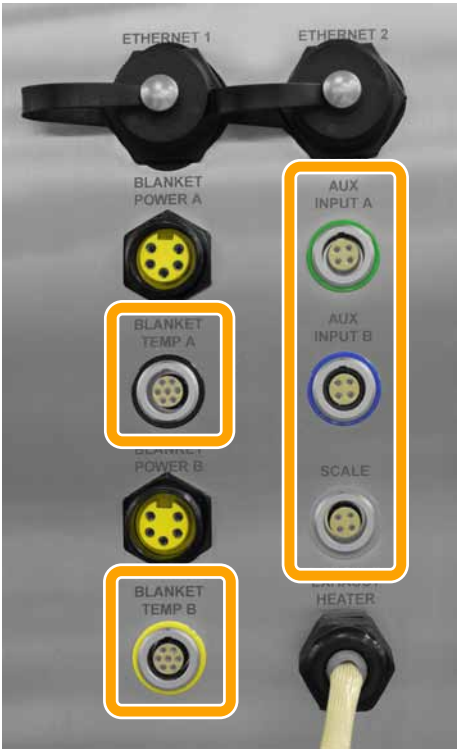


**NOTICE**

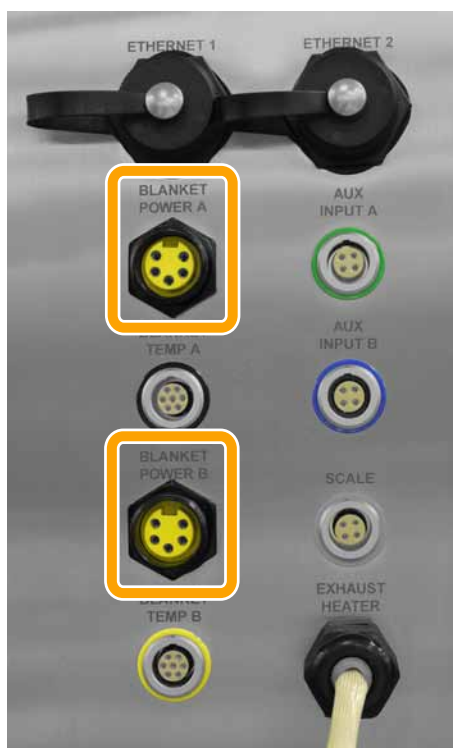
The connectors on the heating blanket temperature measurement connections are color coded.



| Step | Action                                                                                                                                                                                                                                                                                                                                                                                 |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>If a plug needs to be inserted in the heating blanket temperature connectors (<b>BLANKET TEMP A</b>, <b>BLANKET TEMP B</b>), auxiliary inputs (<b>AUX INPUT A</b>, <b>AUX INPUT B</b>) or to the balance connectors (<b>SCALE</b>), follow the instructions below.</p> <ol style="list-style-type: none"><li>1 Align the red dots.</li><li>2 Push until you hear a click.</li></ol> |



| Step | Action                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>If a plug needs to be inserted in any of the heating blanket power connectors (<b>BLANKET POWER A</b>, <b>BLANKET POWER B</b>), follow the instructions below.</p> <ol style="list-style-type: none"><li>1 Align the mating pins.</li><li>2 Push to connect.</li><li>3 Twist the metal ring to lock.</li></ol> |



| Step | Action                                                                           |
|------|----------------------------------------------------------------------------------|
| 7    | Verify that all connectors are connected to their respective channels correctly. |

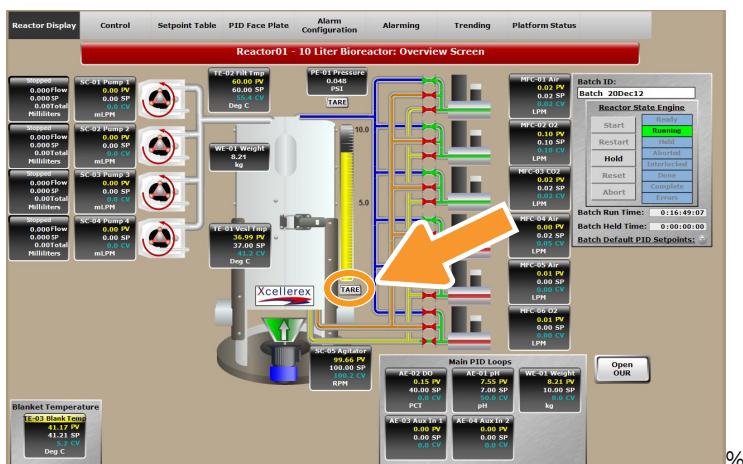
| Verify that ..                  | Is connected to ..            |
|---------------------------------|-------------------------------|
| ETHERNET 1 or 2                 | laptop                        |
| BLANKET POWER A, BLANKET TEMP A | same side of XDR vessel       |
| BLANKET POWER B, BLANKET TEMP B | same side of XDR vessel       |
| RTD cable                       | bioreactor temperature sensor |
| bag pressure                    | bag pressure sensor           |
| pH cable                        | pH sensor                     |
| DO cable                        | DO sensor                     |
| balance (optional)              | balance input                 |
| AUX input(s) (optional)         | auxiliary device(s)           |

- 8      Verify that the exhaust heater is installed and pre-heated.
- 9      If your system is a multi-vessel system, verify that the Ethernet connections between the vessels are correctly made:
- Laptop Ethernet port to **ETHERNET 1** port of the master instrument tower.
  - **ETHERNET 2** port of the master instrument tower to **ETHERNET 1** port of the slave instrument tower.
- See [Connect a multi-vessel system, on page 94](#) for more information.

## Step Action

10 Tare the XDR vessel weight:

- 1 Click the **TARE** button at the bottom of the reactor weight graphics display in the **Reactor Display** window.



- 2 Confirm by clicking **YES** in the pop-up dialog box.

### Note:

Password confirmation is needed to access the function if XDR-10 Benchtop Bioreactor System is a FlexFactory additional component.

## Connect the disposable bag

Follow the instructions below to connect the gas lines to the disposable bag.

## Step Action

- 1 Remove the rubber hood from the filter.

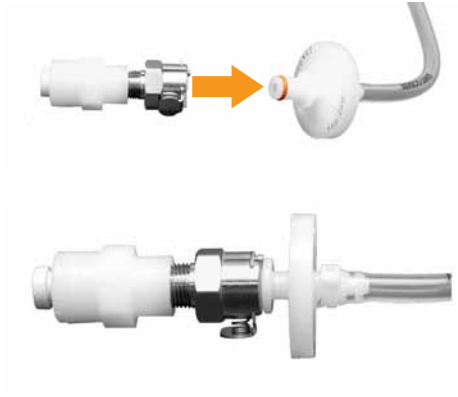


6 Preparation

6.5 Prepare disposable bag

| Step | Action |
|------|--------|
|------|--------|

- 2      Connect the filter to the sparge connector.



- 3      Gently pull the connector and tube up to the tubing manager slots of the bioreactor assembly.



- 4      Connect the flexible tube to sparge 1 connector.  
*Result:* The filter on the incoming gas line is prevented from being wetted.

| Step | Action                                                                                                         |
|------|----------------------------------------------------------------------------------------------------------------|
| 5    | Connect the other line of the sparge gas line to the sparge 1 connector on the instrument tower control panel. |



- 6 If required by the process, connect the headsweep (overlay).
- 7 Connect the bag pressure sensor.

**Tip:**

*The bag pressure sensor is designed to allow only correct connection.*



- 8 Tare the bag pressure sensor until it reads 0 bar (0.0 psig).

## Connect tubing

Connect the tubing by following the instructions below.

| Step | Action                                                                                       |
|------|----------------------------------------------------------------------------------------------|
| 1    | Gently pull sparge 1 tubing (and sparge 2 tubing, if applicable) through the tubing manager. |
| 2    | Gently pull acid and base addition tubing through the tubing manager.                        |
| 3    | Gently pull the headspace gas tubing through the tubing manager.                             |
| 4    | Gently pull the acid and base addition tubing to their respective containers.                |

6 Preparation

6.5 Prepare disposable bag

| Step | Action                                                                                                                                                                              |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Run the acid and base addition tubing through the desired pump: <ol style="list-style-type: none"><li>1 Open the pump head.</li><li>2 Insert the tubing through the pump.</li></ol> |



- 3 Close the pumphead.
- 6 If larger pumps are used and if the tubing is moving in the pump head, tighten the thumb tab half a turn clockwise.



*Result:* The adjustable thumb tab grips the tubing and prevents the tubing from moving in the pump head.



**CAUTION**

**Do not overtighten tabs.** Do not overtighten the adjustable thumb tabs. The flow through the tubing may be cut off.



## Install the exhaust filter heater assembly

Follow the instructions below to install the exhaust filter heater assembly.

| Step | Action                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Open the exhaust filter heater using both hands.                                                                                                     |
| 2    | Hold the exhaust filter heater open with one hand.                                                                                                   |
| 4    | Insert the exhaust filter into the exhaust filter with the other hand, so that top and bottom nubs are inserted into the holes of the filter heater. |



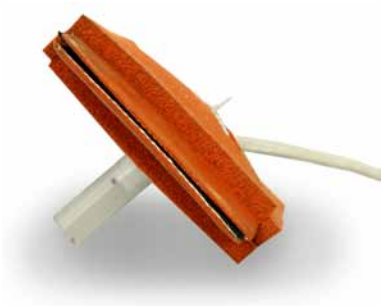
6 Preparation

6.5 Prepare disposable bag

| Step | Action                           |
|------|----------------------------------|
| 5    | Close the exhaust filter heater. |



Result:



| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                         |
|---|-------------------------------------------------------------------------|
| 6 | Push the tube leading from the bag into the exhaust filter holder clip. |
|---|-------------------------------------------------------------------------|



## Heat up the exhaust filter heater

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------|
| 1 | Log in to the software. See <a href="#">Log in, on page 144</a> for instructions for how to log in to the system.              |
| 2 | Locate the exhaust filter heater in the software.                                                                              |
| 3 | Enable the exhaust filter heater.                                                                                              |
| 4 | Set the exhaust filter heater controller to <b>Auto</b> .                                                                      |
| 5 | Enter a temperature setpoint as 60°C.<br><i>Result:</i> The exhaust filter will heat up.                                       |
| 6 | Leave the exhaust filter heater to reach its operating temperature for 30 minutes to 1 hour before filling the bag with media. |



### NOTICE

Failure to set up the exhaust filter heater properly may result in moisture accumulation and a clogged filter, which may lead to severe bag overpressure.

## 6.6 Calibrate the pump

### Frequency

Pump calibration is performed by the user. The pump must be calibrated each time a different tubing size is used in a particular pump. For maximum accuracy pump calibration should be performed routinely to guarantee operational accuracy over time. Please contact your GE representative for help and suggestions.

**Note:** *External pumps are calibrated using the procedure defined by the manufacturer. Please see manufacturer's information for more information.*

### Preparation

The pump calibration procedure determines the flow factor for the pump. The flow factor is used for calculation of the flow rate and the totalized flow.

The following equipment is needed for pump calibration:

- a water reservoir (minimum 2 L)
- tubing (identical to the tubing used during process)
- a collection container (volume minimum 2 L).

**Note:** *The collection container must enable the quantification of collected water. The container could be a graduated vessel or a tared container placed on a balance. Consider the accuracy required for your particular operation.*

To prepare for pump calibration follow the steps described below.



**CAUTION**  
**Pinch hazard.** Do not operate the pumps without the covers in place.

| Step | Action                                                                                              |
|------|-----------------------------------------------------------------------------------------------------|
| 1    | Place the water reservoir onto the same height as the process liquid.                               |
| 2    | Install the tubing into the pump. See <a href="#">Connect tubing, on page 131</a> for instructions. |
| 3    | Put the inlet of the tubing into the water reservoir.                                               |
| 4    | Put the outlet of the tubing into the collection container.                                         |

| Step | Action                                                                                                                                                                      |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | Prime the pump: <ol style="list-style-type: none"> <li>1 set the pump in <b>Local/Manual</b> mode</li> <li>2 run the pump until the tubing is filled with water.</li> </ol> |
| 6    | Discard the priming water.                                                                                                                                                  |

## Calibration

To start the pump calibration follow the instructions below.

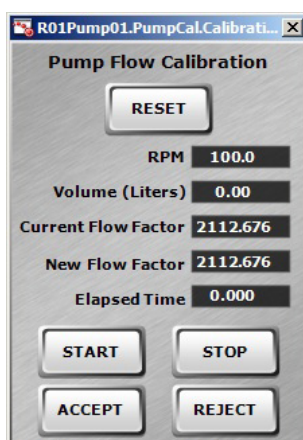


### CAUTION

**Pinch hazard.** Do not operate the pumps without the covers in place.

**Note:** Pump calibration is performed in rpm per volume of transferred liquid. When the pump is run in calibration mode, pump speed is displayed in rpm on PID faceplate.

| Step | Action                                                      |
|------|-------------------------------------------------------------|
| 1    | Empty and tare the collection container, if needed.         |
| 2    | Open the <b>Pump Flow Calibration</b> faceplate dialog box. |



6 Preparation

6.6 Calibrate the pump

| Step | Action                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Click <b>Reset</b> .<br><i>Result:</i> The volume and the elapsed time values are set to zero.                                                                                     |
| 4    | Click <b>Start</b> .<br><i>Result:</i> The pump starts to operate. The <b>Elapsed Time</b> counter will start. The volume shown in <b>Pump Totalizer</b> dialog box will increase. |
| 5    | Run the pump for at least 5 minutes.<br><br><b>Tip:</b><br><i>The longer the pump runs, the more accurate the calibration.</i>                                                     |
| 6    | Click <b>Stop</b> in the <b>Pump Flow Calibration</b> dialog box.                                                                                                                  |
| 7    | Determine the volume of the collected liquid.                                                                                                                                      |
| 8    | Type the volume of the collected liquid into the volume text field in the <b>Pump Flow Calibration</b> dialog box.                                                                 |
| 9    | Click <b>Accept</b> .<br><i>Result:</i> A new flow factor will be calculated and shown in <b>New Flow Factor</b> text field.                                                       |

# 7 Operation

## About this chapter

This chapter provides required information to safely operate XDR-10 Benchtop Bioreactor System.

---

## In this chapter

| Section                                | See page |
|----------------------------------------|----------|
| 7.1 General safety precautions         | 140      |
| 7.2 Start up the system                | 141      |
| 7.3 Configure control loops            | 148      |
| 7.4 Control the batch                  | 173      |
| 7.5 Work with alarms                   | 187      |
| 7.6 Manage the disposable bag contents | 197      |
| 7.7 Finish a batch run                 | 213      |

---

## 7.1 General safety precautions



### WARNING

**Hazardous substances.** When using hazardous chemical and biological agents, take all suitable protective measures, such as wearing protective glasses and gloves resistant to the substances used. Follow local and/or national regulations for safe operation and maintenance of the system.



### WARNING

**Gas leakage hazard.** Make sure that the gas connections are tight in order to avoid gas leakage.



### WARNING

**Slipping hazard.** Remove any spillage on the floor immediately to minimize the risk for slipping accidents.



### CAUTION

**Tuning PID control loops.** Make sure that personnel tuning PID control loops are qualified to perform this task. Incorrectly tuned PID loops could cause injury to personnel and damage the instrument.



### CAUTION

**Changing split range setup.** Only qualified personnel should change the split range percentage. Incorrectly set up split range could cause injury to personnel and damage the instrument.



## 7.2 Start up the system

### Introduction

This section provides information about how to start XDR-10 Benchtop Bioreactor System and how to log in to the software.

---

### In this section

| Section                | See page |
|------------------------|----------|
| 7.2.1 Start the system | 142      |
| 7.2.2 Log in / log out | 144      |

## 7.2.1 Start the system

### Start the system

Follow the instructions below to start the bioreactor.

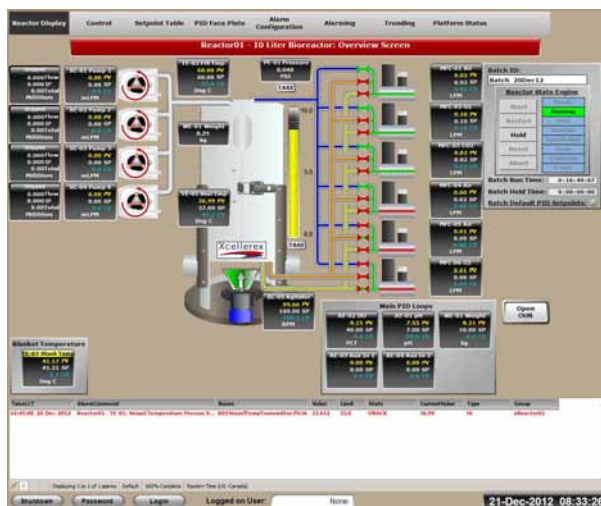
| Step | Action                                                                                  |
|------|-----------------------------------------------------------------------------------------|
| 1    | Make sure that the instrument tower and the laptop are plugged into a power source.     |
| 2    | Turn on the power switch located at the back of the instrument tower to the I-position. |



| Step | Action |
|------|--------|
|------|--------|

|   |                                       |
|---|---------------------------------------|
| 3 | Press the power button on the laptop. |
|---|---------------------------------------|

*Result:* When the system completes booting, the laptop screen shows the overview screen.



## 7.2.2 Log in / log out

### Log in

Follow the instructions below to log in to the Wonderware software.

| Step | Action                                                                                                                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | <p>Open the Wonderware:</p> <ul style="list-style-type: none"><li>• click the <b>WindowViewer</b> icon  on the desktop or on the taskbar or</li><li>• select <b>Start:WindowViewer</b>.</li></ul> |

*Result:* The Wonderware start view opens.



**Note:**  
*After computer restart Wonderware restarts automatically and displays the **Reactor Display** window for **Reactor01**.*

**Step Action**

- 2 Click **Reactors** on the header toolbar. Select the relevant reactor from the drop-down menu, if available.



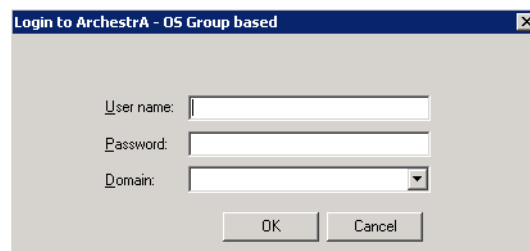
Result: The **Reactor Display** window opens.



- 3 Click the **Login** button on the footer toolbar.

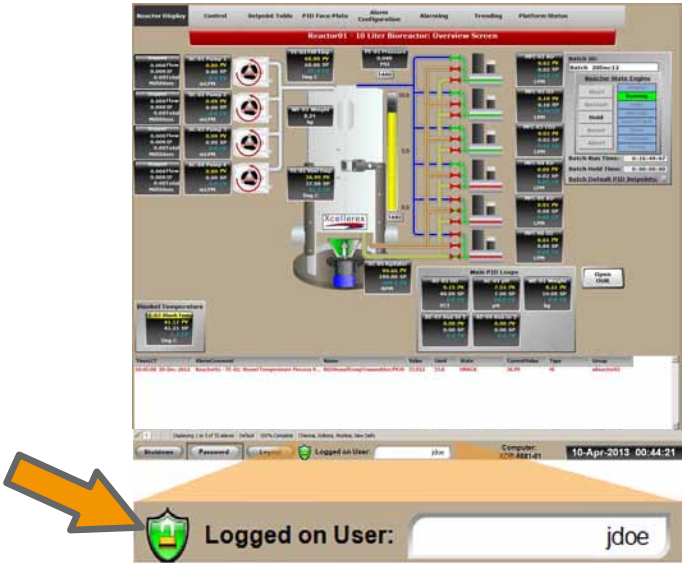


Result: The **Login to Arcestra<sup>1</sup>** dialog opens.



- 4 Type the user name in the **User Name** text field.
- 5 Type the chosen password in the **Password** text field.

- | Step | Action                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Leave the <b>Domain</b> text field blank.<br><br><b>Note:</b><br><i>The domain field is filled in if the bioreactor is a FlexFactory additional component. The domain name may vary depending on user request.</i> |
| 7    | Click the <b>OK</b> button.<br><br><b>Result:</b> The <b>Login</b> button text changes to <b>Logout</b> . The user name appears in the text field on the screen footer and the security symbol turns green.        |



1 Archestra is a trademark of Invensys Systems.

## Log out

Follow the instructions below to log out of the Wonderware software.  
Click the **Logout** button on the screen footer.



**Result:** The user will be logged out. The security symbol will turn red and the user name will appear as **None**.

## Auto log off

| If you have been inactive for ... | Then...                                                                                                                                                                                                                                                                                           |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| more than 25 minutes              | <p>an <b>AutoLogOffWarning</b> message is displayed on the screen.</p>                                                                                                                                           |
| more than 30 minutes              | <p>the user is automatically logged out. A second message is displayed on the screen indicating that the user has been logged out. The security symbol turns red and the user name appears as <b>None</b>.</p>  |

After logging in again, the most recently used window is displayed.

# 7.3 Configure control loops

## Introduction

This section provides the information about how to map and unmap control loops, and how to change the mapping.

For more information about how to set up process control see [Appendix B.3 User interface: control functions, on page 336](#).

---

## In this section

| Section                                      | See page |
|----------------------------------------------|----------|
| 7.3.1 Map a control loop using lookup tables | 149      |
| 7.3.2 Map a control loop using a split range | 156      |
| 7.3.3 Unmap or change mapping                | 162      |
| 7.3.4 Manage a split range                   | 171      |



## 7.3.1 Map a control loop using lookup tables

### Introduction

DO control loop is a typical controller loop that is mapped using lookup tables. In the following example, this loop is controlled by two lookup tables:

- Air MFC
- Oxygen MFC

### Map the control loop to lookup tables

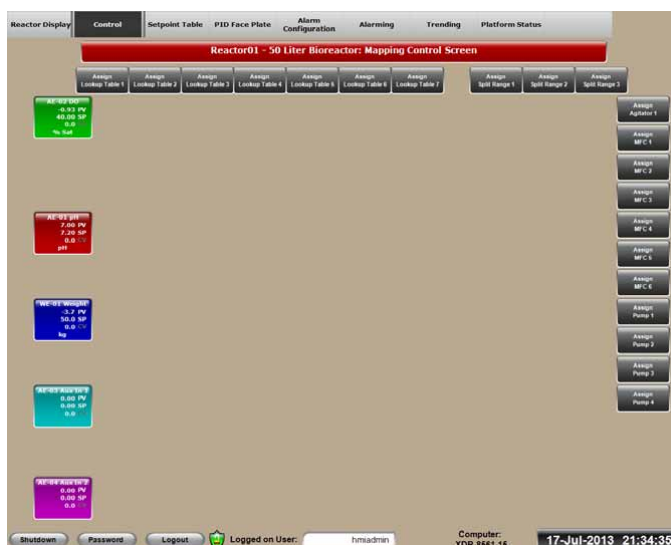
Follow the instructions below to map a PID control loop to the first lookup table.

#### Step Action

- 1 Click the **Control** button on the header toolbar.



*Result:* The **Control** window is displayed. The illustration below shows an unmapped **Control** window.



7 Operation

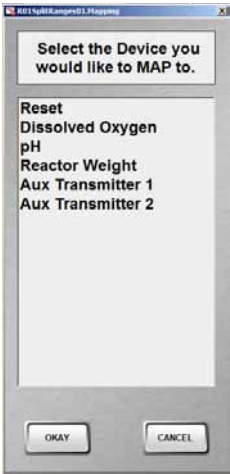
7.3 Configure control loops

7.3.1 Map a control loop using lookup tables

| Step | Action                               |
|------|--------------------------------------|
| 2    | Click <b>Assign Lookup Table 1</b> . |

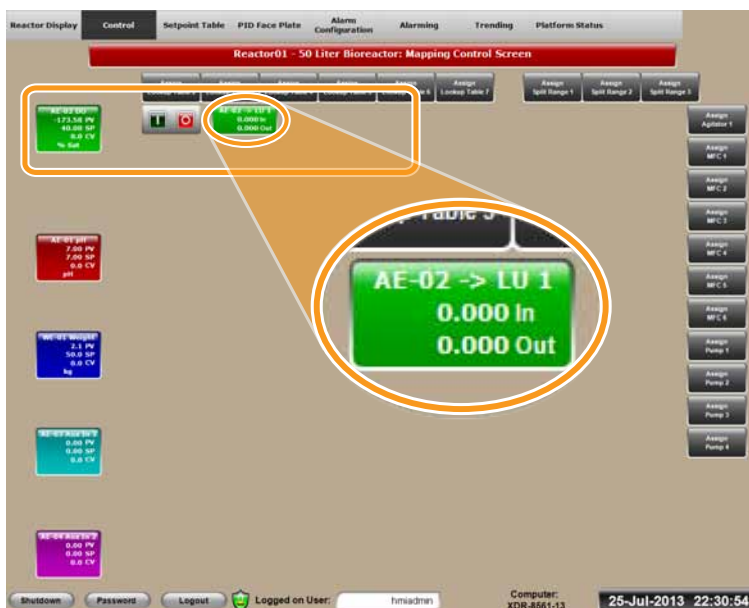


*Result:* A dialog box opens and shows the available mapping options.



| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | <p>Choose an appropriate option, for the DO control loop choose <b>Dissolved Oxygen</b>. Click <b>OKAY</b>.</p> <p><i>Result:</i> The lookup table dialog box closes, the <b>Assign Lookup Table 1</b> object turns green and moves down, lining up with the DO PID control loop overview window.</p> |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



- |   |                                                                                                                                                                                                                                                                                          |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | <p>Click the dark green <b>I</b> button , then click <b>YES</b> in the confirmation dialog.</p> <p><i>Result:</i> The button turns bright green, indicating that <b>Lookup Table 1</b> is active.</p> |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

7 Operation

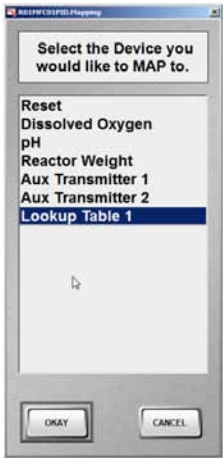
7.3 Configure control loops

7.3.1 Map a control loop using lookup tables

| Step | Action                               |
|------|--------------------------------------|
| 5    | Click <b>Assign MFC 1</b> (Air MFC). |



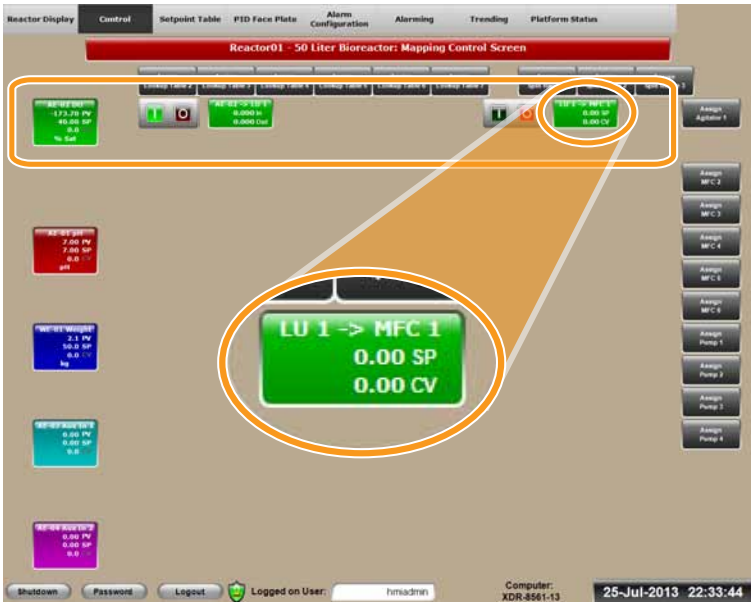
*Result:* A dialog box opens with the available device options.



| Step | Action |
|------|--------|
|------|--------|

|   |                                                                          |
|---|--------------------------------------------------------------------------|
| 6 | Choose <b>Lookup Table 1</b> in the dialog box, then click <b>OKAY</b> . |
|---|--------------------------------------------------------------------------|

*Result:* The **MFC 1** dialog box closes, the **Assign MFC 1** object turns green and moves towards the control loop overview object, lining up with the **DO PID Overview** and the **Lookup Table 1** objects.



|   |                                                                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7 | Click the dark green I button  , then click <b>OKAY</b> in the confirmation dialog. |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

*Result:* The Air MFC (**MFC 1**) is now mapped to **Lookup Table 1**.

|   |                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------|
| 8 | To map the PID control loop to the second lookup table, repeat steps 2 to 7 above with the following components: |
|---|------------------------------------------------------------------------------------------------------------------|

- In step 2, choose **Assign Lookup Table 2**.
- In step 3, choose **Dissolved Oxygen**.
- In step 5, click **Assign MFC 2** (Oxygen MFC).
- In step 6, choose **Lookup Table 2**.

Configure the lookup tables

When both lookup tables have been mapped to the PID control loop, follow the instructions below to configure the first lookup table.

StepAction

- 1Click on the *Lookup Table 1* object.



Result: *Lookup Table 1* opens.

|        | In   | Out    |
|--------|------|--------|
| Row 0  | 0.00 | 0.0000 |
| Row 1  | 0.00 | 0.0000 |
| Row 2  | 0.00 | 0.0000 |
| Row 3  | 0.00 | 0.0000 |
| Row 4  | 0.00 | 0.0000 |
| Row 5  | 0.00 | 0.0000 |
| Row 6  | 0.00 | 0.0000 |
| Row 7  | 0.00 | 0.0000 |
| Row 8  | 0.00 | 0.0000 |
| Row 9  | 0.00 | 0.0000 |
| Row 10 | 0.00 | 0.0000 |
| Row 11 | 0.00 | 0.0000 |
| Row 12 | 0.00 | 0.0000 |
| Row 13 | 0.00 | 0.0000 |
| Row 14 | 0.00 | 0.0000 |
| Row 15 | 0.00 | 0.0000 |
| Row 16 | 0.00 | 0.0000 |
| Row 17 | 0.00 | 0.0000 |
| Row 18 | 0.00 | 0.0000 |
| Row 19 | 0.00 | 0.0000 |

Insert RowDelete Row
Refresh ChartClose Popup
Define Mapping

| Step | Action                                                                                                                                                               |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Enter the desired DO control parameters for <b>MFC 1</b> (Air MFC) in <b>Lookup Table 1</b> .                                                                        |
| 3    | When all parameters have been entered, click <b>Close Popup</b> .                                                                                                    |
| 4    | To enter the DO control parameters for <b>MFC 2</b> (Oxygen MFC) into <b>Lookup Table 2</b> click on the <b>Lookup Table 2</b> object and repeat steps 2 to 3 above. |

## Description of the mapped DO control loop

After completion of the two mapping cycles and configuring the two lookup tables, the DO control loop has been mapped to two lookup tables and two controllers (Air MFC and Oxygen MFC). The following figure displays an image of **Control** window with the completed DO mapping.



**Note:** It is possible to map a third lookup table to DO control and use the agitator in conjunction with the MFCs.

## 7.3.2 Map a control loop using a split range

### Introduction

The pH controller loop is a typical controller loop that is mapped using split range. The pH is controlled by:

- Carbon dioxide MFC or acid pump for the low range control,
- Base pump for the high range control.

### Map a PID control loop using a split range

Follow the instructions below to map a PID control loop to a split range.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                        |
|---|--------------------------------------------------------|
| 1 | Click the <b>Control</b> button on the header toolbar. |
|---|--------------------------------------------------------|



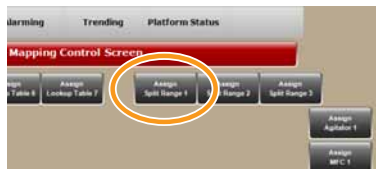
*Result:* The **Control** window is displayed. The illustration below shows an unmapped **Control** window.



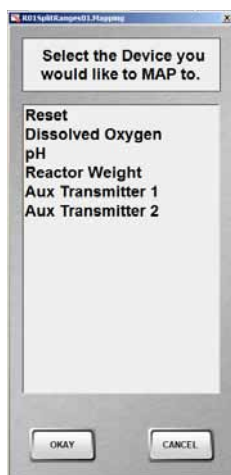


| Step | Action |
|------|--------|
|------|--------|

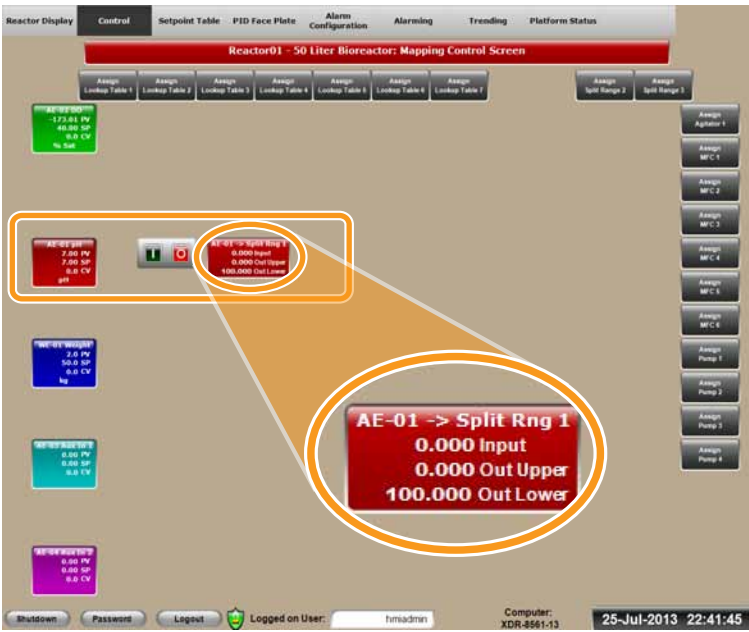
- |   |                                     |
|---|-------------------------------------|
| 2 | Click <b>Assign Split Range 1</b> . |
|---|-------------------------------------|



*Result:* A dialog box opens and shows the available mapping options.



- | Step | Action                                                                                                                                                                                                                                                                          |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Choose an appropriate option, for pH control loop choose <b>pH</b> . Click <b>OKAY</b> .<br><i>Result:</i> The split range overview dialog box closes, the <b>Assign Split Range 1</b> object turns red and moves down, lining up with the pH PID control loop overview object. |



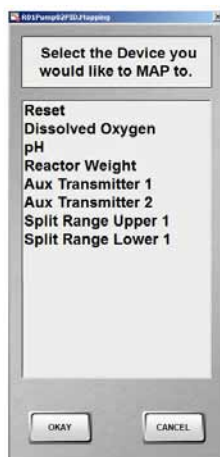
- 4 Click the dark green I button  , then click **YES**.  
*Result:* The button turns bright green, indicating that **Split Range 1** is active.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                         |
|---|-----------------------------------------|
| 5 | Click <b>Assign Pump 1</b> (Base pump). |
|---|-----------------------------------------|



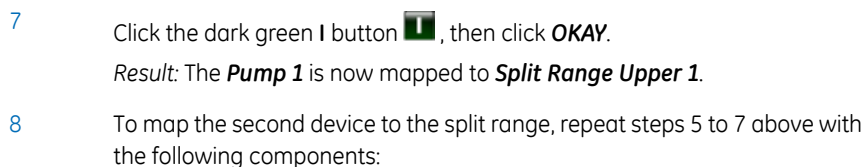
*Result:* A dialog box opens with the available device options.



### 7.3.2 Map a control loop using a split range

6 Choose **Split Range Upper 1** in the dialog box, then click **OKAY**.

*Result:* The dialog box closes, the **Assign Pump 1** object turns red and moves towards the control loop overview object, lining up with the **pH PID Overview** and the **Split Range 1** objects.



The pH is now mapped to **Split Range 1** and **Pump 1**; and to the second device (**MFC 3** or **Pump 2**).

### Illustration of *Control* window with completed pH mapping

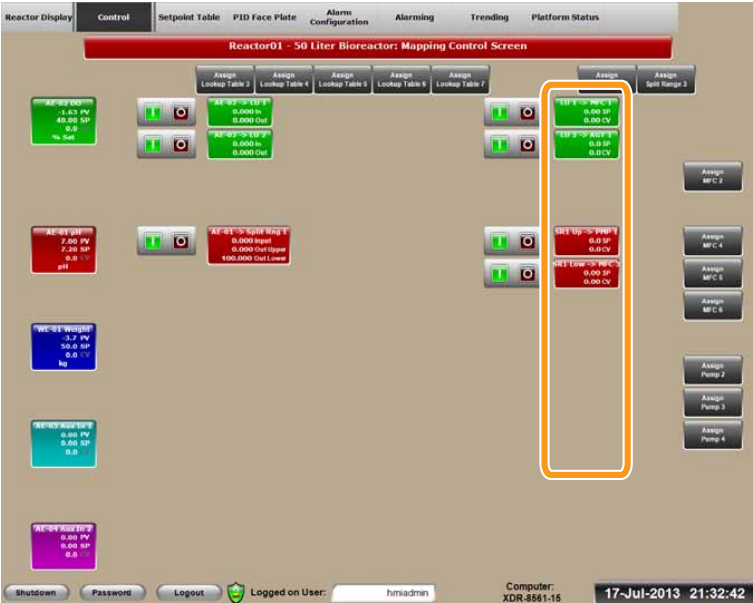


7.3.3
Unmap or change mapping

Unmap a device

Follow the steps below to unmap a device.

| Step | Action                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Locate the device object you want to unmap in <b>Control</b> window. The location of available objects is shown in the illustration below. |



|   |                                                                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Click the dark red  button at the left of the object.<br>Result: A dialog box opens. |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



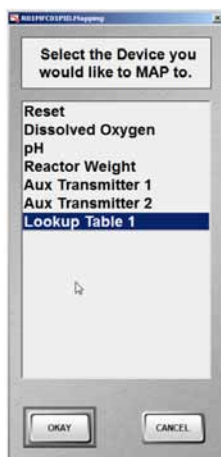
| Step | Action |
|------|--------|
|------|--------|

|   |                    |
|---|--------------------|
| 3 | Click <b>YES</b> . |
|---|--------------------|

*Result:* The bright green **I** button turns dark green , indicating that the device is not active.

|   |                                 |
|---|---------------------------------|
| 4 | Now click on the device object. |
|---|---------------------------------|

*Result:* A mapping dialog box opens with the available device options.



| Step | Action                                                                                                                                                                                                                                                          |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5    | <p>Choose <b>Reset</b> in the dialog box, then click <b>OKAY</b>.</p> <p><i>Result:</i> The dialog box closes, the object turns grey and moves towards the right edge of the <b>Control</b> window, lining up with all available device assignment buttons.</p> |



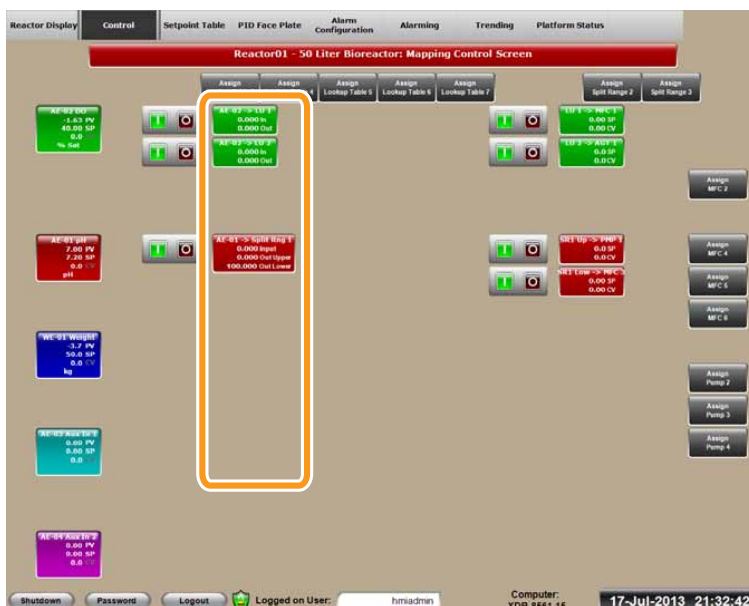


## Unmap a lookup table

Follow the steps below to unmap a lookup table.

### Step Action

- 1 Locate the lookup table object you want to unmap in **Control** window. An example of the object location is shown in the illustration below.



- 2 Click the dark red **O** button  at the left of the object.  
*Result:* A dialog box opens.



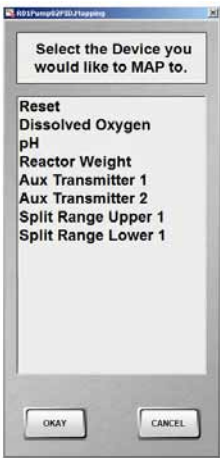
- 3 Click **YES**.  
*Result:* The bright green **I** button turns dark green , indicating that the lookup table is not active.

Step Action

- 4 Now click on the lookup table object.  
*Result:* A lookup table opens.



- 5 Click the **Define Mapping** button.  
*Result:* A mapping dialog box opens with the available device options.



- 6 Choose **Reset** in the dialog box, then click **OKAY**.

**Step Action**

7 Close the lookup table by clicking the **x** at the top right corner of the dialog box.

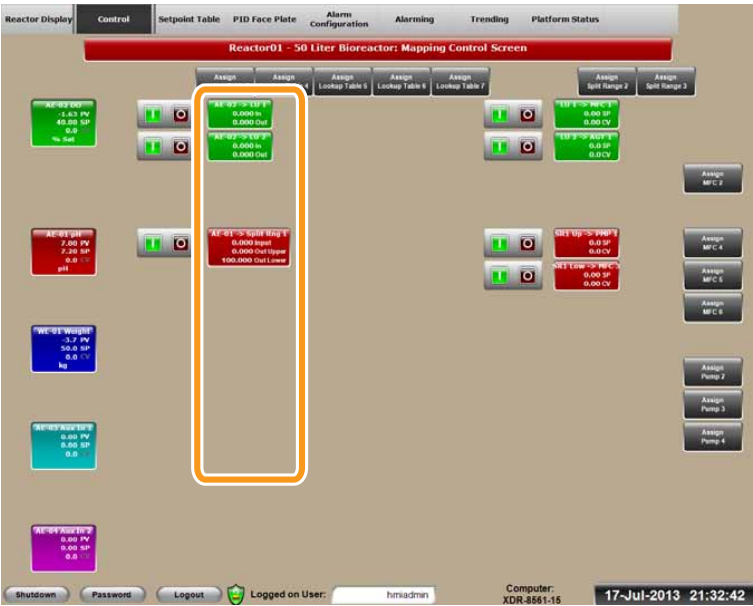
*Result:* The dialog box closes, the lookup table object turns grey and moves towards the top of the **Control** window, lining up with all available intermediate control element buttons.



Unmap a split range

Follow the steps below to unmap a split range.

- | Step | Action                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Locate the split range object you want to unmap in <b>Control</b> window. An example of the object location is shown in the illustration below. |



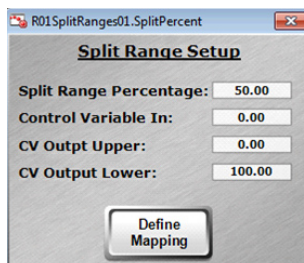
- 2
- Click the dark red **O** button  at the left of the object.
- Result:* A dialog box opens.



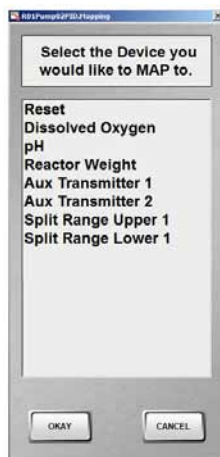
- 3
- Click **YES**.
- Result:* The bright green **I** button turns dark green , indicating that the split range is not active.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------|
| 4 | Now click on the split range object.<br><i>Result:</i> A <b>Split Range setup</b> dialog box opens. |
|---|-----------------------------------------------------------------------------------------------------|

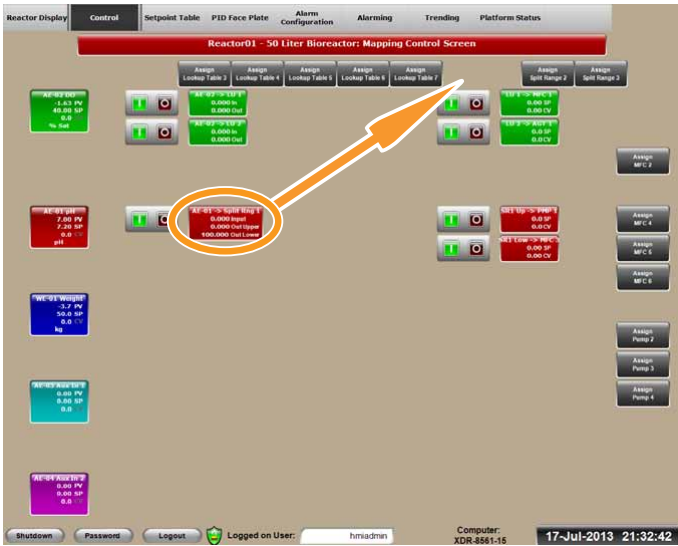


- |   |                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------|
| 5 | Click the <b>Define Mapping</b> button.<br><i>Result:</i> A mapping dialog box opens with the available device options. |
|---|-------------------------------------------------------------------------------------------------------------------------|



- |   |                                                                 |
|---|-----------------------------------------------------------------|
| 6 | Choose <b>Reset</b> in the dialog box, then click <b>OKAY</b> . |
|---|-----------------------------------------------------------------|

| Step | Action                                                                                                                                                                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Close the <b>Split Range setup</b> dialog box by clicking the <b>x</b> at the top right corner of the dialog box.</p> <p><i>Result:</i> The dialog box closes, the split range object turns grey and moves towards the top of the <b>Control</b> window, lining up with all available intermediate control element buttons.</p> |



## Change PID control loop mapping

To change the mapping of a PID control loop follow the instructions below.

| Step | Action                                                                                                                                                                                                                                                             |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Unmap a lookup table or a split range. See <a href="#">Unmap a lookup table, on page 165</a> or <a href="#">Unmap a split range, on page 168</a> for instructions.                                                                                                 |
| 2    | Repeat for a second lookup table or a second split range if applicable.                                                                                                                                                                                            |
| 3    | Map the relevant lookup table or split range to the PID control loop. See <a href="#">Section 7.3.1 Map a control loop using lookup tables, on page 149</a> or <a href="#">Section 7.3.2 Map a control loop using a split range, on page 156</a> for instructions. |

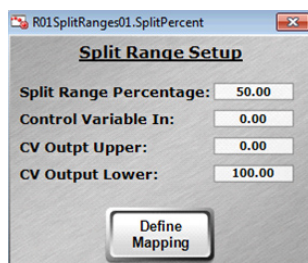
## 7.3.4 Manage a split range

### Change split range functions

When a split range has been mapped to a device, you can click on a split range object to access its functions.



Result: The **Split Range Setup** dialog box will be displayed.



Set an output device to work in reverse

An output device (for example, a pump) can be set to work in reverse; for example, to increase the process variable (PV) value when the control variable (CV) value decreases. To set the pump to work in reverse, follow the instructions below.

| Step | Action                                                                                                                                                                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Unmap the <b>Split Range Upper 1</b> and <b>Split Range Lower 2</b> pumps. See <a href="#">Unmap a device, on page 162</a> for instructions.                                                                                                                                      |
| 2    | Follow the steps 5 to 7 in <a href="#">Map a PID control loop using a split range, on page 156</a> , make the following choices: <ul style="list-style-type: none"><li>• In step 5, click <b>Assign Pump 1</b>.</li><li>• In step 6, choose <b>Split Range Upper 1</b>.</li></ul> |
| 3    | Repeat the steps 5 to 7 making the following choices: <ul style="list-style-type: none"><li>• In step 5, click <b>Assign Pump 2</b>.</li><li>• In step 6, choose <b>Split Range Lower 1</b>.</li></ul> <p><i>Result:</i> The PID control loop is now acting in reverse.</p>       |



## 7.4 Control the batch

### Introduction

This section provides information about how to work with batch control functions, setpoint tables and trends.

---

### In this section

| Section                            | See page |
|------------------------------------|----------|
| 7.4.1 Control functions            | 174      |
| 7.4.2 Configure setpoint tables    | 180      |
| 7.4.3 Start, stop and hold a batch | 182      |
| 7.4.4 Configure trends             | 184      |

## 7.4.1 Control functions

### Access PID control loop faceplate

To access a PID control loop faceplate select the desired PID controller display:

- from the **Reactor Display** window  
or
- from the **Control** window  
or
- from the **PID Face Plate** window.

See [Appendix B.1 User interface: windows, on page 284](#) for detailed description of these windows.

### Temperature control

Follow the instructions below to set the temperature control of the XDR vessel.

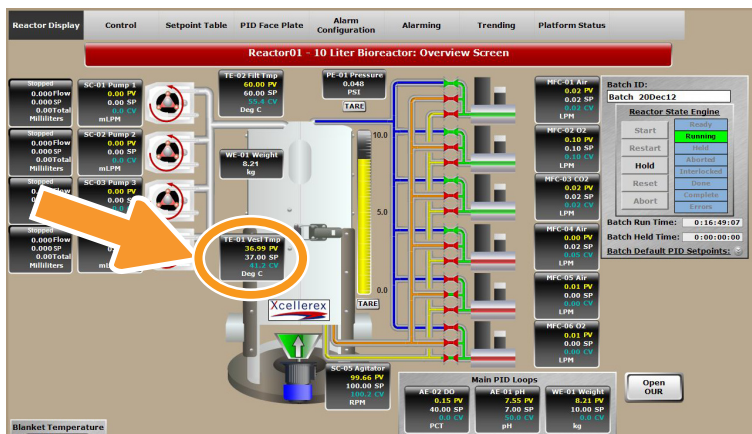
| Step | Action                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------|
| 1    | Display the <b>Reactor Display</b> window by selecting <b>Reactor Display</b> button on header toolbar. |



*Result:* The **Reactor Display** window is displayed.

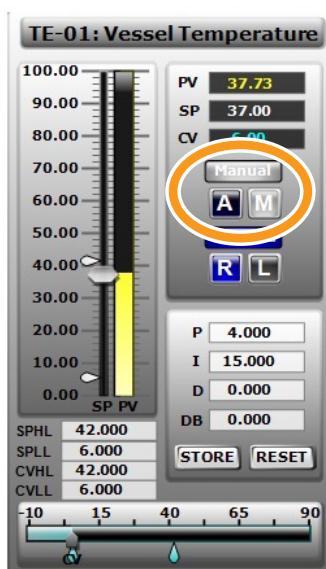
**Step Action**

- 2 Open the **Vessel Temperature** faceplate by clicking on PID control loop temperature display panel.



Result: The **Vessel Temperature** faceplate opens.

- 3 Set the temperature to **Auto** mode by clicking on the **A** button.



- 4 Type the desired temperature setpoint in the **SP** text field.

Agitation control

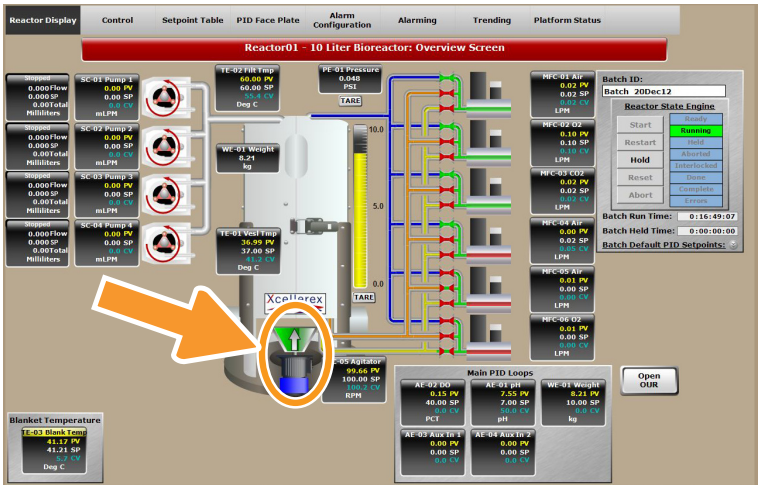
Dissolved oxygen level can be controlled by changing the agitation speed. Follow the instructions below to enable agitation control.

StepAction

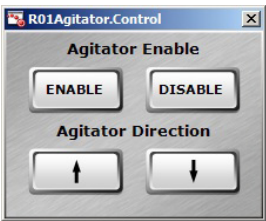
- 1Click the *Reactor Display* button on the header toolbar.



- 2Click the agitator icon in the *Reactor Display* window.



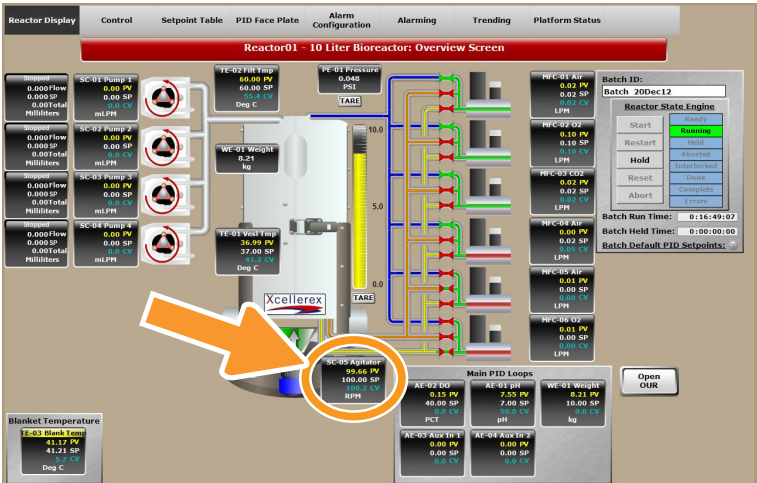
Result: The *Agitator Enable/Disable* dialog box opens.



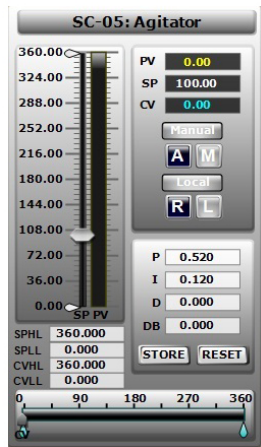
| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | <p>In the <b>Agitator Enable/Disable</b> dialog box,</p> <ul style="list-style-type: none"><li>• click <b>ENABLE</b> to enable the agitator,</li><li>• click the “up” arrow for pumping up or the “down” arrow for pumping down.</li></ul> <p>Close the dialog box.</p> <p><i>Result:</i> The agitator block icon will turn blue and the arrow will point to the selected direction when it is ready for operation.</p> <p><b>Note:</b></p> <p><i>The agitator block icon displays the following colors:</i></p> <ul style="list-style-type: none"><li>• Solid blue when the agitator is enabled</li><li>• Flashing grey and white when the agitator is disabled.</li></ul> <p><b>Note:</b></p> <p><i>The background around the agitator direction arrow turns from red to green when the agitator is on.</i></p> |

Step Action

- 4 Click the agitator object in *Reactor Display* window to open the *Agitator* PID faceplate.



Result: The *Agitator* faceplate is displayed.



- 5 Type the desired agitation setpoint parameter value into the *SP* text field.
- 6 Monitor the system to make sure that agitation control is working as expected.

**Note:** Dissolved oxygen level can also be controlled by mapping the agitator to the DO control loop.

If the impeller baseplate is not correctly positioned, the agitation does not work correctly. During agitation the agitator emits a loud clicking noise and the agitator motor is detached from the impeller baseplate. To correct the problem follow the instructions below.

- 1 Lift the impeller baseplate up to detach the agitator motor.
  - 2 Arrange the impeller baseplate correctly, as described in [Install the disposable bag in the XDR vessel, on page 108](#).
-

## 7.4.2 Configure setpoint tables

### Use of Setpoint Table

The **Setpoint Table** gives the user a possibility to assign different values to a control variable during a batch run. Up to twenty steps for each control loop can be programmed. Each step allows to keep the setpoint at a defined level for a specified time period or to introduce a change of the setpoint. The change can be defined to occur either stepwise or gradually from the start setpoint to the end setpoint.

When configuring a gradient change to a setpoint, the user should take into account the maximal increase rate allowed by the hardware or control system for this parameter. The gradient should be configured within the limits of the equipment or PID control loop functionality. See [Section 10.2 CV and SP units and ranges, on page 270](#) for info about the ranges of PID control loops.

The user can set a selected number of steps to repeat. When the last selected step ends, the process returns to the first selected step and repeats the defined sequence of gradient steps.

### Configure Setpoint Table

Follow the instructions below to assign setpoint changes to a control variable.

| Step | Action                                                                                                                                                                                                                       |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Click the <b>Setpoint Table</b> button on the header toolbar.                                                                                                                                                                |
| 2    | Locate the relevant PID control loop setpoint table in the <b>Setpoint Table</b> window.                                                                                                                                     |
| 3    | Click the <b>Configure</b> button to open the <b>Setpoint Table Configuration</b> dialog box of a chosen PID control loop. See <a href="#">Setpoint Table Configuration, on page 332</a> for information on this dialog box. |



| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4    | <p>Enter the setpoint start, setpoint end and duration values for each step in the text fields.</p> <p><b>Note:</b></p> <p><i>Stepwise parameter changes can cause a PID control loop to oscillate around a setpoint. A gradient change of the parameter might facilitate the control loop to settle at the defined value.</i></p> <p><b>Note:</b></p> <p><i>If a PID control loop fails to settle at setpoint after a gradient change of the value, the I and P values might need adjusting. See <a href="#">PID faceplate dialog box, on page 319</a>.</i></p> |
| 5    | <p>If needed, set the steps to repeat by marking the start and stop steps in the <b>Loop</b> columns.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 6    | <p>Click on <b>Apply Changes</b>.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

The setpoint table is designed to be used in connection with the **Batch Manager**. If a setpoint table is enabled but not started, it is started automatically when **Batch Manager** is started.

See [Batch Manager display, on page 182](#) and [Batch Manager display, on page 292](#).

### 7.4.3 Start, stop and hold a batch

#### Batch Manager display

**Batch Manager** display is part of the **Reactor Display** window. The **Batch Manager** display enables the user to enter batch setpoints, monitor batch run time and batch held time, initiate, hold and abort a batch. See [Batch Manager display, on page 292](#) for overview.

#### Manage batches

| If you want to...                                                | Then...                                                                                                                                                                                                                                                                                                                              |
|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| display the <b>Batch Default PID Setpoints</b> drop-down display | click on the double arrow button in the <b>Batch Manager</b> display.                                                                                                                                                                                                                                                                |
| display the <b>Default PID Setpoints</b> dialog box              | click on any value in the <b>Batch Default PID Setpoints</b> drop-down display.                                                                                                                                                                                                                                                      |
| change batch default setpoints                                   | <ul style="list-style-type: none"><li>Enter the setpoints into the appropriate text fields in the <b>Default PID Setpoints</b> dialog box.</li><li>Click <b>OKAY</b>.</li></ul> <p><b>Note:</b><br/><i>The new setpoints are loaded when the batch is started.</i></p>                                                               |
| start a batch                                                    | <p>click the <b>Start</b> button.</p> <p><i>Result:</i></p> <ul style="list-style-type: none"><li>The new setpoints are loaded.</li><li>All configured PID control loops are set to <b>Auto</b> mode with a zero output (except the pH control loop that has output 50).</li><li>The <b>Batch Run Time</b> counter starts.</li></ul> |

| If you want to...                                         | Then...                                                                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| put the batch on hold                                     | <p>click the <b>Hold</b> button.</p> <p><i>Result:</i></p> <ul style="list-style-type: none"> <li>• The batch state is shown as <b>Held</b>.</li> <li>• The <b>Batch Run Time</b> counter stops.</li> <li>• The <b>Batch Held Time</b> counter starts.</li> <li>• All pumps are put into <b>Manual/Remote</b> mode.</li> </ul> |
| leave the <b>Held</b> state and continue the batch run    | <p>click <b>Restart</b>.</p> <p><i>Result:</i></p> <ul style="list-style-type: none"> <li>• The current batch run resumes.</li> <li>• The <b>Batch Run Time</b> counter continues.</li> <li>• The <b>Batch Held Time</b> counter stops.</li> <li>• The pumps return to <b>Auto/Remote</b> mode.</li> </ul>                     |
| stop the batch run                                        | <p>click <b>Abort</b>.</p> <p><i>Result:</i></p> <ul style="list-style-type: none"> <li>• The current batch run stops.</li> <li>• The batch state is shown as <b>Held</b> and <b>Errors</b>.</li> <li>• All pumps are put into <b>Manual/Remote</b> mode.</li> </ul>                                                           |
| return the <b>Batch Manager</b> to the <b>Ready</b> state | <p>click <b>Reset</b>.</p>                                                                                                                                                                                                                                                                                                     |

**Note:** When a PID control loop is in **Remote** mode and is not mapped to a device or configured via a setpoint table, the value entered in the **Batch Default PID Setpoints** will be the active setpoint.

## 7.4.4 Configure trends

### Trending application

Please see also the manufacturer's general help for Trending application. The application help is available in **Start:All programs:Wonderware:Books:Historian Client User Guide**, if installed at recommended location.

### Configure trends

To configure the trends follow the instructions below.

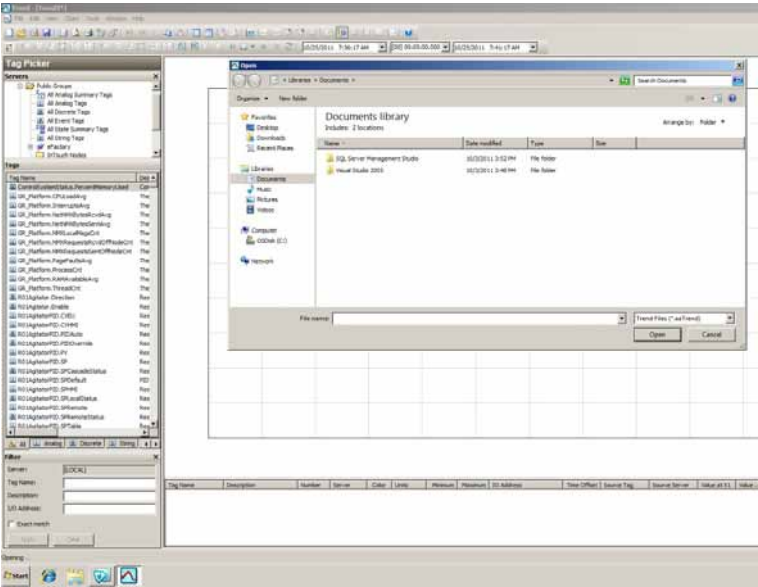
| Step | Action |
|------|--------|
|------|--------|

- |   |                                                         |
|---|---------------------------------------------------------|
| 1 | Click the <b>Trending</b> button on the header toolbar. |
|---|---------------------------------------------------------|



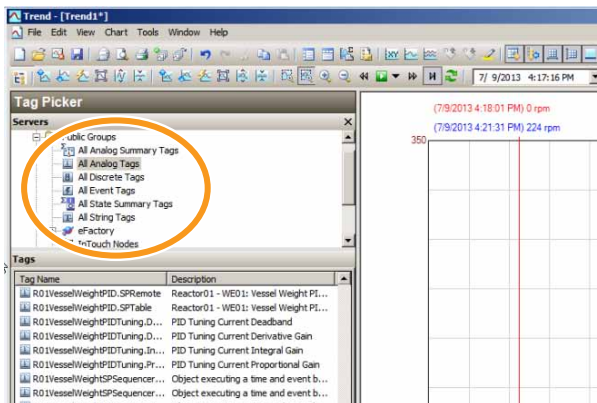
Result: The **Trending** window opens.

- |   |                                                                                        |
|---|----------------------------------------------------------------------------------------|
| 2 | Select <b>File:Open</b> from the top menu bar to display the list of available trends. |
|---|----------------------------------------------------------------------------------------|

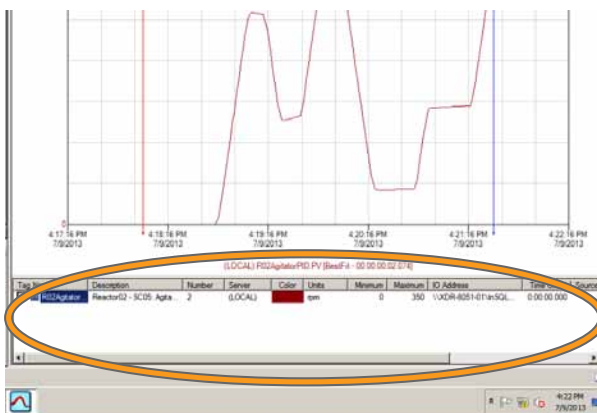


**Step Action**

- 3 Select a group to display the available trends in this group.



- 4 Double-click on a tag in the **Tag Picker** pane to move it to the **Pens** pane.
- 5 Click on a pen in the **Pens** pane to associate that pen with the vertical red and blue cursors.



**Note:**

The cursors may be dragged left or right to read specific values at specific times.

**Note:**

Right-click on a pen and select **Configure** to get access to trend pen configuration parameters.

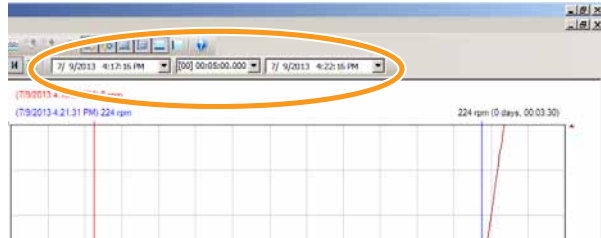
## 7 Operation

### 7.4 Control the batch

#### 7.4.4 Configure trends

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------|
| 6 | Use drop-down menus at the top of the screen for rapid selection of times and dates for the trends. |
|---|-----------------------------------------------------------------------------------------------------|



## 7.5 Work with alarms

### Introduction

This section provides information about how to monitor and control the batch using alarms and alarm logs.

---

### In this section

| Section                          | See page |
|----------------------------------|----------|
| 7.5.1 Set and acknowledge alarms | 188      |
| 7.5.2 Use event and alarm logs   | 195      |

## 7.5.1 Set and acknowledge alarms

### General

Alarms can be set and configured for each individual instrument. Value based alarms can be configured for each parameter based on pre-specified ranges. More info about pre-specified ranges can be found in the instrument Turnover Package.

---

### Access to alarm setup

To display the available alarms for a specific process variable follow the instructions below.

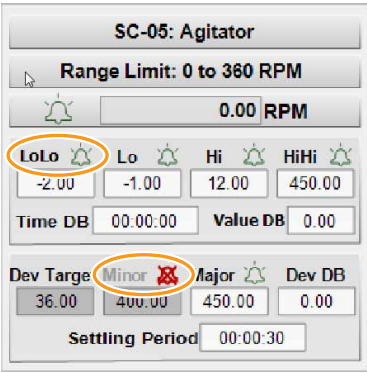
| Step | Action                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Select <b>Alarm Configuration</b> on the header toolbar to open the alarm setup window for an individual instrument.                    |
| 2    | Locate the relevant module for the process variable in the <b>Alarm Configuration Screen 1</b> or <b>Alarm Configuration Screen 2</b> . |

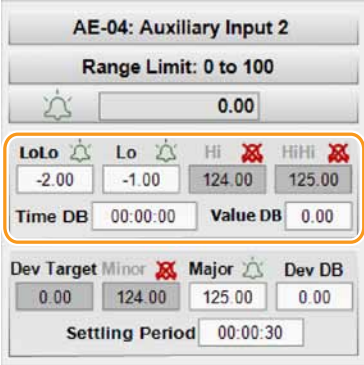
---



## Configure alarms

Display the alarm setup screen for the individual instrument as described above. To configure the alarms follow the instructions below.

| If you want to...          | then...                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| enable or disable an alarm | <p>click on the bell symbol next to the alarm you want to enable or disable.</p>  <p><i>Result:</i> The bell symbol changes to indicate the status of the alarm:</p> <ul style="list-style-type: none"> <li>to green if the alarm is enabled</li> <li>to red and crossed over if the alarm is disabled.</li> </ul> <p>The disabled alarm value is shown in a grey text field.</p> |

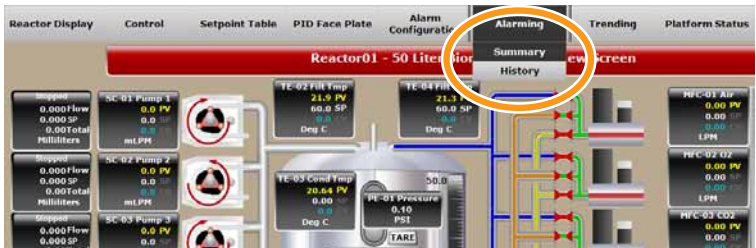
| If you want to...                        | then...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| define the range limits of the set alarm | <div><div>1 make sure that the bell symbols are green for the alarms you want to activate</div><div>2 type the appropriate values into the relevant text fields</div><div>3 type the values for <b>Time DB</b> (deadband) and <b>Value DB</b> (hh:mm:ss) into the text fields.</div></div> <div></div> <p>The range limits of the alarm would notify the operator when a parameter is outside of the expected range of operation.</p> <p><b>Note:</b><br/><i>Setting the deadband values avoids the alarm from coming on and off ("chattering") when close to the limit.</i></p> <p><b>Note:</b><br/><i>LoLo and HiHi are critical alarms. Lo and Hi are warning alarms.</i></p> |

| If you want to...                                         | then...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>set an alarm for deviation from parameter setpoint</p> | <ol style="list-style-type: none"> <li>1 make sure that the bell symbols are green for the deviation alarms you want to activate</li> <li>2 type the desired values into the relevant text fields</li> <li>3 type the values for <b>Dev DB</b> (deadband) and <b>Settling Period</b> into the text fields.</li> </ol> <div> </div> <p>The limits <b>Dev Target Minor</b> and <b>Dev Target Major</b> would notify the operator when a parameter is not achieving its setpoint.</p> <p><b>Note:</b><br/> <b>Dev Target Minor</b> is a warning alarm. <b>Dev Target Major</b> is a critical alarm.</p> |

View and acknowledge alarms

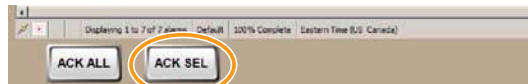
Follow the instructions below to acknowledge the alarms.

| Step | Action                                                                                    |
|------|-------------------------------------------------------------------------------------------|
| 1    | Select <b>Alarming:Alarm Summary</b> from the header toolbar to view the alarming screen. |



**Step Action**

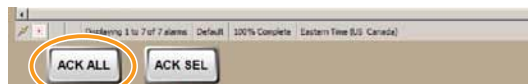
- 2 To acknowledge an alarm:
  - select the alarm
  - click **ACK SEL** (Acknowledge Selected) button at the bottom of the window



**Note:**

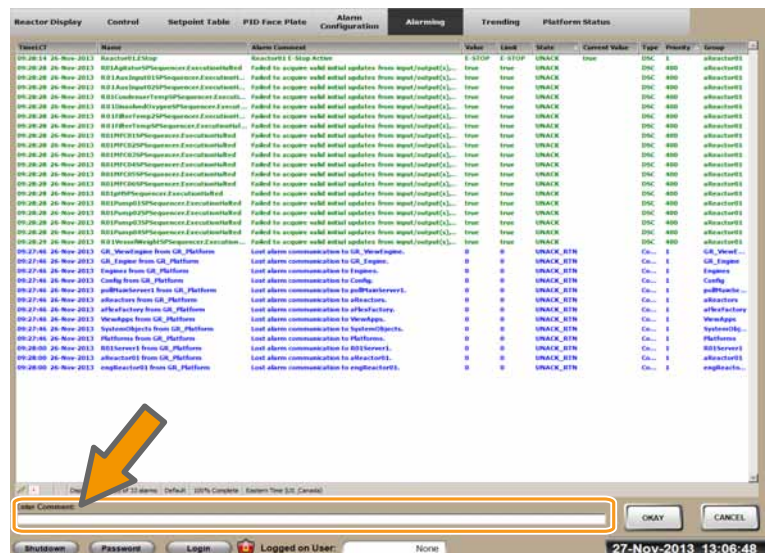
Multiple alarms can be acknowledged by selecting the alarms and clicking **ACK SEL**.

- or click **ACK ALL** (Acknowledge All) button on the footer toolbar to acknowledge all alarms



- or right-click on the selected alarm and choose the desired option from a drop-down menu.

**Result:** A dialog field will open at the bottom of the **Alarm Summary** window.



| Step         | Action                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3            | <p>Type a comment in the dialog field if suitable. Click <b>OKAY</b> to save the comment.</p> <p><b>Note:</b></p> <p><i>It is not necessary to include user name and time of acknowledgement in the comment. This information is automatically recorded by the system.</i></p> <p><b>Tip:</b></p> <p><i>It is good practice to provide sufficiently detailed comments for alarms. This helps to keep appropriate batch records.</i></p> |
| <b>Note:</b> | <ul style="list-style-type: none"><li>• Acknowledged alarms are displayed in steady black text on white background on all alarm screens.</li><li>• Unacknowledged alarms blink in red and green text on white background on all alarm screens.</li><li>• Unacknowledged return alarms (that have been active but are no longer in active state) are displayed in steady blue text on white background on all alarm screens.</li></ul>   |

## 7.5.2 Use event and alarm logs

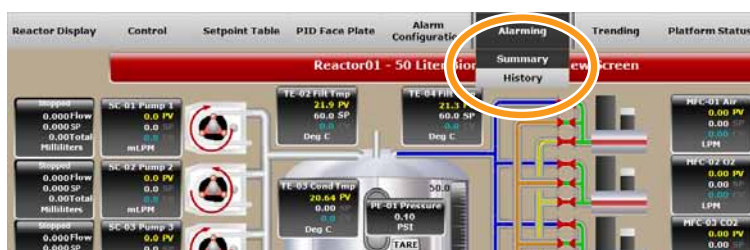
### Apply filters to the alarm list

The filter function allows the user to select only a relevant group of alarms and/or events for viewing. If the bioreactor is part of FlexFactory, the alarms and events from all additional components can be displayed at any connected X-Station. In case of stand-alone bioreactor systems, the filter list will contain any bioreactors connected to the system.

To apply the filter, follow the steps below.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                     |
|---|-------------------------------------------------------------------------------------|
| 1 | Select <b>Alarming:History</b> from the header toolbar to view the alarming screen. |
|---|-------------------------------------------------------------------------------------|



- |   |                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------|
| 2 | Choose the items you want to view: alarms, events, or both, by selecting the relevant button at the bottom of the window. |
|---|---------------------------------------------------------------------------------------------------------------------------|



- |   |                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Click the <b>FILTER</b> button at the bottom of the window.<br><i>Result:</i> A list of all available additional components will be displayed. |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|

- |   |                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | Click on the unit that you want to display. Click <b>Apply</b> .<br><i>Result:</i> The <b>Alarm History</b> table will show only the items connected to the selected system. |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Note:**

The **All** filter allows the user to view platform status and system connectivity alarms and/or events.

Search for an alarm or event

| Step | Action                                                                                                                                                                                                                                                                                                                                     |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Determine on which system the alarm or event occurred. Display the alarms and events for this system by following steps 1-4 in <a href="#">Apply filters to the alarm list, on page 195</a> .                                                                                                                                              |
| 2    | Click the button <b>Start Time</b> and enter the relevant date and time in the pop-up dialog box.                                                                                                                                                                                                                                          |
| 3    | Click the button <b>End Time</b> and enter the relevant date and time in the pop-up dialog box.                                                                                                                                                                                                                                            |
| 4    | Click <b>Apply</b> .<br><br><i>Result:</i> The alarms and events list will be refreshed according to your chosen limits.<br><br><b>Tip:</b><br><i>You can sort the displayed alarms and events alphabetically by their tag names or descriptions, by clicking the <b>Name</b> column header or the <b>Alarm-Comment</b> column header.</i> |



## 7.6 Manage the disposable bag contents

### Introduction

This section provides information about how to fill the disposable bag with culture media and how to control liquid and gas flow.

---

### In this section

| Section                                  | See page |
|------------------------------------------|----------|
| 7.6.1 Fill the disposable bag with media | 198      |
| 7.6.2 Calibrate the DO probe             | 200      |
| 7.6.3 Measure oxygen uptake rate         | 204      |
| 7.6.4 Measure the flow volume            | 207      |
| 7.6.5 Change pump flow direction         | 210      |
| 7.6.6 Change gas flow path               | 212      |

7.6.1 Fill the disposable bag with media

Fill the bag with culture media

**Tip:** It is recommended to use the largest pump connected to the system for fill and harvest operations.

Follow the instructions below to fill the disposable bag.

| Step | Action                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Install the tubing for filling the disposable bag through the relevant pump head on the instrument tower front panel. See <a href="#">Connect tubing, on page 131</a> for instructions. |
| 2    | Weld or connect the media reservoir onto the tubing.                                                                                                                                    |
| 3    | Verify that all clamps are open on the tubing that connects the disposable bag with the media reservoir.                                                                                |
| 4    | Verify that the XDR vessel is tared. See <a href="#">Complete the bag installation, on page 123</a> for instructions.                                                                   |
| 5    | Map a lookup table to the weight controller. See <a href="#">Section 7.3.1 Map a control loop using lookup tables, on page 149</a> for detailed instructions.                           |
| 6    | Populate the lookup table with following values:                                                                                                                                        |

| In   | Out                            |
|------|--------------------------------|
| 0    | 0                              |
| 99.8 | 0                              |
| 100  | Maximal flow rate for the pump |

|    |                                                                                                                                                                                                                                                           |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7  | Map the pump to the lookup table. See <a href="#">Section 7.3.1 Map a control loop using lookup tables, on page 149</a> for detailed instructions.                                                                                                        |
| 8  | Set the pump to <b>Auto</b> and <b>Remote</b> mode.<br><br><i>Result:</i> A map has been set up which starts the pump when the CV of the PID vessel weight control loop is 99.8. If the XDR vessel weight decreases below this value, the pump will stop. |
| 9  | Open the PID faceplate dialog box for XDR vessel weight from the <b>Reactor Display</b> window.                                                                                                                                                           |
| 10 | Set the mode to <b>Manual</b> and <b>Local</b> .                                                                                                                                                                                                          |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 11   | <p>Type the value for desired weight in the <b>SP</b> text field. Type 100 in the <b>CV</b> text field.</p> <p><i>Result:</i> The pump starts to run.</p>                                                                                                                                                                                                                                      |
| 12   | <p>Set the PID vessel weight control loop into <b>Auto</b> mode.</p> <p><b>Note:</b></p> <p><i>Do not leave the pump running in manual mode unless you intend to manually stop the system.</i></p> <p><i>Result:</i> The pump now runs under controlled conditions (until the XDR vessel weight exceeds the setpoint). When the weight exceeds the setpoint, the pump speed drops to zero.</p> |
| 13   | <p>When the disposable bag filling is completed, disable mapping for the pump to make sure that no outside fluid transfer processes can re-start the system. See <a href="#">Unmap a device, on page 162</a> for detailed instructions.</p>                                                                                                                                                    |

## 7 Operation

### 7.6 Manage the disposable bag contents

#### 7.6.2 Calibrate the DO probe

## 7.6.2 Calibrate the DO probe

### Preparation

**Note:** *If the bioreactor is used in a GMP regulated environment, the DO probe is a GMP critical component.*

**Note:** *For operational safety, a password can be set for DO calibration. See the manufacturer's manual for instructions how to enable the password protection.*

Perform the following calibration procedures on DO probe keeping the order shown below:

- 1 Temperature calibration
- 2 Calibration at 0% saturation level
- 3 Calibration at 100% saturation level.

These procedures are described further down in this section.

Before DO probe calibration make sure that the following has been completed:

- The disposable bag has been filled with media.
- The media has had time to equilibrate to the process temperature.
- The temperature probe has been calibrated. See [Section 10.3 Temperature probe calibration, on page 271](#) for instructions.
- The DO probe has been energized / polarized for a minimum of two hours from the time the cable was connected (polarographic sensors only).



#### **WARNING**

**Fire and explosion hazard.** Follow the instructions below to avoid a fire or explosion when using oxygen:

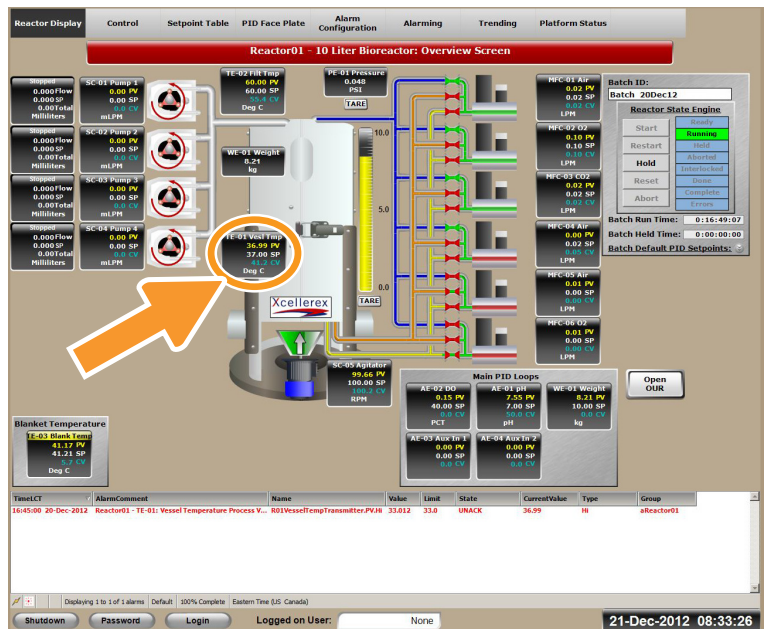
- Monitor oxygen flow rates displayed on the user interface.
- Check for leaks, poor connections, or damages to the equipment prior to use.
- Use proper ventilation when operating the bioreactor using oxygen.
- Do NOT expel oxygen into an enclosed space.

## Calibrate the DO probe temperature

Before performing the oxygen calibration, calibrate the DO probe temperature as described in the instructions below.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Verify that the agitator is running at full operational speed.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 2 | Do the following using pH/DO transmitter display on the instrument tower: <ol style="list-style-type: none"> <li>1 Press <b>Menu</b>.</li> <li>2 Select <b>Calibrate</b> and press <b>Enter</b>.</li> <li>3 Select <b>Sensor 2</b> and press <b>Enter</b>.</li> <li>4 Select <b>Temperature</b> and press <b>Enter</b>.</li> <li>5 Find out the current media temperature. It is displayed on the bioreactor temperature sensor object in the <b>Reactor Display</b> window.</li> </ol> |



- 6 Type the current media temperature into the text field in the DO calibration display on the instrument tower. Press **Enter**.
- 7 Press **Exit** repeatedly to return to the home screen.

## 7 Operation

### 7.6 Manage the disposable bag contents

#### 7.6.2 Calibrate the DO probe

### Calibrate the DO probe at 0% saturation level

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Turn off gas inputs that contain oxygen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2    | Direct N <sub>2</sub> into the bioreactor through the sparge tubing at maximum flow.<br><br><b>Note:</b><br><i>N<sub>2</sub> is recommended, although CO<sub>2</sub> can be used.</i>                                                                                                                                                                                                                                                                                                                                                                   |
| 3    | Open the trend for the DO value (see <a href="#">Section 7.4.4 Configure trends, on page 184</a> ) and monitor the DO reading. Wait until the DO value stabilizes at minimum level.<br><br><b>Tip:</b><br><i>For fastest mass transfer rates and best equilibrium time, use the smaller size sparge disc.</i>                                                                                                                                                                                                                                           |
| 4    | Do the following using pH/DO transmitter display on the instrument tower: <ol style="list-style-type: none"><li>1 Press <b>MENU</b>.</li><li>2 Select <b>Calibrate</b> and press <b>ENTER</b>.</li><li>3 Select <b>Sensor 2</b> and press <b>ENTER</b>.</li><li>4 Select <b>Oxygen</b> and press <b>ENTER</b>.</li><li>5 Select <b>Zero Cal</b> and press <b>ENTER</b>.<br/><i>Result: WAIT is displayed.</i></li><li>6 Wait until <b>Sensor Zero done</b> is displayed.</li><li>7 Press <b>EXIT</b> repeatedly to return to the home screen.</li></ol> |

### Calibrate the DO probe at 100% saturation level

| Step | Action                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------|
| 1    | Turn off all non-air gas inputs.                                                                             |
| 2    | Direct air into the bioreactor through the sparge tubing at the flow rate equal to 100% controlled variable. |

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3    | Open the trend for the DO value (see <a href="#">Section 7.4.4 Configure trends, on page 184</a> ) and monitor the DO reading. Wait until the DO value stabilizes at maximum level.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 4    | Do the following using pH/DO transmitter display on the instrument tower: <ol style="list-style-type: none"><li>1 Press <b>MENU</b>.</li><li>2 Select <b>Calibrate</b> and press <b>ENTER</b>.</li><li>3 Select <b>Sensor 2</b> and press <b>ENTER</b>.</li><li>4 Select <b>Oxygen</b> and press <b>ENTER</b>.</li><li>5 Select <b>Air Cal</b> and press <b>ENTER</b>.</li><li>6 Select <b>Start Calibration</b>, press <b>ENTER</b>.</li><li>7 Type the current barometric pressure into the text field, press <b>ENTER</b>.<br/><i>Result: WAIT</i> is displayed.</li><li>8 When the calibration is successfully completed, the screen will return to the calibration sub-menu.</li><li>9 Press <b>EXIT</b> repeatedly to return to the home screen.</li></ol> |

## 7.6.3 Measure oxygen uptake rate

### Oxygen uptake rate

The oxygen uptake rate (OUR) is an objective measure of metabolic activity of the cells in a culture. The measured oxygen uptake rate can help to optimize growth affecting parameters during a cell culture process.

The OUR measurement process is described in the table below:

| Stage | Description                                                                                                                                                                                                                                                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | The OUR calculator schedules a request to perform the test with the programmable logic controller.<br><br><b>Note:</b><br><i>If the dissolved oxygen level deviates from setpoint more than <math>\pm 1.0\%</math>, the request is denied. The system returns to normal operation.</i> |
| 2     | The OUR calculator shuts down all MFCs which are in <b>Auto/Local</b> or <b>Auto/Remote</b> mode.                                                                                                                                                                                      |
| 3     | The OUR calculator delays the test start by a time period that is equal to the operator-defined degas time.<br><br><b>Note:</b><br><i>The degas time allows the gas bubbles to escape from the solution.</i>                                                                           |
| 4     | The OUR calculator takes an initial DO measurement ( <b>DOStart</b> , % saturation).                                                                                                                                                                                                   |
| 5     | The OUR calculator continues to measure the DO level until the measured DO level equals the operator-defined minimal dissolved oxygen level.                                                                                                                                           |
| 6     | The OUR calculator takes a final DO measurement ( <b>DOFinal</b> , % saturation).                                                                                                                                                                                                      |
| 7     | The OUR calculator performs the calculation and displays the result (mmol / (L × h)).                                                                                                                                                                                                  |

### Measure oxygen uptake rate

To be able to use the oxygen uptake rate calculator, make sure that the following conditions are met:

- Dissolved oxygen (DO) concentration must be within the range of  $\pm 1.0\%$  of setpoint.



- An estimated value of minimal allowed level of dissolved oxygen (target level of dissolved oxygen) is required to perform the measurement.

**Note:** ***DO minimal** should be high enough to guarantee that the cultured cells do not suffer any damage due to low level of oxygen during the measurement.*

- Agitation should be switched on during the measurement to guarantee the accuracy of the result.

Follow the instructions below to perform an oxygen uptake rate measurement.

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Open the <b>Oxygen Uptake Rate</b> (OUR) dialog box by clicking the <b>Open OUR</b> button in the <b>Reactor Display</b> window. See <a href="#">Oxygen Uptake Rate, on page 329</a> for more information on OUR dialog box.                                                                                                                                                                                                                          |
| 2    | Press <b>Clear Old Data</b> to clear the previous measurement result (if present).                                                                                                                                                                                                                                                                                                                                                                    |
| 3    | Visually estimate the time needed for gas bubbles to clear the cell culture (degas time).<br>Observe the following guidelines: <ul style="list-style-type: none"> <li>• Too long estimated degas time reduces measurement accuracy because the calculation time will be shorter.</li> <li>• Too short estimated degas time reduces measurement accuracy because oxygen transfer from gas phase to the culture media is still taking place.</li> </ul> |
| 4    | Verify that the degas time is long enough to allow clearing of the gas bubbles from the sparge disc to the top of the cell culture.                                                                                                                                                                                                                                                                                                                   |
| 5    | Enter the estimated degas time into the text field <b>Degas Time: (sec)</b> .                                                                                                                                                                                                                                                                                                                                                                         |
| 6    | Estimate the minimal theoretical allowed level of dissolved oxygen (% saturation). Verify that this level of dissolved oxygen is acceptable for your cell culture.                                                                                                                                                                                                                                                                                    |
| 7    | Enter the minimal allowed level of dissolved oxygen into the text field <b>DO minimal</b> .<br><br><b>Note:</b><br><i>This entry is in saturation fraction units, where 0.00 is 0% and 1.00 is 100% saturation.</i>                                                                                                                                                                                                                                   |

### 7.6.3 Measure oxygen uptake rate

R010xOxygenUptakeRate.OxygenU...

X

Oxygen Uptake Rate:

Start OUR

Terminate OUR

Clear Old Data

Degas Time: (sec)

15

DO Minimal:

0.1

Request Accepted

OUR Data

DOStart

0.397

DOFinal

0.000

Time: (seconds)

151.400

Oxygen Uptake Rate

0.000

**Note:** We recommend to compare and verify the results of the OUR measurement using the methods established at your local facility.

## 7.6.4 Measure the flow volume

### Measure the liquid flow

Follow the instructions below to measure the pump flow volume.

| Step | Action |
|------|--------|
|------|--------|

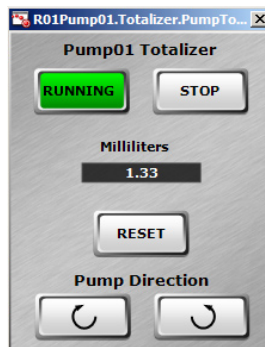
- |   |                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------|
| 1 | Click the pump flow totalizer object in the <b>Reactor Display</b> window to open the <b>Pump Totalizer</b> dialog box. |
|---|-------------------------------------------------------------------------------------------------------------------------|

*Result:* The **Pump Totalizer** dialog box opens.



- |   |                                                            |
|---|------------------------------------------------------------|
| 2 | Click the <b>START</b> button to start the pump totalizer. |
|---|------------------------------------------------------------|

*Result:* The measurement of the pumped volume starts. The **START** button turns green and the label text changes to **RUNNING**. The **OFF** button turns grey and the label text changes to **STOP**. The recorded volume is continuously updated in the text box **Milliliters**.



- |   |                                                                                        |
|---|----------------------------------------------------------------------------------------|
| 3 | Click the <b>STOP</b> button to stop the pump totalizer when the process is completed. |
|---|----------------------------------------------------------------------------------------|

| Step | Action                                                     |
|------|------------------------------------------------------------|
| 4    | Click the <b>RESET</b> button to reset the pump totalizer. |

Measure the gas flow

Follow the instructions below to measure the volume that passes through the mass flow controller.

**Note:** The MFC totalizer can be started either when the MFC is running or stopped.

| Step | Action                                                                                                                                                                             |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Click on the MFC flow totalizer object in the <b>Reactor Display</b> window to open the <b>MFC Totalizer</b> dialog box.<br><br>Result: The <b>MFC Totalizer</b> dialog box opens. |



|   |                                                                                                                                                                                                                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | Click the <b>START</b> button to start the MFC totalizer.<br><br>Result: The measurement of the pumped volume starts. The <b>START</b> button turns green and the label text changes to <b>RUNNING</b> . The <b>OFF</b> button turns grey and the label text changes to <b>STOP</b> . The recorded volume is continuously updated in the text box <b>Liters</b> . |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|



|   |                                                                                       |
|---|---------------------------------------------------------------------------------------|
| 3 | Click the <b>STOP</b> button to stop the MFC totalizer when the process is completed. |
|---|---------------------------------------------------------------------------------------|

| Step | Action                                                    |
|------|-----------------------------------------------------------|
| 4    | Click the <b>RESET</b> button to reset the MFC totalizer. |

## 7.6.5 Change pump flow direction

### Change pump flow direction



**NOTICE**

Do not change pump flow direction when the pump totalizer is running.

The same pump can be used to fill and harvest the bioreactor. Change the pump direction if you want to switch from filling the XDR vessel to draining the vessel.

If you have unintentionally installed the tubing for backwards flow, you can change the direction of the pump to correct it. You would not need to remove and re-install the tubing.

| Step | Action                                                                                                                                                                                   |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Click on the pump flow totalizer object in the <i>Reactor Display</i> window to open the <b>Pump Totalizer</b> dialog box.<br><i>Result:</i> The <b>Pump Totalizer</b> dialog box opens. |



| Step | Action                                                                                                                                                                                                                                              |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>At the bottom of the dialog box, click on the button indicating the required flow direction.</p> <p><i>Result:</i> The flow direction changes. The arrow on the pump icon in <b>Reactor Display</b> window shows the current flow direction.</p> |



## 7.6.6 Change gas flow path

### Redirect gas flow

A bank of solenoid valves, or alternatively the gas manifold inside the instrument tower, allows the user to change the flow path of a specific gas and redirect the gas to the intended destination.

If you want to send one gas (for example, pure oxygen) through one set of sparge discs and a different gas through another set, follow the steps below.

| Step | Action                                                                                                                                                                   |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Click on a relevant solenoid valve object in <i>Reactor Display</i> window.                                                                                              |
| 2    | Choose the gas flow path from the drop-down list: <ul style="list-style-type: none"><li>• <i>Sparge 1</i></li><li>• <i>Sparge 2</i></li><li>• <i>Headsweep</i></li></ul> |



|   |                                                                     |
|---|---------------------------------------------------------------------|
| 3 | Confirm by clicking <i>SELECT</i> or <i>DESELECT</i> .              |
| 4 | Repeat the steps 1 to 3 to define the flow path for the second gas. |



## 7.7 Finish a batch run

### Introduction

This section provides information about the final stages of a batch run.

---

### In this section

| Section                         | See page |
|---------------------------------|----------|
| 7.7.1 Remove the disposable bag | 214      |
| 7.7.2 Shut down the system      | 215      |

---

## 7 Operation

### 7.7 Finish a batch run

#### 7.7.1 Remove the disposable bag

## 7.7.1 Remove the disposable bag

### Remove the disposable bag

Follow the instructions below to remove the the disposable bag from the XDR vessel.

| Step | Action                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Empty the disposable bag.                                                                                                                               |
| 2    | Remove the temperature probe from the disposable bag.                                                                                                   |
| 3    | Disconnect the pH cables, DO cables, and bag pressure cable.                                                                                            |
| 4    | Disconnect sparge and overlay pneumatic tubing from sparge and overlay filters.                                                                         |
| 5    | Remove exhaust filter from the exhaust filter assembly.                                                                                                 |
| 6    | Remove the probes and decontaminate according to facility procedures.                                                                                   |
| 7    | If the site policy requires decontamination of the bag prior to disposal, rinse the walls of the empty bag with a decontamination solution, then drain. |
| 8    | Dispose of the bag according to local procedures.                                                                                                       |

## 7.7.2 Shut down the system

### Exit software

Before shutting down the software, make sure that the system is in a safe state and that all mechanical systems are switched off.

**Note:** Only the supervisor or the administrator can exit the software.



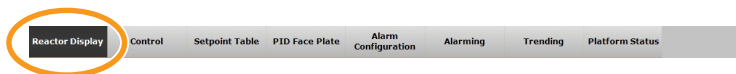
#### NOTICE

Always shut down the software using the instructions below. Failure to shut down the computer in a proper way might result in software corruption and/or hardware failure.

Follow the instructions below to exit the software.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                                |
|---|----------------------------------------------------------------------------------------------------------------|
| 1 | Display the <b>Reactor Display</b> window by clicking the <b>Reactor Display</b> button on the header toolbar. |
|---|----------------------------------------------------------------------------------------------------------------|



- |   |                                                                                  |
|---|----------------------------------------------------------------------------------|
| 2 | Click the <b>Shutdown</b> button at the lower left corner of the footer toolbar. |
|---|----------------------------------------------------------------------------------|



**Result:** The Wonderware application will close and the Windows desktop will be visible.

- |   |                                                                                                                                                                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | Log off from Windows: <ol style="list-style-type: none"> <li>1 Press the Windows button on the keyboard.</li> <li>2 Click the <b>Start</b> button at the lower left corner of the computer screen.</li> <li>3 Select <b>Shut down:Log off</b> from the pop-up menu.</li> </ol> |
| 4 | Log in as administrator.                                                                                                                                                                                                                                                       |
| 5 | Click the <b>Start</b> button at the lower left corner of the computer screen.                                                                                                                                                                                                 |
| 6 | Select <b>Shut down</b> from the pop-up menu. Follow the prompts to shut down the computer.                                                                                                                                                                                    |

Turn off the bioreactor

Follow the instructions below to turn off the bioreactor.

| Step | Action                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Turn off the pneumatic supply valves to the equipment.<br><i>Result:</i> The pneumatic supply to the control panel will be isolated.         |
| 2    | Turn on the mass flow controllers to 1 SLPM for each gas supply.<br><i>Result:</i> Any remaining pressure in the pneumatic lines will bleed. |
| 3    | Verify that no flow is present on the MFC PID faceplates.                                                                                    |
| 4    | Turn off the switch located at the back of the instrument tower to the <b>O</b> -position.                                                   |



*Result:* The power to the instrument tower will be turned off.

# 8 Maintenance

## About this chapter

This chapter provides required information to enable users and service personnel to clean, maintain, calibrate and store XDR-10 Benchtop Bioreactor System.

---

## In this chapter

| Section                                            | See page |
|----------------------------------------------------|----------|
| 8.1 General safety precautions                     | 218      |
| 8.2 Add and remove users                           | 219      |
| 8.3 Passwords                                      | 227      |
| 8.4 System maintenance                             | 229      |
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| 8.7 Calibration schedule                           | 245      |
| 8.8 Cleaning                                       | 246      |
| 8.9 Storage, moving and reinstallation             | 248      |
| 8.10 Lock-Out / Tag-Out (LOTO): turn-off procedure | 249      |
| 8.11 Lock-Out / Tag-Out (LOTO): turn-on procedure  | 251      |

---

## 8.1 General safety precautions



### **WARNING**

**Trained personnel.** Maintenance of this product must be performed by properly trained personnel only.



### **WARNING**

**Turn off equipment.** Turn off XDR-10 Benchtop Bioreactor System and Lock-Out / Tag-Out (LOTO) any equipment before doing electrical maintenance.



### **CAUTION**

**Contamination hazard.** Before performing any service work on XDR-10 Benchtop Bioreactor System, make sure that the system has been properly decontaminated.



### **CAUTION**

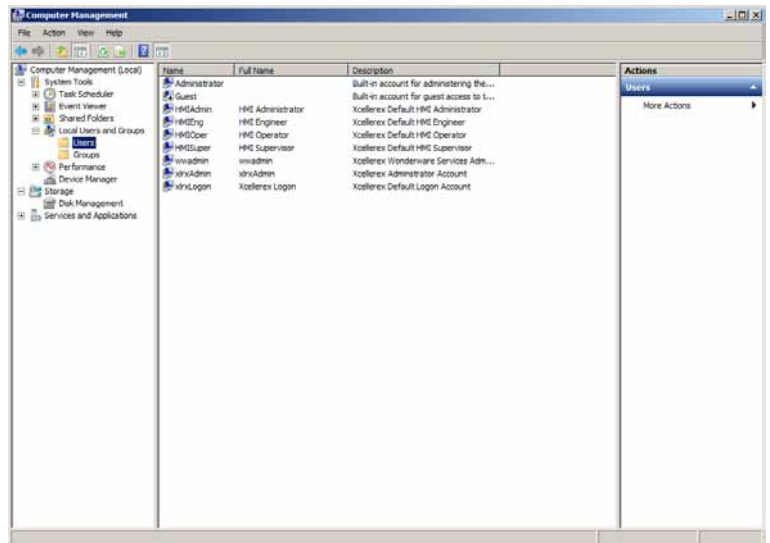
**Inspect cables.** Cables need to be inspected for wear and damage. Replace damaged cables before connecting power to the system.

## 8.2 Add and remove users

### Add a user account

Only an administrator has permission to add new user accounts. Follow the steps below to add a user account.

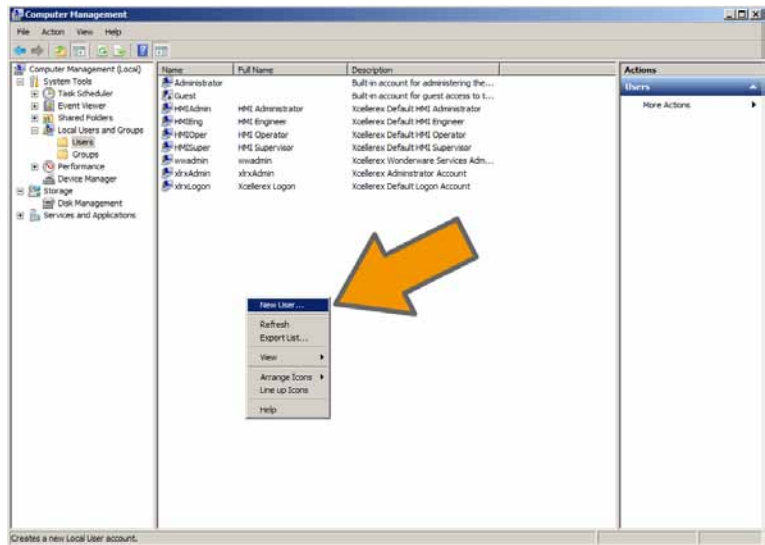
- | Step | Action                                                                                                                                                                                                    |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Log off from Windows: <ol style="list-style-type: none"> <li>1 Press the Windows button on the keyboard.</li> <li>2 Click the <b>Start</b> button.</li> <li>3 Select <b>Shut down:Log off</b>.</li> </ol> |
| 2    | Log in as administrator.                                                                                                                                                                                  |
| 3    | From the <b>Start</b> menu, select <b>Administrative Tools:Computer Management</b> .<br><i>Result: The <b>Computer Management</b> window opens.</i>                                                       |



- |   |                                                                |
|---|----------------------------------------------------------------|
| 4 | Navigate to <b>System Tools:Local Users and Groups:Users</b> . |
|---|----------------------------------------------------------------|

Step Action

- 5 Right-click in the white space in the center pane and select **New User** from the pop-up menu.



- 6 Complete the **New User** dialog. Set a temporary password for the new user according to your company policy. Tick the box **User must change password at next logon**.

**Note:**  
*For 21CFR Part 11 compliance, the user must select their own password before using the system. The administrator may make a temporary password and provide it to the user.*

- 7 Click **Create** to add the user.  
**Result:** The dialog box closes. The new user is added to the list in the center pane.

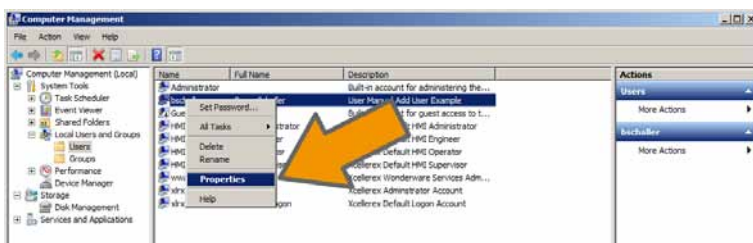


## Configure user properties

Follow the steps below to configure the properties for the added user.

### Step Action

- 1 Right-click on the new user in the center pane, select **Properties**.

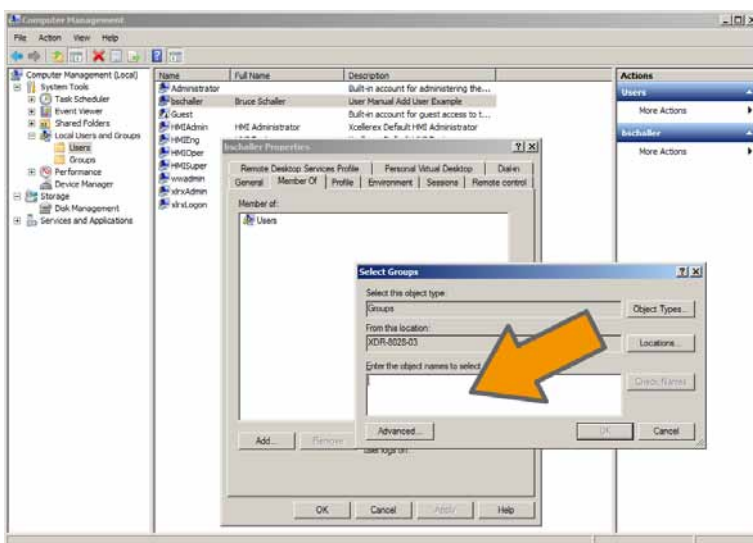


*Result:* A pop-up window opens.

- 2 Navigate to the tab **Member of**. Click the **Add** button.

*Result:* A new pop-up window opens.

- 3 Type the group names HMIOperators, HMISupervisors, HMIAdministrators, as appropriate for the added user, in the text field in the topmost pop-up window.



- 4 Click the button **Select Names** at the right of the text field.

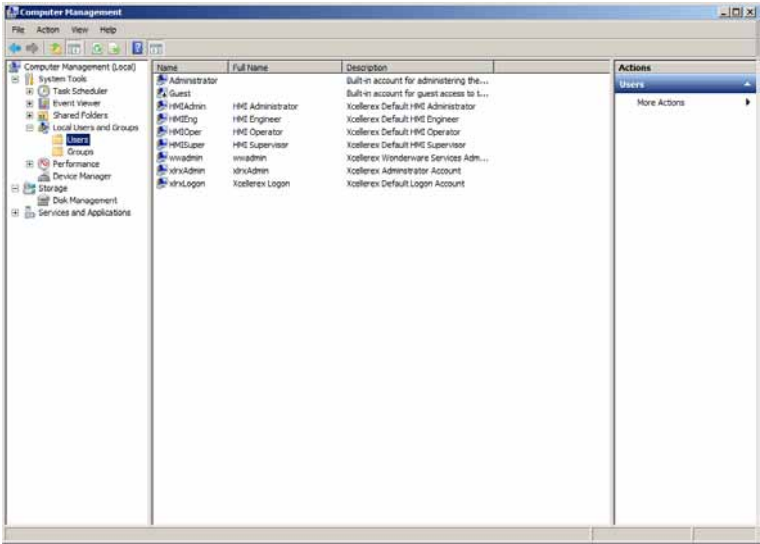
*Result:* The qualified group names will populate the box.

| Step | Action                                                |
|------|-------------------------------------------------------|
| 5    | Close the pop-up dialog boxes by clicking <b>OK</b> . |
| 6    | Close the <b>Computer Management</b> window.          |
| 7    | Log off.                                              |

Unlock a locked-out user account

Only an administrator has permission to unlock a user account.

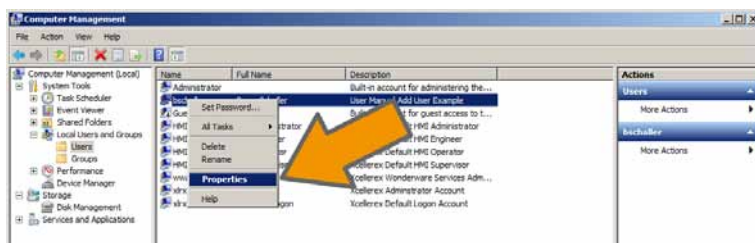
| Step | Action                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Log in as administrator.                                                                                                                     |
| 2    | From the <b>Start</b> menu, select <b>Administrative Tools:Computer Management</b> .<br>Result: The <b>Computer Management</b> window opens. |



|   |                                                                |
|---|----------------------------------------------------------------|
| 3 | Navigate to <b>System Tools:Local Users and Groups:Users</b> . |
|---|----------------------------------------------------------------|

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                            |
|---|----------------------------------------------------------------------------|
| 4 | Right-click on the new user in the center pane, select <b>Properties</b> . |
|---|----------------------------------------------------------------------------|



*Result:* A pop-up window opens.

- |   |                                                                          |
|---|--------------------------------------------------------------------------|
| 5 | Clear the tick from <b>Account is locked out</b> box.                    |
| 6 | Close the pop-up dialog boxes and the <b>Computer Management</b> window. |
| 7 | Log off.                                                                 |

## Disable a user account

Only an administrator has permission to disable the accounts. Follow the steps below to disable a user account.

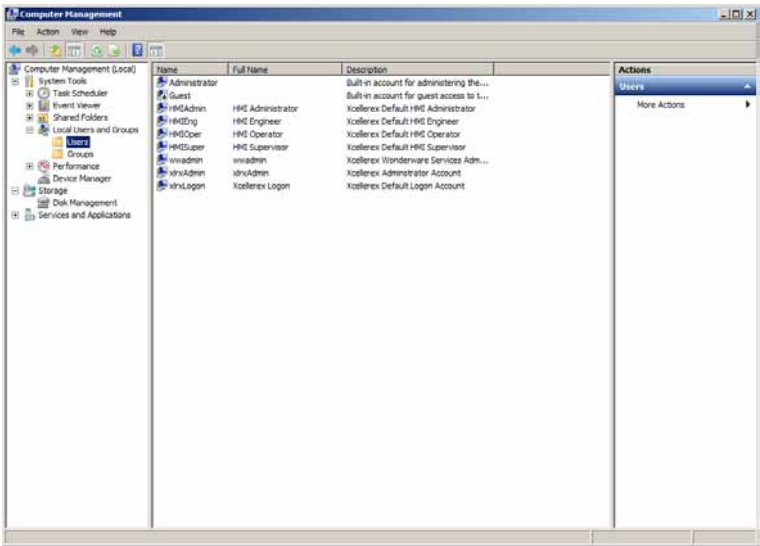
| Step | Action |
|------|--------|
|------|--------|

- |   |                          |
|---|--------------------------|
| 1 | Log in as administrator. |
|---|--------------------------|

- Step

Action
- 2

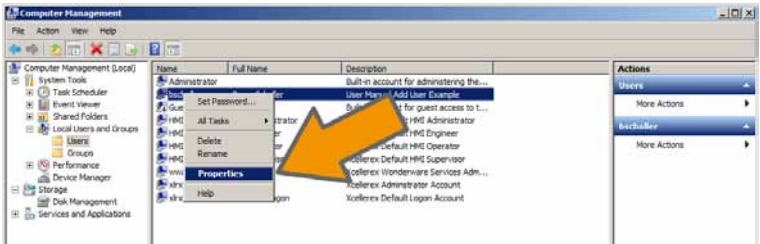
From the **Start** menu, select **Administrative Tools:Computer Management**.  
*Result:* The **Computer Management** window opens.



- 3

Navigate to **System Tools:Local Users and Groups:Users**.
- 4

Right-click on the new user in the center pane, select **Properties**.



*Result:* A pop-up window opens.

- 5

Tick the **Account is disabled** box. Click **OK**.
- 6

Close the pop-up dialog boxes and the **Computer Management** window.
- 7

Log off.

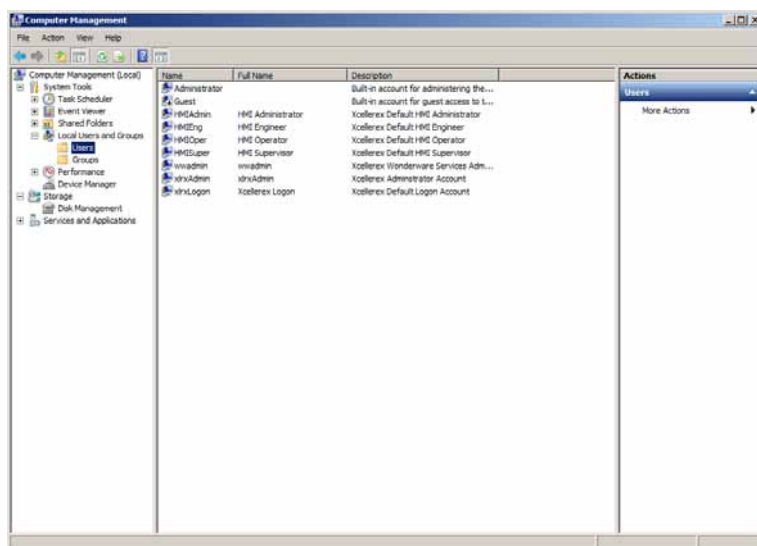
## Remove a user account

**Note:** The user will be permanently removed and will not be able to access any password-protected functions following this procedure. It will not change any historical data on the server.

Only an administrator has permission to remove the accounts. Follow the steps below to permanently remove a user account.

**Note:** Adding a user with the same user name again will not restore access to information particular to the original user. Consider disabling a user account instead if the user access might need to be renewed in the future.

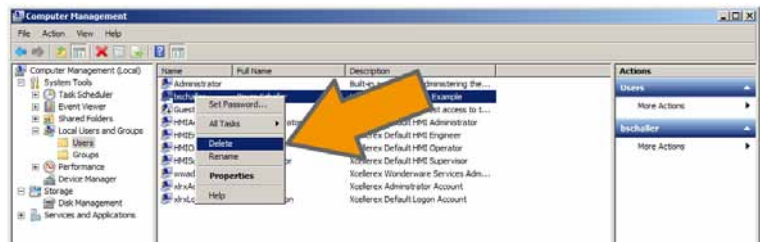
- | Step | Action                                                                                                                                       |
|------|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Log in as administrator.                                                                                                                     |
| 2    | From the <b>Start</b> menu, select <b>Administrative Tools:Computer Management</b> .<br>Result: The <b>Computer Management</b> window opens. |



- |   |                                                                |
|---|----------------------------------------------------------------|
| 3 | Navigate to <b>System Tools:Local Users and Groups:Users</b> . |
|---|----------------------------------------------------------------|

Step Action

- 4 Right-click on the user name in the center pane, select **Delete**.



Result: A pop-up warning window opens.

- 5 Confirm the removal of the user account if the consequences of the removal are acceptable.
- 6 Close the pop-up dialog boxes and the **Computer Management** window.
- 7 Log off.

## 8.3 Passwords

### Password policy

Passwords are bound by 21CFR Part 11 and expire according to predetermined intervals set by the customer.

When logging in for the first time, the user needs to change the password.

When a password has expired, it needs to be changed.

### Account logout

Entering the wrong password three times results in account logout. If your account has been locked out:

- Wait 30 minutes for an automatic unlock  
or
- Ask your system administrator to unlock it.

### Change the password

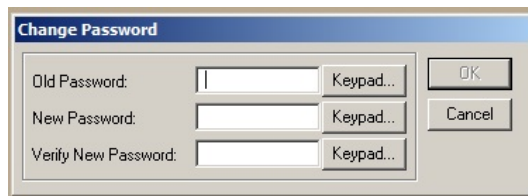
Follow the instructions below to change the password.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                         |
|---|---------------------------------------------------------|
| 1 | Click the <b>Password</b> button on the footer toolbar. |
|---|---------------------------------------------------------|



Result: **Change Password** window opens.



- |   |                        |
|---|------------------------|
| 2 | Type the old password. |
|---|------------------------|

| Step | Action                                                                                                                            |
|------|-----------------------------------------------------------------------------------------------------------------------------------|
| 3    | Type the new password.<br><br><b>Note:</b><br><i>Passwords must be at least 6 characters in length and can be used only once.</i> |
| 4    | Type the new password to confirm.                                                                                                 |
| 5    | Click <b>OK</b> .<br><br><i>Result:</i> The password has been changed.                                                            |



## 8.4 System maintenance

### Responsibilities

It is the responsibility of the user to monitor the instrument. Regular functional verification of the system should be undertaken to make sure that the equipment is functioning properly, and to correct any problems before they have an operational impact. The customer should maintain operational logs according to local site procedures.

Agitator alignment and other physical operating parameters should be recorded in a maintenance log. This log will assist the user in requesting service on any critical component before operational problems arise. See each specific section to confirm the tasks that are to be performed by GE representative.

All inspection and maintenance performed by the user should be carried out in a safe operating manner using relevant health and safety standards and practices as established within the country where the equipment is installed. Local provincial bylaws have to be followed. The owner of the instrument is responsible that relevant standards and practices are followed and a safe operating environment is maintained.

---

### Hardware maintenance schedule

It is the responsibility of the system owner and the user to make sure that the required maintenance is performed. See user-performed maintenance details in [Fuses, on page 233](#), [Maintenance performed by the user, on page 230](#) and [Maintenance performed by calibration technician, on page 231](#). All maintenance that is not described in these sections must be performed by a GE service engineer. See the following table for more information.

| Hardware part           | Frequency                                           |
|-------------------------|-----------------------------------------------------|
| Cables and connectors   | Annually and after system relocation                |
| Fuses                   | As needed. See <a href="#">Fuses, on page 233</a> . |
| Hinges and handles      | Annually and after system relocation                |
| Instrument tower        | Annually and after system relocation                |
| Watson-Marlow pump head | Annually and after system relocation                |

The user should inspect the system for signs of wear and damage and request a service visit if anything abnormal is found.

Contact your GE representative to schedule maintenance and service.

---

Maintenance performed by the user



NOTICE

All critical components of the bioreactor must be calibrated annually or at a period outlined by the on-site metrology department. All critical components should be added to the on-site calibration database.

The table below shows the recommended maintenance and calibration schedule. For detailed instructions for calibration procedures, see [Chapter 6 Preparation, on page 95](#).

| Activity                                             | Weekly | Monthly | Semi-annually | Annually | As needed |
|------------------------------------------------------|--------|---------|---------------|----------|-----------|
| Agitator speed accuracy verification <sup>1, 2</sup> |        |         | x             |          |           |
| Cleaning                                             | x      |         |               |          |           |
| DO probe calibration                                 |        |         |               |          | x         |
| pH probe calibration                                 |        |         |               |          | x         |
| Pump calibration <sup>3</sup>                        |        |         |               |          | x         |

- <sup>1</sup> Contact your GE representative to schedule the verification.
- <sup>2</sup> If XDR-10 Benchtop Bioreactor System is used less than 12 times a year, the verification can be performed annually.
- <sup>3</sup> A pump should be calibrated each time a different tubing size is used.

## Maintenance performed by calibration technician

The table below shows the recommended maintenance and calibration schedule.

| Activity                                        | Weekly | Monthly | Semi-annually | Annually | As needed |
|-------------------------------------------------|--------|---------|---------------|----------|-----------|
| DO transmitter calibration                      |        |         |               |          | x         |
| Exhaust filter heater temperature calibration   |        |         |               | x        |           |
| Mass flow controllers' calibration <sup>1</sup> |        |         |               | x        |           |
| pH transmitter calibration                      |        |         |               |          | x         |
| Temperature probe calibration <sup>2</sup>      |        |         |               |          | x         |

- <sup>1</sup> During MFC calibration process a second set of MFCs can be used to minimize the down time of the equipment. See [Section 10.5 Mass flow controller replacement, on page 276](#) for replacement instructions.
- <sup>2</sup> Temperature probe should be calibrated before each batch, or at least every six months.

For exhaust filter heater temperature calibration and temperature probe calibration instructions see [Section 10.4 Exhaust filter heater calibration, on page 275](#) and [Section 10.3 Temperature probe calibration, on page 271](#).

For other calibration procedures, see the respective manufacturer's documentation.

## Agitator drive head



### WARNING

**Turn off equipment.** Turn off XDR-10 Benchtop Bioreactor System and Lock-Out / Tag-Out (LOTO) any equipment before doing electrical maintenance.

The agitator drive head should be examined as needed for wear and damage.

- Lock-Out / Tag-Out (LOTO) the instrument.
- Inspect for bolt tightness (both agitator bolts and joining bolts) and damage.
- Remove the agitator drive head and inspect bearing, replace at signs of wear.
- Replace bolts/nuts from agitator drive head with new parts.

- Verify that the agitator drive head is properly aligned and Unlock/Untag the equipment.

## Balance

The balance should be examined as needed for wear and damage. For repair contact GE.

## Cables and connectors



**WARNING**  
**Turn off equipment.** Turn off XDR-10 Benchtop Bioreactor System and Lock-Out / Tag-Out (LOTO) any equipment before doing electrical maintenance.

The cables and their connectors should regularly be inspected for damage or excessive wear. The following procedure is recommended for inspection of cables and connectors.

| Step | Action                                                                                                                                                |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Inspect the power cord for frayed or loose wires and damaged cables.                                                                                  |
| 2    | Inspect blanket heater cables and connectors for frayed or loose wires and damaged cables.                                                            |
| 3    | Inspect blanket heater Resistance Temperature Detector cables for loose wires and damaged cables.                                                     |
| 4    | Inspect Ethernet cables that connect the instrument tower with the laptop for loose wires and damaged cables.                                         |
| 5    | If the system is part of a multi-vessel system, inspect Ethernet cable that connects the different SV controllers for loose wires and damaged cables. |
| 6    | Inspect the bag pressure sensor cable for loose wires and damaged cables.                                                                             |

The cables and connectors on XDR-10 Benchtop Bioreactor System shall be repaired as needed. If any cables require replacement, replace them together with its connector with the same type of cable and connector.

## Fuses

Fuses shall be replaced as needed. See [Section 8.5 Replace fuses, on page 234](#) for instructions.

---

## Instrument tower

The instrument tower shall be examined for wear and damage. For proper inspection of instrument tower contact GE.

The instrument tower may require updates or service. Contact GE to schedule service.

---

## SV controller

Contact GE to schedule service.

---

## 8.5 Replace fuses



### WARNING

**Qualification.** Make sure that replacement of fuses is carried out by qualified personnel who are adequately trained, understand, adhere to local regulations and XDR-10 Benchtop Bioreactor System *Operating Instructions*, and have a thorough knowledge of the XDR-10 Benchtop Bioreactor System.

- Note:** If the fuse blows repeatedly, contact your GE representative for help.
- Note:** All applicable fuses for the system are listed with tag name and amperage on the inside of the control panel door.

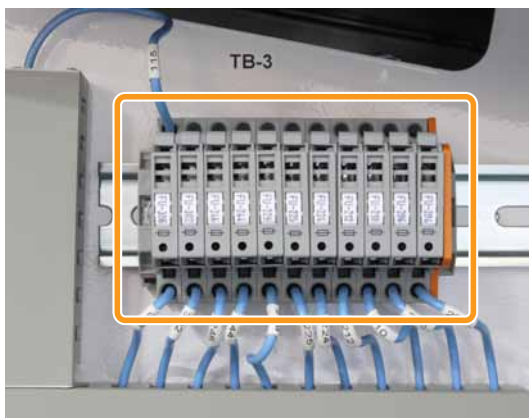
### Illustration of fuses used for the AC components



| Part | Description               |
|------|---------------------------|
| 1    | 10 A fuse                 |
| 2    | The set of other AC fuses |

## Illustration of fuses used for the DC components

The illustration below shows a set of fuses used for the DC components.



## Replace the 10 A AC fuse

One 10 A fuse is used in the XDR-10 Benchtop Bioreactor System.  
Open the instrument tower side door to access the fuses.

| Step | Action                                                       |
|------|--------------------------------------------------------------|
| 1    | Turn off and Lock-Out / Tag-Out (LOTO) the instrument tower. |

| Step | Action                                                                                                                                               |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | Open the instrument tower door as described below. <ol style="list-style-type: none"><li>1 Locate the screws on the instrument tower door.</li></ol> |

A photograph of the back of a black instrument tower. Multiple orange arrows point to the screws along the top, sides, and bottom edges of the door, indicating where to remove them.

|  |                                                                                                                                             |
|--|---------------------------------------------------------------------------------------------------------------------------------------------|
|  | <ol style="list-style-type: none"><li>2 Release the screws with a Phillips screwdriver.</li><li>3 Lift the door and set it aside.</li></ol> |
|--|---------------------------------------------------------------------------------------------------------------------------------------------|

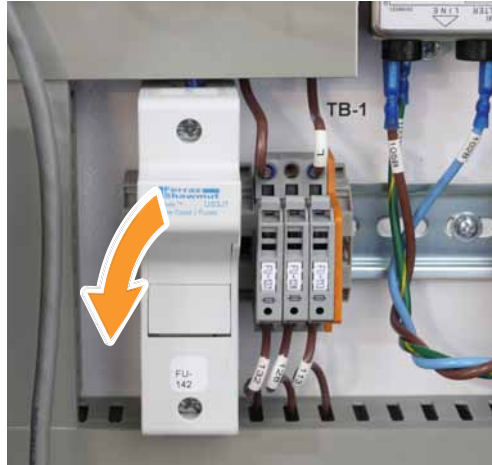
Follow the instructions below to replace the 10 A fuse for the AC components:

| Step | Action                                            |
|------|---------------------------------------------------|
| 1    | Locate the 10 A fuse inside the instrument tower. |

A photograph of the interior of the instrument tower with the door open. An orange circle highlights a fuse block, and a large orange arrow points to it from the right side of the image.



| Step | Action                       |
|------|------------------------------|
| 2    | Press the access cover down. |



*Result:* The fuse is visible inside the fuse holder.



## 8 Maintenance

### 8.5 Replace fuses

| Step | Action |
|------|--------|
|------|--------|

- |   |                              |
|---|------------------------------|
| 3 | Pull out the fuse cartridge. |
|---|------------------------------|



- |   |                                                   |
|---|---------------------------------------------------|
| 4 | Place the new fuse in the fuse holder.            |
| 5 | Push the access cover back up to close the cover. |
| 6 | Re-install the instrument tower door.             |

### Replace the other AC fuses and the DC fuses

All DC fuses and all AC fuses (except the 10 A AC fuse) are replaced using the same procedure.

Open the instrument tower side door to access the fuses.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                              |
|---|--------------------------------------------------------------|
| 1 | Turn off and Lock-Out / Tag-Out (LOTO) the instrument tower. |
|---|--------------------------------------------------------------|

| Step | Action |
|------|--------|
|------|--------|

|   |                                                    |
|---|----------------------------------------------------|
| 2 | Open the instrument tower door as described below. |
|---|----------------------------------------------------|

- 1 Locate the screws on the instrument tower door.



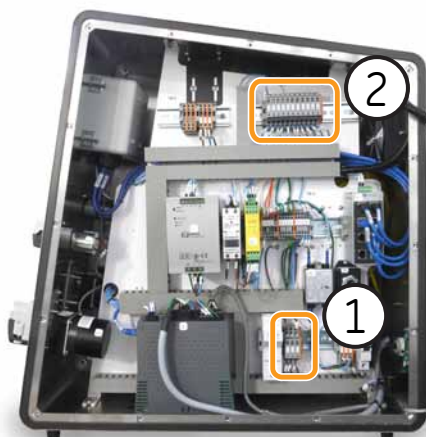
- 2 Release the screws with a Phillips screwdriver.

- 3 Lift the door and set it aside.

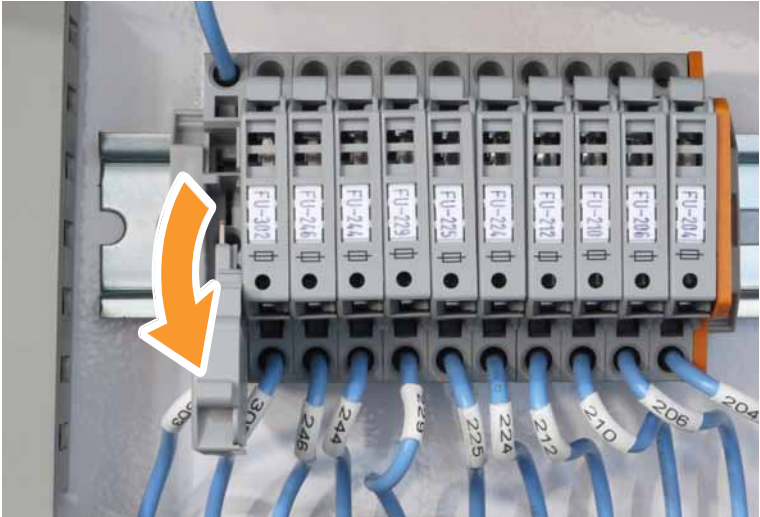
Follow the instructions below to replace the fuses:

| Step | Action |
|------|--------|
|------|--------|

|   |                                                                          |
|---|--------------------------------------------------------------------------|
| 1 | Locate the AC fuses (1) or the DC fuses (2) inside the instrument tower. |
|---|--------------------------------------------------------------------------|



| Step | Action                     |
|------|----------------------------|
| 2    | Push down the fuse holder. |

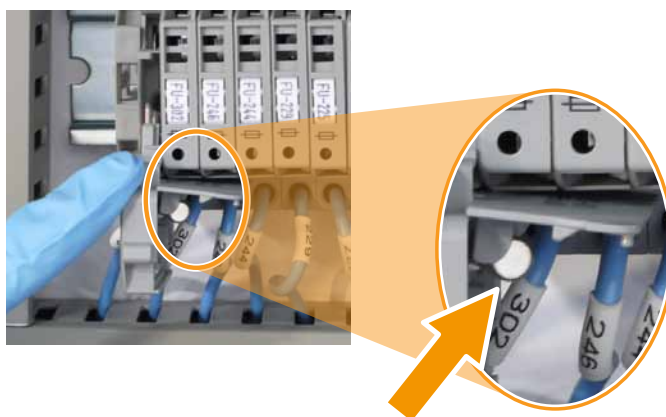


| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                         |
|---|-------------------------------------------------------------------------|
| 3 | Lift up the right side of the fuse holder to open the fuse holder door. |
|---|-------------------------------------------------------------------------|



*Result:* The fuse will be visible inside the fuse holder.



| Step | Action |
|------|--------|
|------|--------|

- |   |                  |
|---|------------------|
| 4 | Remove the fuse. |
|---|------------------|



- |   |                                   |
|---|-----------------------------------|
| 5 | Place the new fuse in the holder. |
|---|-----------------------------------|

**Note:**

*Make sure the fuse is securely placed in the door.*

- |   |                                                               |
|---|---------------------------------------------------------------|
| 6 | Push the fuse holder door back down to close the fuse holder. |
| 7 | Push the fuse holder up to its original position.             |
| 8 | Re-install the instrument tower door.                         |

## 8.6 Software maintenance

### Backups



#### NOTICE

It is recommended that backups of critical data files are taken regularly. Please refer to the site policy on backup and restore time schedule.

### Anti-virus software



#### NOTICE

Use anti-virus software on all server and workstation computers within your instrument package.

Below is a summary of the Wonderware policy on anti-virus protection.

New viruses are discovered almost every day. To protect yourself from virus attacks, Wonderware suggests:

- Isolate the plant control network (PCN) from the corporate network.
- Virus scan your systems on a regular basis.
- Wonderware does not endorse any particular anti-virus package as there is a large number of such products available on the market.
- Stay current on information related to virus protection trends.

### Conflicts with anti-virus software

If your Wonderware application conflicts with anti-virus software:

- Make sure that you have the latest version of the anti-virus software.
- Run the anti-virus software to make sure that no viruses are present on your computer.
- Disable the anti-virus software, and then run your application.

- If possible, periodically re-run the anti-virus software during scheduled maintenance times (planned downtime).
- When the anti-virus software is disabled, do not run any applications that could transfer a virus (for example email or file sharing). Do not insert USB flash drives because they can be a source of viruses.

Wonderware will post warnings on any significant anti-virus software conflicts with our software products. Please check the web site at [www.wonderware.com/support/mmi](http://www.wonderware.com/support/mmi) for the most current information.

---

## Microsoft Windows operating system security updates

Below is a summary of the Wonderware policy on Windows security updates.

- Wonderware understands the need to keep current with Windows security updates.
  - Due to the frequency and number of Windows security updates it is not practical to extensively test all Wonderware products with all updates.
  - Wonderware Technical Support advises customers to back up their systems prior to loading any security updates.
  - Wonderware support customers to install Windows security updates. If any conflicts arise with Wonderware software as a result of Windows security updates, please report the issues via normal support channels.
  - Wonderware follows a process to proactively notify customers of any known conflicts between Wonderware software and Windows security updates via warnings posted on [www.wonderware.com/support/mmi](http://www.wonderware.com/support/mmi).
-



## 8.7 Calibration schedule



### NOTICE

All critical components of XDR-10 Benchtop Bioreactor System must be calibrated annually or at a period outlined by the on-site metrology department. All critical components should be added to the on-site calibration database.

The following items require calibration:

- Agitator
- Mass flow controllers
- pH/DO Transmitters
- Pumps - user calibrated
- Temperature RTD
- Vessel weight platform

## 8.8 Cleaning

### Safety precautions



#### WARNING

**Cleaning.** Always clean the equipment in a well ventilated area. Never immerse any part of the equipment in liquid or spray liquid on the equipment. Always make sure that the equipment is completely dry before plugging it in. Always follow all environmental, health, and safety guidelines pertaining to the materials used.



#### NOTICE

The instrument should be cleaned weekly or on an as needed basis, as outlined by the manufacturing schedule. XDR vessel interior needs to be cleaned between batches.



#### NOTICE

XDR-10 Benchtop Bioreactor System is resistant to the following agents:

- Ethanol 70%
- ACTISAN™
- Spor-Klenz™

## Instructions for cleaning

| Step | Action                                                                                                                                                                                                                                                                                                                                                                                                       |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Use a non-abrasive cloth with mild detergent and water to clean the exterior of the instrument tower and XDR vessel.                                                                                                                                                                                                                                                                                         |
| 2    | Check all stainless steel components for signs of surface rust. If rust is found, do as follows: <ol style="list-style-type: none"><li>1 Scrub areas of surface rust with an extra-fine mildly abrasive cleaning pad.</li><li>2 Wipe the treated areas with a surface passivation chemical.</li><li>3 Wipe the treated areas with a Water For Injection (WFI) soaked cloth to remove the chemical.</li></ol> |
| 3    | If enclosure louvers are clogged with dust or debris, vacuum the louvers to remove any build-up.                                                                                                                                                                                                                                                                                                             |

## 8 Maintenance

### 8.9 Storage, moving and reinstallation

## 8.9 Storage, moving and reinstallation

Contact your GE representative for instructions on how to store, move and re-install the instrument.

## 8.10 Lock-Out / Tag-Out (LOTO): turn-off procedure



### WARNING

**High voltage.** It is essential for the safety of personnel working in or around electrically powered equipment to follow a company policy and procedure for Lock-Out / Tag-Out (LOTO).

**Note:** *This section is not intended to describe or supersede a comprehensive Lock-Out / Tag-Out (LOTO) policy that includes thorough procedures and frequent training.*

**Note:** *Locking out a bioreactor during an ongoing batch process will result in loss of data.*

Follow the instructions below to turn off XDR-10 Benchtop Bioreactor System.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Turn off the pneumatic supply valves to the equipment.<br><i>Result:</i> The pneumatic supply to the control panel will be isolated.         |
| 2 | Turn on the mass flow controllers to 1 SLPM for each gas supply.<br><i>Result:</i> Any remaining pressure in the pneumatic lines will bleed. |
| 3 | Lock out the gas supply valves using a lock with a tag.                                                                                      |
| 4 | Verify that no flow is present on the MFC PID faceplates.                                                                                    |
| 5 | Remove the plug from the instrument tower.                                                                                                   |

| Step | Action                                                                          |
|------|---------------------------------------------------------------------------------|
| 6    | Set the power switch at the back of the instrument tower to <b>O</b> -position. |



*Result:* The power to the instrument tower is turned off.

## 8.11 Lock-Out / Tag-Out (LOTO): turn-on procedure



### WARNING

**High voltage.** It is essential for the safety of personnel working in or around electrically powered equipment to follow a company policy and procedure for Lock-Out / Tag-Out (LOTO).

**Note:** This section is not intended to describe or supersede a comprehensive Lock-Out / Tag-Out (LOTO) policy that includes thorough procedures and frequent training.

Follow the instructions below to turn on XDR-10 Benchtop Bioreactor System.

| Step | Action |
|------|--------|
|------|--------|

- |   |                                                                         |
|---|-------------------------------------------------------------------------|
| 1 | Remove locks and tags from the supply gas.                              |
| 2 | Turn on the gas supply gases.                                           |
| 3 | Plug in the cord to the instrument tower.                               |
| 4 | Set the power switch at the back of the instrument tower to I-position. |



**Result:** The instrument tower is switched on.

# 9 Troubleshooting

## About this chapter

This chapter provides required information to enable users and service personnel to identify and correct problems that may occur when operating XDR-10 Benchtop Bioreactor System. If the suggested actions in this guide do not solve the problem or if the problem is not covered by this guide, contact your GE representative for advice.

---

## In this chapter

| Section                     | See page |
|-----------------------------|----------|
| 9.1 Instrument tower        | 253      |
| 9.2 Laptop                  | 254      |
| 9.3 XDR vessel              | 255      |
| 9.4 Temperature monitoring  | 256      |
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| 9.9 Bag pressure            | 263      |
| 9.10 Agitation              | 264      |
| 9.11 Mass flow controllers  | 265      |
| 9.12 Vessel weight platform | 266      |

---



## 9.1 Instrument tower

| Problem                                                                                                                  | Possible causes                                                       | Corrective action                                                                                                  |
|--------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| The instrument tower is disconnected from the laptop.                                                                    | The IP setting of the laptop is incorrect.                            | Set the IP address configuration of the controller laptop to match the information in the Factory Acceptance Test. |
|                                                                                                                          | The connection cord is disconnected.                                  | Verify that the connection between the laptop and the instrument tower is complete.                                |
|                                                                                                                          | The instrument tower is switched off or disconnected from main power. | Verify that the instrument tower is switched on and powered.                                                       |
|                                                                                                                          | A fuse has blown.                                                     | Replace the fuse.                                                                                                  |
|                                                                                                                          | Defective Ethernet switch.                                            | Replace the switch.                                                                                                |
|                                                                                                                          | The PLC has failed.                                                   | Contact your GE representative to schedule service.                                                                |
| No power supply to instrument tower.                                                                                     | Power switch is in the <b>O</b> (off) position.                       | Turn on the power.                                                                                                 |
|                                                                                                                          | Circuit breaker is tripped.                                           | Verify that the circuit breaker is safe to reset.<br>Reset the circuit breaker.                                    |
| Ethernet switches are not communicating (the light on the port where the instrument tower is connected is not blinking). | Broken or damaged Ethernet cable.                                     | Determine which cable is broken or damaged using an Ethernet cable tester. Replace the cable.                      |
|                                                                                                                          | Broken or damaged Ethernet connector.                                 | Verify all connections using an Ethernet cable tester. Replace the connector.                                      |
|                                                                                                                          | Defective Ethernet switch.                                            | Replace the switch.                                                                                                |
|                                                                                                                          | Main power to the cabinet is off.                                     | Turn on the main power.                                                                                            |
| A loud hissing sound from the instrument tower.                                                                          | A gas tubing has come loose in transit or in operation.               | Contact your GE representative to schedule service.                                                                |

## 9.2 Laptop

| Problem                                  | Possible causes                                                                    | Corrective action                                                                               |
|------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| No power supply to the laptop.           | Circuit breaker is tripped.                                                        | Verify that the circuit breaker is safe to reset.<br>Reset the circuit breaker.                 |
|                                          | System is on a GFI (Ground Fault Interrupted) circuit.                             | Make sure that the circuit is not GFC interrupted. GFC circuits will reduce system reliability. |
| Ethernet switches are not communicating. | Broken or damaged Ethernet cable.                                                  | Determine which cable is broken or damaged using an Ethernet cable tester. Replace the cable.   |
|                                          | Broken or damaged Ethernet connector.                                              | Verify all connections using an Ethernet cable tester. Replace the connector.                   |
|                                          | Defective Ethernet switch.                                                         | Replace the switch.                                                                             |
|                                          | Main power to the cabinet is off.                                                  | Turn on the main power.                                                                         |
| The laptop does not display data.        | Ethernet cable connecting the laptop to the instrument tower is missing or broken. | Install or replace the cable.                                                                   |

## 9.3 XDR vessel

| Problem                                           | Possible causes                                                   | Corrective action                                                                                               |
|---------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| XDR vessel will not heat.                         | Cables are not connected.                                         | Connect the cables.                                                                                             |
|                                                   | Heater circuit breaker is tripped.                                | Reset the circuit breaker.                                                                                      |
|                                                   | Cables damaged or disconnected.                                   | Connect or replace the power cables.                                                                            |
| Agitator servo drive is not functioning properly. | Ethernet cable is missing from the drive or is loose.             | Connect the Ethernet cable.                                                                                     |
|                                                   | The motor is overloaded.                                          | Acknowledge the agitator fault and attempt to restart the motor. If the error persists, contact GE for service. |
|                                                   | The power cable is disconnected.                                  | Connect the power cable.                                                                                        |
|                                                   | The drive is broken.                                              | Replace the drive.                                                                                              |
|                                                   | Circuit breaker is tripped.                                       | Reset the circuit breaker.                                                                                      |
|                                                   | A fuse has blown.                                                 | Replace the fuse.                                                                                               |
|                                                   | Agitator drive head bearing pack is damaged or in need of grease. | Apply grease or replace the bearing pack.                                                                       |

## 9.4 Temperature monitoring

| Problem                                                                    | Possible causes                                        | Corrective action                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature monitoring is not working as expected.                         | Temperature probe has failed.                          | Replace the temperature probe. If the failure occurred during a batch run, follow the procedure below: <ol style="list-style-type: none"> <li>1 Turn off the agitator.</li> <li>2 Replace the temperature probe.</li> <li>3 Resume normal processing.</li> </ol> |
|                                                                            | Temperature probe is not inserted into the bioreactor. | Insert temperature probe into the thermowell.                                                                                                                                                                                                                    |
|                                                                            | Heating blanket(s) is not functioning.                 | Replace the heating blanket.                                                                                                                                                                                                                                     |
|                                                                            | Sensor connection to cable is loose.                   | Connect the sensor cable.                                                                                                                                                                                                                                        |
| Temperature measurements are inaccurate or reading 128°C.                  | The temperature probe is not connected.                | Connect the temperature probe.                                                                                                                                                                                                                                   |
|                                                                            | The temperature probe wire is damaged.                 | Contact your GE representative to schedule service.                                                                                                                                                                                                              |
| The system is taking very long time (> 6 h) to reach temperature setpoint. | Only one heating blanket is functional.                | Verify that the heating blanket connector is firmly seated. Using your hand, verify that both heating blankets are warm. If the heating blanket is still not functioning, call your GE representative to schedule service.                                       |

## 9.5 pH/DO control

| Problem                                                                                                                       | Possible causes                                                                            | Corrective action                                                                                                                                                                                                                                                                               |
|-------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Measurement reading is not shown on X-Station control panel but is shown on pH/DO transmitter on bioreactor instrument tower. | Sensor cable is not properly connected.                                                    | Connect the sensor cable.                                                                                                                                                                                                                                                                       |
| pH sensor changes are very slow: two sensors change their readings at different rates.                                        | The pH sensor needs cleaning.                                                              | If available, switch the input to the second pH channel.<br><br>Keep probes clean between uses, and clean them with a solution designed to maintain their properties. Replace probes on a regular cycle.                                                                                        |
| pH sensor changes are very slow: pH control is not rapid enough for the application.                                          | The tuning parameters or the concentration of the applied acid or base is not sufficient.  | Perform a study to determine the best tuning parameters for your system and available reagents.                                                                                                                                                                                                 |
| Measurement value is not as expected.                                                                                         | pH or DO connector was wetted and did not dry completely.                                  | Verify that the connectors are clean and dry. The connector may be cleaned with isopropyl or methyl alcohol to assist with the removal of water from beneath the contacts.<br><br><b>Note:</b><br><i>Do not immerse the plug ends in liquid. Use an aerosol spray to introduce the alcohol.</i> |
|                                                                                                                               | The probe was not standardized prior to installation to XDR-10 Benchtop Bioreactor System. | Make sure all probes are standardized prior to installation.                                                                                                                                                                                                                                    |
|                                                                                                                               | pH or DO connector is not properly tightened or installed.                                 | <ol style="list-style-type: none"> <li>1 Remove and re-attach the sensor from the cable.</li> <li>2 Carefully push the connector together as it is being tightened.</li> </ol>                                                                                                                  |

| Problem                                                           | Possible causes                                                           | Corrective action                                                                                                                                                                                                                 |
|-------------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Different probes in the same solution show different pH readings. | One of the pH probes is not calibrated.                                   | Calibrate pH probes before use.                                                                                                                                                                                                   |
|                                                                   | Probe may be at the end of its life cycle.                                | Replace the probe.                                                                                                                                                                                                                |
| pH/DO transmitter displays <b>Fault.</b>                          | A probe is broken.                                                        | Replace the probe.                                                                                                                                                                                                                |
|                                                                   | The probe element is not properly connected.                              | Consult the transmitter manual, located in the system Turnover Package, to find and resolve the problem.                                                                                                                          |
|                                                                   | The probe model is not compatible with XDR-10 Benchtop Bioreactor System. | Verify that both the probe element and the probe match the original probe shipped with the system.<br><br>If the use of a different probe is required for your process, contact your local GE representative to schedule service. |

## 9.6 Valves

| Problem                                                                            | Possible causes                      | Corrective action                                                                     |
|------------------------------------------------------------------------------------|--------------------------------------|---------------------------------------------------------------------------------------|
| Valves are not opening or closing.                                                 | System air supply is cut off.        | Verify that incoming air supply pressure is in the range shown in the PID face-plate. |
|                                                                                    | System air pressure is insufficient. | Make sure that adequate air pressure is available.                                    |
| The instrument tower emits a hissing sound when all mass flow controllers are off. | A pneumatic supply hose is loose.    | Verify that all pneumatic connections are properly made and not leaking.              |

## 9.7 pH deviation

| Problem                                                        | Possible causes                                    | Corrective action                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| pH is not coming to equilibrium even if the pumps are running. | The deadband is set to 0.                          | pH control must utilize a deadband. If no deadband is used, acid and base will be alternately introduced. Define a deadband appropriate to your process.                                                                                                                                                                                                                                       |
|                                                                | Acid/base supply is empty.                         | Fill the acid/base supply vessel.                                                                                                                                                                                                                                                                                                                                                              |
|                                                                | The pumps are not primed.                          | Prime the pumps.                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                | Feed line before or after the pump is kinked.      | Free the feed line.                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                | Feed line before or after the pump is clamped.     | Free the feed line.                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                | PID parameters are not appropriate for the system. | Conduct a study to verify the control parameters. The following factors have been identified as important: <ul style="list-style-type: none"><li>• Quantity of media</li><li>• The pump type</li><li>• Concentration of acid / base</li><li>• Mapping strategy</li><li>• Buffering capability of media</li><li>• Mixing of the XDR vessel contents (weight and viscosity dependent).</li></ul> |



## 9.8 Pumps

| Problem                                | Possible causes                                                                                                    | Corrective action                                                                                                                                                                                                                                                                                                                                     |
|----------------------------------------|--------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The tubing is moving in the pump head. | The tubing clamps in the pump head are not properly set for the installed tubing.                                  | Tighten the tubing clamps in the pump head.                                                                                                                                                                                                                                                                                                           |
|                                        | The tubing is not fastened at the ends of the 313 series pump.                                                     | <ol style="list-style-type: none"> <li>1 Verify that the pinches on either side of the pump head are set to hold the size of the tubing in use.</li> <li>2 Adjust the tube pinches using the thumbscrews on the lower right and left sides of the pump.</li> </ol>  |
| Pump drive head is not turning.        | <ul style="list-style-type: none"> <li>• Loose wiring</li> <li>• Failed motor</li> <li>• Broken gearbox</li> </ul> | Contact your GE representative for replacement.                                                                                                                                                                                                                                                                                                       |
| The tubing is worn out.                | All tubing used in the pumps will wear out with use over time.                                                     | <p>Move the section of worn out tubing to the left or right.</p> <p>Use only tubing rated for use in peristaltic pump head.</p>                                                                                                                                                                                                                       |
| The pumped volume is inaccurate.       | The pump was not calibrated after the tubing was changed.                                                          | Calibrate the pump using the same tubing as planned for operation.                                                                                                                                                                                                                                                                                    |

| Problem                  | Possible causes                                                                                                                | Corrective action                                                                                                                           |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| The pump is not turning. | The system is in <b>E-Stop Active</b> mode.                                                                                    | Verify that the cause of the <b>E-Stop Active</b> condition is eliminated, and clear the <b>E-Stop Active</b> . Try to use the pumps again. |
|                          | Instrument weight is more than 20% above its volumetric capacity. The system is automatically preventing an overfilling event. | Reduce the instrument weight.                                                                                                               |
|                          | A fuse has blown.                                                                                                              | Switch to a functional pump head until a repair can be made. Contact your GE representative for service.                                    |

## 9.9 Bag pressure

| Problem                   | Possible causes                                                           | Corrective action                                                                                                                                                                                                                                                                                                       |
|---------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bag pressure is too high. | The bag pressure sensor cable is not connecting with the sensor assembly. | Make sure that the cable connector is oriented correctly and is firmly pushed together.                                                                                                                                                                                                                                 |
|                           | The input on the system has an error.                                     | Contact your GE representative to schedule service.                                                                                                                                                                                                                                                                     |
|                           | The filter has become wet.                                                | <ol style="list-style-type: none"> <li>1 Stop the mass flow controllers.</li> <li>2 Clamp off the affected filter.</li> <li>3 Install a new filter, maintain aseptic conditions during the procedure.</li> <li>4 Use a clamp or a hemostat to isolate the wet filter and prevent contamination of the batch.</li> </ol> |
|                           | The filter is undersized for the gas flow rate that is being used.        | Install a larger filter to prevent excessive backpressure.                                                                                                                                                                                                                                                              |
|                           | The bag pressure was not tared when the bag was installed.                | <ol style="list-style-type: none"> <li>1 Stop all gas flow into the bag.</li> <li>2 Wait until the bag pressure reaches 0 bars (15-20 seconds).</li> <li>3 Tare the bag pressure sensor.</li> </ol>                                                                                                                     |
|                           | The bag pressure sensor is unplugged.                                     | Plug in the pressure sensor.<br><br><b>Note:</b><br><i>If the sensor was tared previously, it does not need to be tared again.</i>                                                                                                                                                                                      |

## 9.10 Agitation

| Problem                      | Possible causes                                                         | Corrective action                                                                                                                                                                                                           |
|------------------------------|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The agitator does not start. | The agitator is not enabled.                                            | Enable the agitator. See <a href="#">Agitation control, on page 176</a> for instructions.                                                                                                                                   |
|                              | A fuse has blown and the agitator is not powered.                       | Replace the fuse.                                                                                                                                                                                                           |
|                              | The system is in the state of <b>E-Stop Active</b> .                    | Start the agitator when the system has been restarted after emergency shutdown.<br><br><b>Note:</b><br><i>The agitator cannot be started while the system is in the state E-stop Active.</i>                                |
|                              | The bioreactor is in <b>Manual</b> mode and cannot accept the setpoint. | <ol style="list-style-type: none"><li>1 Switch the system to <b>Auto</b> mode.</li><li>2 Enter the setpoint.</li></ol><br><b>Note:</b><br><i>When the bioreactor is in <b>Manual</b> mode the setpoint will be ignored.</i> |
|                              | The agitator drive or motor may have failed.                            | Contact your GE representative to schedule service.                                                                                                                                                                         |

## 9.11 Mass flow controllers

| Problem                                                       | Possible causes                                                                              | Corrective action                                               |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| The mass flow controller is not reaching setpoint.            | The incoming gas supply is insufficient.                                                     | Make sure that the gas supply is sufficient for the instrument. |
|                                                               | The gas supply has run out.                                                                  | Replace the gas supply.                                         |
| The cabinet is making a clicking sound when the MFCs are off. | The solenoid valves are opening and closing because of an error in the mass flow controller. | Calibrate the mass flow controller.                             |

## 9.12 Vessel weight platform

| Problem                                            | Possible causes                                                                              | Corrective action                                                                                                                        |
|----------------------------------------------------|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| The system weight is not being measured correctly. | The surface is not able to bear the weight platform under maximum load at points of support. | Verify that the instrument installation requirements have been followed. See <a href="#">Bench, on page 90</a> for detailed description. |
|                                                    | The platform is not stable and there are vibrations during weighing.                         |                                                                                                                                          |
|                                                    | Vibrations from other machines are interfering with installation of weight platform.         |                                                                                                                                          |
|                                                    | Other materials were added to the balance after it was tared.                                | Remove the added materials from the balance.                                                                                             |
|                                                    | The system was not tared after the bag was installed.                                        | Ensure the bag is tared before filling it with media.                                                                                    |
|                                                    | The input has drift.                                                                         | Restart the instrument tower and the laptop. If this does not resolve the issue, contact your GE representative to schedule service.     |

# 10 Reference information

## About this chapter

This chapter provides required information that may become useful when installing, operating, maintaining and troubleshooting XDR-10 Benchtop Bioreactor System. It also contains ordering information.

---

## In this chapter

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| 10.2 CV and SP units and ranges        | 270      |
| 10.3 Temperature probe calibration     | 271      |
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---

# 10.1 System specifications

The table below shows system specifications for XDR-10 Benchtop Bioreactor System. The data refer to a single-vessel system.

| Specification             | System                            | Value                                                                  |
|---------------------------|-----------------------------------|------------------------------------------------------------------------|
| Supply voltage            | XDR-10 Benchtop Bioreactor System | 110 VAC ± 10%, 1 phase, 50/60 Hz, 7.9 A                                |
|                           |                                   | 220 VAC ± 10%, 1 phase, 50/60 Hz, 3.8 A                                |
|                           | Laptop                            | 100-240 VAC, 1 phase, 50/60 Hz, 2.5 A                                  |
| Power plug                | XDR-10 Benchtop Bioreactor System | One power plug                                                         |
|                           | Instrument tower                  | IEC style power cord attached with a US power plug or an EU power plug |
|                           | Laptop                            | Power cord attached with a US plug only                                |
| Maximal power consumption | XDR-10 Benchtop Bioreactor System | 500 VA                                                                 |
| Gas pressure              | XDR-10 Benchtop Bioreactor System | 25 psig at the regulator for all gas types                             |
| Dimensions (W × H × D)    | Instrument tower                  | 38 × 71 × 71 cm<br>(15 × 28 × 28 in)                                   |
|                           | Mini X-Station                    | 46 × 71 × 84 cm<br>(18 × 28 × 33 in)                                   |
|                           | Laptop                            | 45 × 4 × 25 cm<br>(18 × 2 × 10 in)                                     |
|                           | XDR vessel                        | 33 × 82 × 36 cm<br>(13 × 32 × 14 in)                                   |
|                           | Balance                           | 45 × 8 × 45 cm<br>(18 × 3 × 18 in)                                     |
| Weight                    | Instrument tower                  | 55 kg                                                                  |
|                           | Laptop                            | < 5 kg                                                                 |
|                           | XDR vessel                        | 22 kg                                                                  |
|                           | Balance                           | 25 kg                                                                  |



| Specification       | System                            | Value                 |
|---------------------|-----------------------------------|-----------------------|
| Ambient temperature | XDR-10 Benchtop Bioreactor System | 5°C to 30°C           |
| Relative humidity   | XDR-10 Benchtop Bioreactor System | ≤ 60%, non-condensing |
| Sound level         | XDR-10 Benchtop Bioreactor System | < 70 dB(A)            |

The table below shows installation and moving specific information for XDR-10 Benchtop Bioreactor System. The data refer to a single-vessel system.

| Specification                                           | Components                                    | Value                                 |
|---------------------------------------------------------|-----------------------------------------------|---------------------------------------|
| Footprint (W × D)                                       | Instrument tower                              | 38 × 71 cm<br>(15 × 28 in)            |
|                                                         | Mini X-Station                                | 46 × 84 cm<br>(18 × 33 in)            |
|                                                         | Laptop                                        | 45 × 25 cm<br>(18 × 10 in)            |
|                                                         | XDR vessel                                    | 33 × 36 cm<br>(13 × 14 in)            |
|                                                         | Balance                                       | 45 × 45 cm<br>(18 × 18 in)            |
| System moved with forklift<br>- Min space (W × H)       | Crate 1                                       | 94 × 130 cm<br>(37 × 52 in)           |
|                                                         | Crate 2                                       | 94 × 130 cm<br>(37 × 52 in)           |
| Load bearing (transportation)<br>- Max weight           | Crate 1                                       | 118 kg                                |
|                                                         | Crate 2                                       | 118 kg                                |
| Load bearing (installation site, bench)<br>- Max weight | Instrument tower, laptop, XDR vessel, balance | 120 kg                                |
| Minimum bench size<br>(W × H × D)                       | Instrument tower, laptop, XDR vessel, balance | 183 × 92 × 92 cm<br>(72 × 36 × 36 in) |

## 10.2 CV and SP units and ranges

| Controller loop                   | Setpoint (SP)                                   | Controlled variable (CV)                       |
|-----------------------------------|-------------------------------------------------|------------------------------------------------|
| Agitator speed                    | revolutions per minute (rpm) <sup>1</sup>       | revolutions per minute (rpm) <sup>1</sup>      |
| Auxiliary input 1                 | 0 to 100                                        | 0% to 100%                                     |
| Auxiliary input 2                 | 0 to 100                                        | 0% to 100%                                     |
| Heating blanket temperature       | 0°C to 100°C                                    | 0% to 100%                                     |
| Dissolved oxygen (DO)             | 0% to 200% saturation                           | 0% to 100%                                     |
| Exhaust filter heater temperature | 0°C to 100°C                                    | 0% to 100%                                     |
| Mass flow controllers (MFC)       | standard liters per minute (SLPM) <sup>1</sup>  | standard liters per minute (SLPM) <sup>1</sup> |
| pH                                | 0 to 14                                         | 0% to 100%                                     |
| Pumps                             | milliliters per minute (mL/min) <sup>2, 3</sup> | 0% to 100%                                     |
| Vessel temperature                | 0°C to 100°C                                    | -10°C to 90°C                                  |
| Vessel weight                     | 0 to nominal size, kg                           | 0% to 100%                                     |

<sup>1</sup> The range varies and is defined by system size.

<sup>2</sup> Automatically scaled to an appropriate range when pump calibration is performed.

<sup>3</sup> When a pump is run in calibration mode, pump speed is displayed in rpm on PID faceplate.

The units for CVHL, CVLL, SPHL and SPLL always match the units and ranges of the CV and SP, respectively.

## 10.3 Temperature probe calibration

### Introduction



#### NOTICE

Do not use electronic simulation of resistance to calibrate the temperature probe.



#### NOTICE

Do not calibrate the temperature probe while the vessel is being controlled to a temperature setpoint.

**Note:** *If the instrument is used in a GMP compatible environment, the temperature probe is a GMP critical component.*

The temperature probe must be calibrated by a calibration technician.

The temperature probe calibration is a three-point calibration. The batch operating temperature should be used as the middle calibration point. The temperature probe is calibrated using an offset.

**Note:** *The probe tip may contain one or two resistance temperature detectors (RTD), depending on your instrument configuration. Both RTDs have to be calibrated simultaneously.*

### Preparation

Before you start to calibrate the temperature probe, prepare the following:

- a temperature calibration standard

**Note:** *The accuracy of the temperature calibration standard is the responsibility of the site metrology department.*

- a constant temperature circulating bath.

**Note:** *If additional circulating baths are available, they can be set to the two end-point calibration temperatures. This would allow to shorten the total calibration time, as there would be no need to change the temperature of the primary circulating bath.*

Calibration

- Step

Action
- 1

Set the circulating bath temperature to the batch operating temperature (middle calibration point).

**Note:**

*The batch operating temperature is the crucial temperature of the process.*
- 2

Make sure that the connections between the bioreactor instrument tower and the temperature probe are correctly made.
- 3

Set the standard probe of the temperature calibration instrument and the temperature probe into the circulating bath, no more than 20 mm apart. Make sure that the temperature probe is inserted into the liquid by at least 7.5 cm.

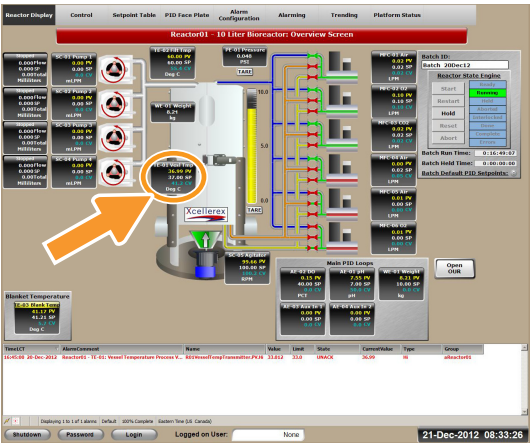
**Note:**

*Do not wet the probe connector.*
- 4

Wait until the system reaches the equilibrium.
- 5

Record the data for both the temperature probe and the temperature standard as follows:

  - The data for the temperature probe is displayed in the vessel weight temperature object, located near the center of the **Reactor Display** window.



If the probe contains two RTDs, record both A and B channels.

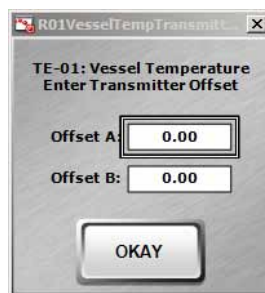
- The standard temperature is displayed by the temperature indicator on the temperature standard.

| Step | Action                                                                                                                                                                                                                                |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | Set the circulating bath temperature to one of the calibration end point temperatures; or use another bath if available. Repeat steps 3 to 5 above.                                                                                   |
| 7    | Set the circulating bath temperature to the other calibration end point temperature; or use another bath if available. Repeat steps 3 to 5 above.                                                                                     |
| 8    | Evaluate the obtained results considering the following: <ul style="list-style-type: none"> <li>• Manufacturer's tolerance: <math>\pm 0.5^{\circ}\text{C}</math></li> <li>• Process tolerance: determined by the end user.</li> </ul> |

## Adjustment

If the temperature probe is out of tolerance, follow the steps below to adjust the probe.

| Step | Action                                                                                                                                                                                                                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Using the data obtained during the calibration procedure, compute the offset to adjust the probe temperature to the recorded standard temperature:<br>Offset = standard temperature reading - probe reading.<br><br><b>Note:</b><br><i>Use the data obtained at operating temperature (middle calibration point) for best overall accuracy.</i> |
| 2    | If the probe contains two RTDs, calculate the offsets for both A and B channels.                                                                                                                                                                                                                                                                |
| 3    | Click on the vessel weight temperature object, located at the lower left corner of <b>Reactor Display</b> window.<br><br><i>Result:</i> The calibration offset dialog box will open.                                                                                                                                                            |



| Step | Action                                                            |
|------|-------------------------------------------------------------------|
| 4    | Type the computed offsets into the text fields of the dialog box. |
| 5    | Click <b>OKAY</b> .                                               |

If the adjustment of the temperature probe at the operating temperature does not bring the system into tolerance, replace the temperature probe and repeat the calibration procedure.

If the calibration of the new temperature probe does not bring the system into tolerance, contact your GE representative for service.

## 10.4 Exhaust filter heater calibration

### Preparation

The exhaust filter heater must be calibrated by a calibration technician.

Before you start to calibrate the exhaust filter heater, prepare the following:

- A temperature calibration standard with thermocouple with the following characteristics:
  - A beaded thermocouple or a thermocouple probe with diameter < 2 mm
  - The length of the thermocouple should fit within the filter heater entirely
  - Suggested type: a narrow ungrounded sheath, or a flat surface measuring type
  - For test accuracy ratio 4:1, the minimum required accuracy of the thermocouple is  $\pm 1.25^{\circ}\text{C}$
- Tape, rated for working environment

### Calibration

The recommended calibration is a single point calibration at the batch operating temperature.

Follow the instructions below to calibrate the exhaust filter heater.

| Step | Action                                                                                                                                                                                                                                    |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Place the thermocouple inside of the exhaust filter heater body, halfway up the length of the body and at an angle of $90^{\circ}$ to the wire entry point.                                                                               |
| 2    | If the thermocouple is a probe type thermocouple, verify that the entire length of the probe is in contact with the inside wall of the exhaust filter heater.                                                                             |
| 3    | Close the exhaust filter heater body using tape to prevent the leakage of warmed air and simulate the presence of the filter.                                                                                                             |
| 4    | Warm the exhaust filter heater: set the exhaust filter heater in <b>Auto/Local</b> mode and enter the setpoint as described for actual use. See <a href="#">Heat up the exhaust filter heater, on page 135</a> for detailed instructions. |
| 5    | Wait at least one hour for the system to come to thermal equilibrium.                                                                                                                                                                     |
| 6    | Follow your metrology department procedures in recording and comparing the measured temperature for the unit under test and the standard.                                                                                                 |

## 10.5 Mass flow controller replacement

Mass flow controller (MFC) replacement should be performed by qualified personnel. Contact your GE representative for more info.

To replace mass flow controllers follow the instructions below. To avoid an incorrect replacement, work with only one MFC at a time.

| Step | Action                                                                                                                                                     |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Turn off and Lock-Out / Tag-Out (LOTO) XDR-10 Benchtop Bioreactor System.                                                                                  |
| 2    | Open the instrument tower side panel as described below. <ol style="list-style-type: none"><li>1 Locate the screws on the instrument tower side.</li></ol> |



- 2 Release the screws with a Phillips screwdriver.
- 3 Lift the instrument side panel and set it aside.
- 3 Disconnect the following cords from one MFC:
  - Power
  - Signal
  - Pneumatic

**Tip:**

*A flat-head screwdriver with #1 head may be required to disconnect the cords.*



| Step | Action                                                                            |
|------|-----------------------------------------------------------------------------------|
| 4    | Disconnect the pneumatic inlet and outlet fittings using a wrench.                |
| 5    | Remove the Ethernet switch from the DIN rail by following the instructions below: |



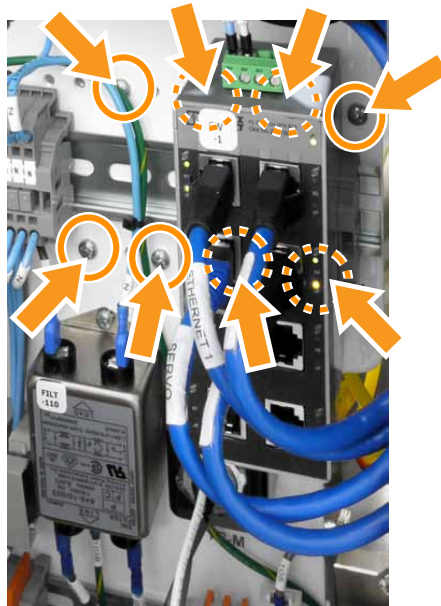
- 1 Disconnect the power connector from the switch by pulling it out.
- 2 Note the location of each plug in the switch.
- 3 Remove the Ethernet plugs from the Ethernet switch.
- 4 Use a flat-head screwdriver to pull the locking tab away from the DIN rail.

**Note:**

*The locking tab is located on the bottom of the switch, close to the DIN rail.*

- 5 Tilt the switch upwards and pull towards you to remove the Ethernet switch.

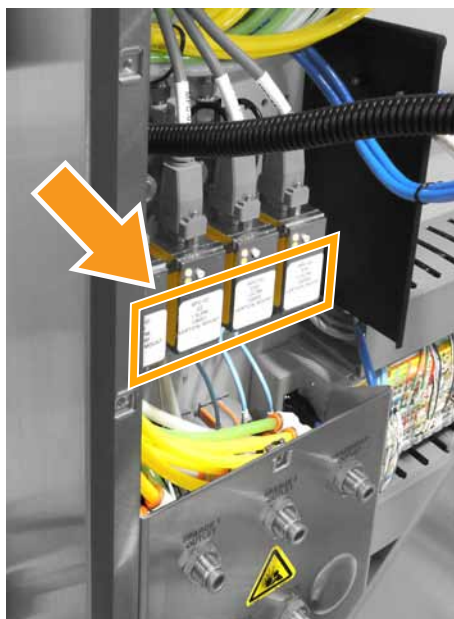
| Step | Action                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------|
| 6    | Dismount the MFC from the instrument by removing the mounting screws of the MFC. Use a Phillips screwdriver with #2 head. |



**Note:**

*Four of the screws are located behind the location for the Ethernet switch, which was removed in step 5 above.*

| Step | Action                                                                                                                                                                                                                                                                    |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Check the MFC labels, verify that the replacement MFC is identical to the removed MFC:</p> <ul style="list-style-type: none"><li>• Calibrated gas</li><li>• Input pressure</li><li>• Output pressure</li><li>• Minimum flow rate</li><li>• Maximum flow rate</li></ul> |



- |    |                                                                                                                                             |
|----|---------------------------------------------------------------------------------------------------------------------------------------------|
| 8  | Mount the replacement MFC to the central mounting plate.                                                                                    |
| 9  | Connect the replacement MFC to the connectors: <ul style="list-style-type: none"><li>• Power</li><li>• Signal</li><li>• Pneumatic</li></ul> |
| 10 | Repeat steps 3-9 for each MFC to be replaced.                                                                                               |
| 11 | Close the side of the instrument tower.                                                                                                     |

10 Reference information

10.5 Mass flow controller replacement

| Step | Action                                                                                                   |
|------|----------------------------------------------------------------------------------------------------------|
| 12   | Turn on the XDR-10 Benchtop Bioreactor System following the Lock-Out / Tag-Out (LOTO) turn-on procedure. |
| 13   | Verify that the MFCs function as expected by flowing gas through them.                                   |

## 10.6 More information

For further information regarding the following questions please refer to our website or GE representative:

- System recommendations
- Literature
- Service
- Training
- Ordering information

Contact information can be found on the back page of this document.

For more advanced technical information, contact the manufacturer. See [Manufacturing information, on page 11](#).

# Appendix A Information about Appendix

## Introduction

Following this information section, the following sections are found in this Appendix:

Appendix B. User interface description.

Appendix C. Export and save data.

Appendix B and Appendix C are provided in English only.

---

## User interface description

This appendix provides a description of Wonderware software user interface, including the summary windows, dialog boxes and control functions. This appendix also gives an overview of setting up process control and describes the functioning of some control loops.

---

## Export and save data

This appendix provides information about how to manage the collected data after a completed batch run.

---

# Appendix B User interface description

## Introduction

This appendix provides a description of Wonderware software user interface, including the summary windows, dialog boxes and control functions.

---

## Contents

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---

# B.1 User interface: windows

## Introduction

This section gives an overview of summary windows in Wonderware software.

---

## In this section

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---



## B.1.1 Reactor Display

### Reactor Display window description

**Reactor Display** is the default window at startup. This window can also be accessed from the header toolbar. It provides a detailed graphical display of the bioreactor system layout.

**Note:** *If the bioreactor is a FlexFactory additional component, another header toolbar will be present at the top of the screen. It allows the user to navigate between different additional components. Click on the relevant bioreactor to access the **Reactor Display** window.*

---

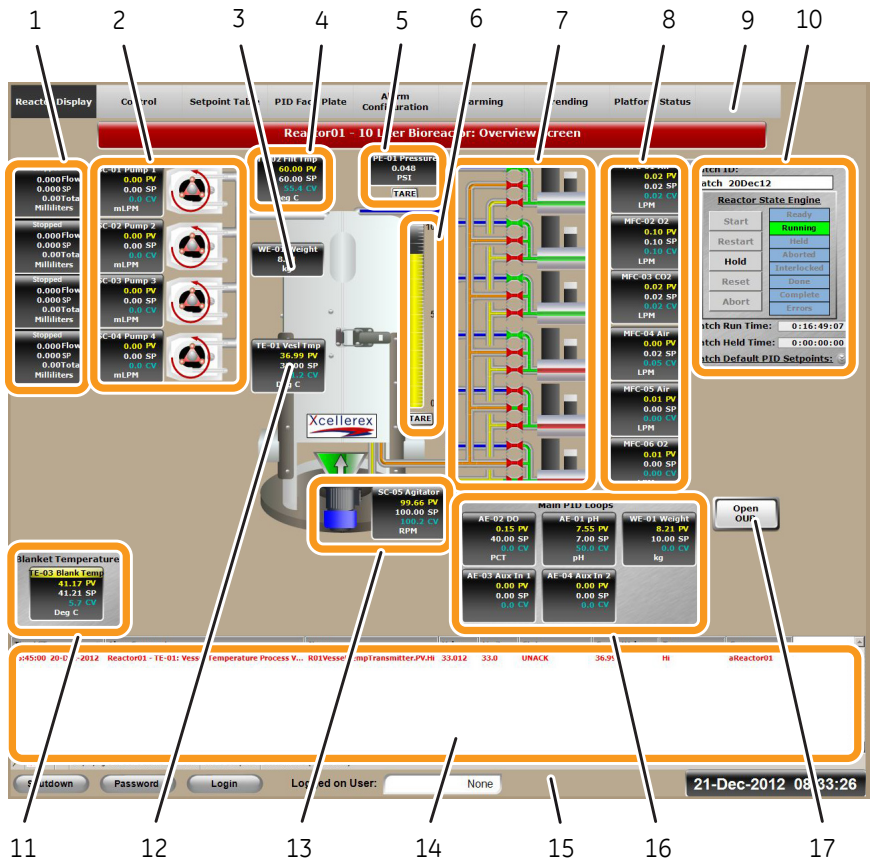
B User interface description

B.1 User interface: windows

B.1.1 Reactor Display

Illustration of the Reactor Display window

The following illustration shows the *Reactor Display* window.

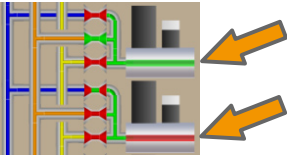


| Part | Description                                           |
|------|-------------------------------------------------------|
| 1    | Pump totalizer objects                                |
| 2    | Pump objects and icons                                |
| 3    | Reactor weight object                                 |
| 4    | Exhaust filter heater temperature object              |
| 5    | Bag pressure object and bag pressure tare button      |
| 6    | Reactor weight graphics and vessel weight tare button |

## B User interface description

### B.1 User interface: windows

#### B.1.1 Reactor Display

| Part | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Solenoid valves and mass flow controller (MFC) displays</p> <p><b>Note:</b><br/><i>The MFCs are displayed as gray cylinders with a line depicting the flow path through the center.</i></p>  <p><i>The flow path colors denote the following:</i></p> <ul style="list-style-type: none"><li>• green - gas flow active</li><li>• red - no gas flow.</li></ul> <p><b>Note:</b><br/><i>Clicking on a valve opens a dialog box displaying the options for that valve, if any are available.</i></p> |
| 8    | MFC PID loop overview object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 9    | Header toolbar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 10   | <b>Batch Manager</b> display                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11   | Heating blanket temperature object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 12   | Vessel temperature object                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 13   | Agitator object and agitator icon                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 14   | Alarm summary pane                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 15   | Footer toolbar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| 16   | Main PID loops objects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 17   | Oxygen uptake rate (OUR) display button ( <b>Open OUR</b> )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

B User interface description

B.1 User interface: windows

B.1.1 Reactor Display

Header toolbar

The header toolbar is located at the top of the screen and is available from all application interfaces. All windows are accessible from this toolbar.

The following illustration shows the header toolbar for stand-alone bioreactor.



When an option is selected on the header toolbar, a drop-down menu with additional choices may be available.

The following table shows an overview of the available options for each menu item on the header toolbar.

| Menu item                  | Available options       | Number of pages |
|----------------------------|-------------------------|-----------------|
| <i>Reactor Display</i>     | <i>Reactor01</i>        | 1               |
|                            | <i>Reactor02</i>        | 1               |
|                            | <i>Reactor0X</i>        | 1               |
|                            | <i>Reactor Overview</i> | 1               |
| <i>Control</i>             | <i>Reactor01</i>        | 1               |
|                            | <i>Reactor02</i>        | 1               |
|                            | <i>Reactor0X</i>        | 1               |
|                            | <i>Reactor Overview</i> | 1               |
| <i>PID Face Plate</i>      | <i>Reactor01</i>        | 2               |
|                            | <i>Reactor02</i>        | 2               |
|                            | <i>Reactor0X</i>        | 2               |
|                            | <i>Reactor Overview</i> | 1               |
| <i>Alarm Configuration</i> | <i>Reactor01</i>        | 2               |
|                            | <i>Reactor02</i>        | 2               |
|                            | <i>Reactor0X</i>        | 2               |
|                            | <i>Reactor Overview</i> | 1               |

## B User interface description

### B.1 User interface: windows

#### B.1.1 Reactor Display

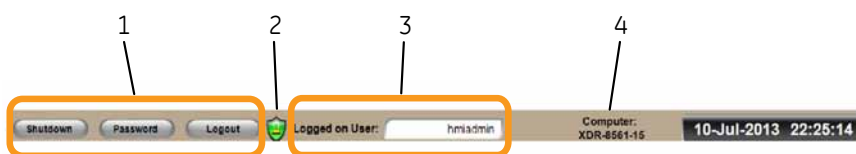
| Menu item              | Available options       | Number of pages |
|------------------------|-------------------------|-----------------|
| <b>Alarming</b>        | <b>Alarm Summary</b>    | 1               |
|                        | <b>Alarm History</b>    | 1               |
|                        | <b>Reactor Overview</b> | 1               |
| <b>Trending</b>        | <b>Reactor01</b>        | 1               |
|                        | <b>Reactor02</b>        | 1               |
|                        | <b>Reactor0X</b>        | 1               |
| <b>Platform Status</b> | <b>Reactor01</b>        | 1               |
|                        | <b>Reactor02</b>        | 1               |
|                        | <b>Reactor0X</b>        | 1               |

**Note:** The number of reactors depends on system setup. **Reactor0X** denotes the last installed reactor.

## Footer toolbar

The footer toolbar is located at the bottom of the **Reactor Display** window. It allows logging in, changing the password and shutting down the software. It also displays the information about which user is currently logged in.

The following illustration shows the footer toolbar.



| Part | Function                       |
|------|--------------------------------|
| 1    | Interactive buttons            |
| 2    | Security symbol                |
| 3    | User identification text field |
| 4    | Computer identification        |

Alarm summary pane

The alarm summary pane is shown at the bottom of the **Reactor Display** window and presents the current alarms with a date and time stamp. Full scale display of this pane is available via header toolbar **Alarming** option.

The following illustration shows the alarm summary pane.

| Time/CT              | Alarm/Comment                                       | Name                             | Value  | Unit  | State     | Current Value | Type  | Group      |
|----------------------|-----------------------------------------------------|----------------------------------|--------|-------|-----------|---------------|-------|------------|
| 13:27:14 04-Aug-2018 | Reactor A agitator Fault                            | R01Agitator ReactorFault         | Ok     | Flow  | UNACK_RTN | false         | DSC   | Reactor01A |
| 13:27:26 04-Aug-2018 | Reactor01 - AG01: Reached Oxygen Process Var...     | R01Oxygen01OxygenTransmitt...    | -45.0  | 100.0 | UNACK_RTN | 0             | Major | Reactor01A |
| 13:27:38 04-Aug-2018 | Reactor01 - AG01: Reached Oxygen Process Var...     | R01Oxygen01OxygenTransmitt...    | -45.0  | 15.0  | UNACK_RTN | 0             | Minor | Reactor01A |
| 13:27:37 04-Aug-2018 | Reactor01 - PE01: High Pressure Process Variable    | R01HighPressureTransmitterPV...  | -0.124 | 0.0   | UNACK     | -0.124        | Lt    | Reactor01A |
| 13:27:37 04-Aug-2018 | Reactor E-Stop Action                               | Reactor01EStop                   | E-STOP |       | UNACK     | True          | DSC   | Reactor01A |
| 13:28:07 04-Aug-2018 | Reactor01 - TE02: Exhaust Silica Temperature: Be... | R01ExhaustSilicaTemperaturePV... | 877.99 | -1.0  | UNACK_RTN | 0             | Lt    | Reactor01A |

For description of table contents see [Alarm Summary and Alarm History tables, on page 307](#).

Display objects

Display objects are found in the **Reactor Display** window. Display objects are read-only objects and do not allow modification of the displayed values.

The following illustration is an example of a display object.



Active objects

Active objects are found in the **Reactor Display** window. Active objects let the user to access and modify the state of the process. Clicking the object opens a dialog box and allows the user to manage process control.

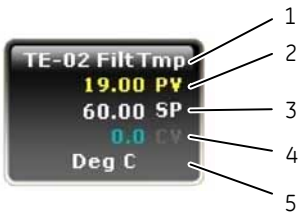
Active objects that are connected to PID control loops can also be used to change the control mode of the displayed component between **Auto**, **Local**, **Remote**, and **Manual**.

The following illustration is an example of an active object.



PID loop overview displays

PID loop overview displays are shown in the **Reactor Display** window. Clicking on a PID loop overview display opens the relevant PID faceplate. The following illustration is an example of PID loop overview display.



| Part | Name                  | Function                                 |
|------|-----------------------|------------------------------------------|
| 1    | PID loop denotation   | The tagname of the parameter             |
| 2    | Process Variable (PV) | The actual measurement of the parameter  |
| 3    | Setpoint (SP)         | The target value of the parameter        |
| 4    | Control Variable (CV) | The controller output                    |
| 5    | Unit                  | The unit of measurement of the parameter |

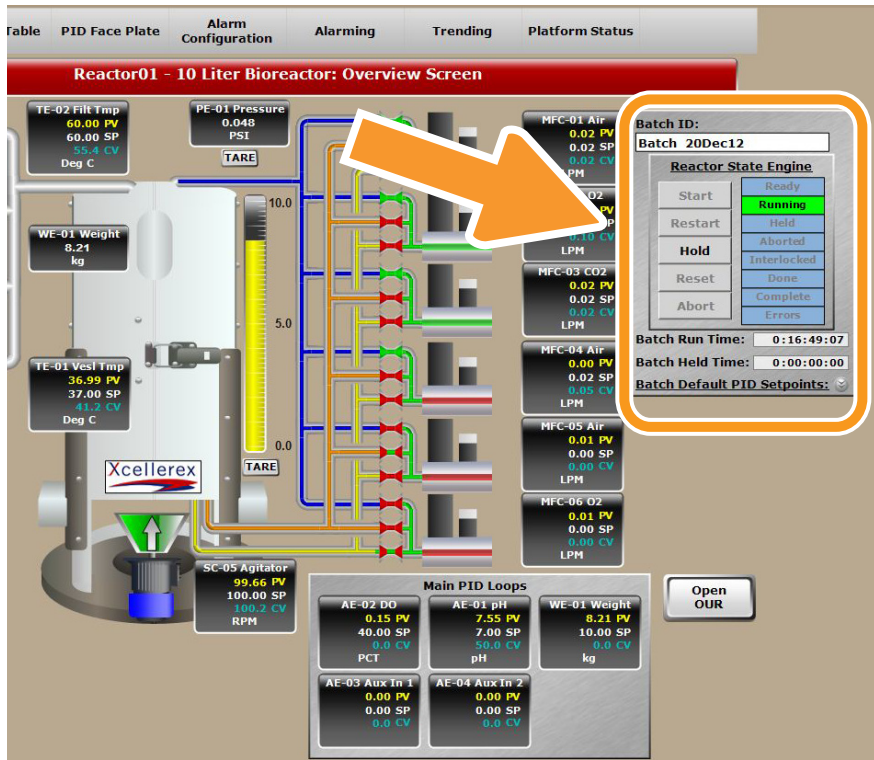
## B User interface description

### B.1 User interface: windows

#### B.1.1 Reactor Display

## Batch Manager display

The **Batch Manager** display is part of the **Reactor Display** window.

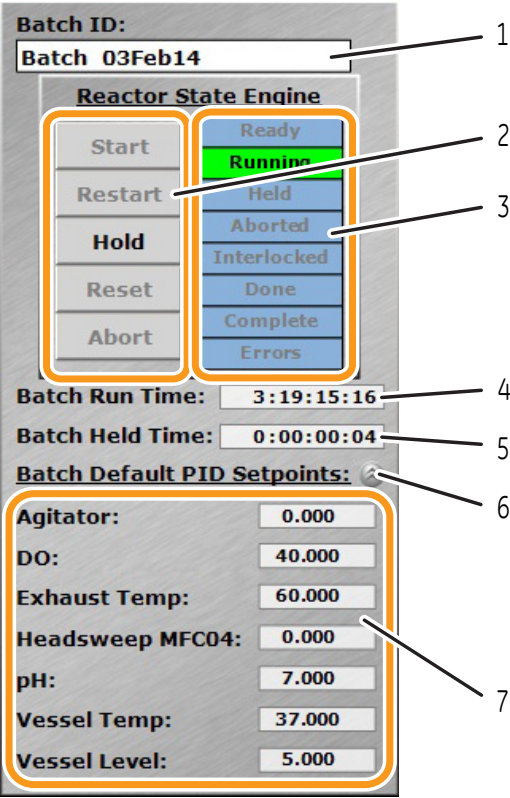


The **Batch Manager** display consists of two parts:

- **Reactor State Engine** display (always shown)
- **Batch Default PID Setpoints** display (drop-down display). Click the the double-arrow button to open or close the **Batch Default PID Setpoints** part of the display.

The following figure shows the **Batch Manager** display with both parts visible.





| Part | Function                                                                                                         |
|------|------------------------------------------------------------------------------------------------------------------|
| 1    | Text field for batch ID information (optional).<br><br><b>Note:</b><br><i>This text field can be left blank.</i> |

B User interface description

B.1 User interface: windows

B.1.1 Reactor Display

| Part | Function                                                                                                                                                                                                                                                  |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2    | <p>Selection buttons to move to different reactor states:</p> <ul style="list-style-type: none"><li>1 Start</li><li>2 Restart</li><li>3 Hold</li><li>4 Reset</li><li>5 Abort</li></ul> <p><b>Note:</b><br/><i>Only valid transitions are enabled.</i></p> |
| 3    | The fields to inform the user about the current batch state. The current batch state is shown in green.                                                                                                                                                   |
| 4    | The length of time the batch has been in <b>Running</b> state, shown as days:hours:minutes:seconds.                                                                                                                                                       |
| 5    | The length of time the batch has been in <b>Held</b> state, shown as days:hours:minutes:seconds.                                                                                                                                                          |
| 6    | Double-arrow button to open or close the <b>Batch Default PID Setpoints</b> part of the window (located below the button).                                                                                                                                |
| 7    | <b>Batch Default PID Setpoints</b> part of the window.                                                                                                                                                                                                    |

Clicking any of the text fields in the **Batch Default PID Setpoints** display opens the **Default PID Setpoints** dialog box that shows an overview of all current batch setpoints.

## B.1.2 Control

### Control window description

The **Control** window is accessed from the header toolbar. The **Control** window allows users who have appropriate access level to map PID control loops, to configure the interaction of units that are part of the bioreactor control system. See [Section 7.3 Configure control loops, on page 148](#) for more information.

All elements in the **Control** window fall into three categories as described below.

| Type                          | Examples                                                                         |
|-------------------------------|----------------------------------------------------------------------------------|
| Input devices (transmitters)  | Auxiliary inputs<br>Dissolved oxygen sensor<br>pH sensor<br>Vessel weight sensor |
| Output devices                | Mass flow controllers<br>Pumps<br>Agitator                                       |
| Formula elements <sup>1</sup> | <b>Lookup Tables</b><br><b>Split Ranges</b>                                      |

<sup>1</sup> See [Intermediate control elements, on page 339](#) for the use of formula elements.

Mapping a PID control loop establishes a connection between a transmitter unit (input device) and a control element (output device), optionally through an intermediate control element.

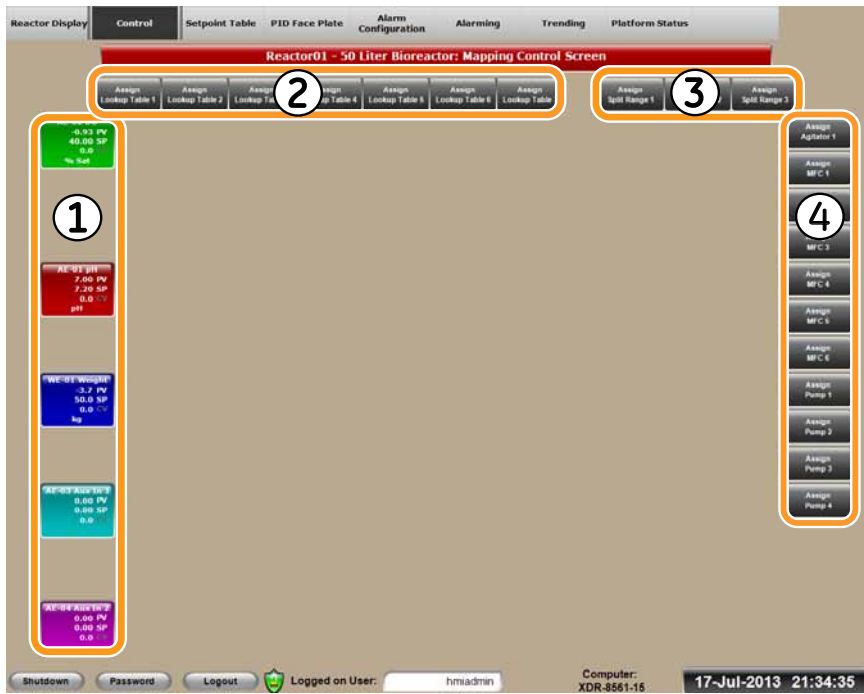
B User interface description

B.1 User interface: windows

B.1.2 Control

Illustration of the Control window without mapped devices

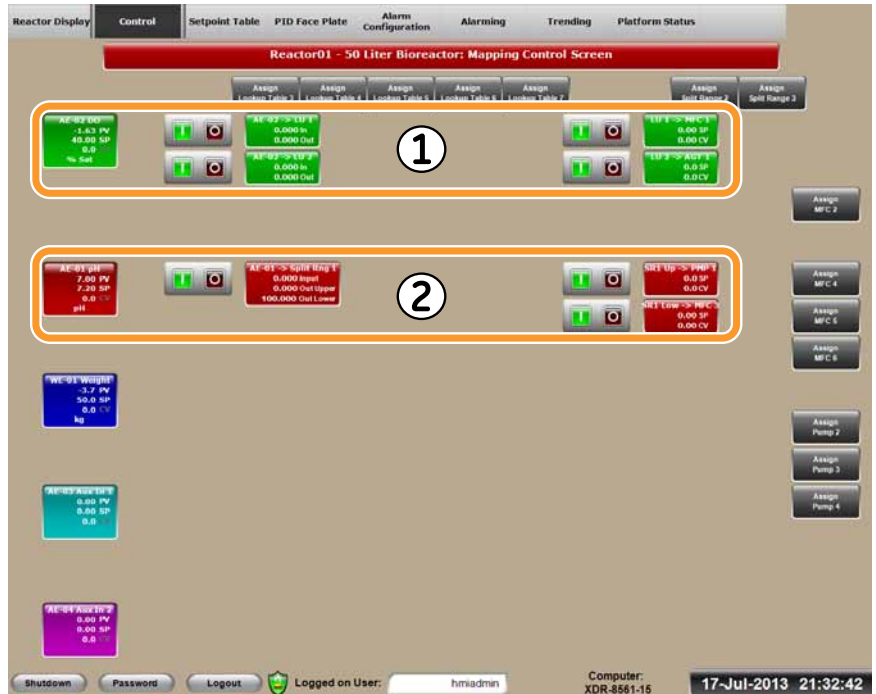
The following figure shows the general layout of the **Control** window without any mapped devices.



| Part | Description                              |
|------|------------------------------------------|
| 1    | Inputs / Transmitters                    |
| 2    | Buttons for assignment of lookup tables  |
| 3    | Buttons for assignment of split ranges   |
| 4    | Buttons for assignment of output devices |

## Illustration of the Control window with mapped devices

The following figure shows a **Control** window mapped for pH and DO control.



| Part | Function                                                                                 |
|------|------------------------------------------------------------------------------------------|
| 1    | Dissolved oxygen (DO) transmitter mapped to two lookup tables and two controller devices |
| 2    | pH transmitter mapped to a split range and two controller devices                        |

See [Section 7.3 Configure control loops, on page 148](#) for mapping instructions.

B.1.3 Setpoint Table

Setpoint Table window description

The **Setpoint Table** window is accessed from the header toolbar. The **Setpoint Table** window allows users to define automatic changes to PID control loop setpoints according to selectable criteria. **Setpoint Table Screen 1** displays all primary PID control loops and **Setpoint Table Screen 2** displays all secondary PID control loops.

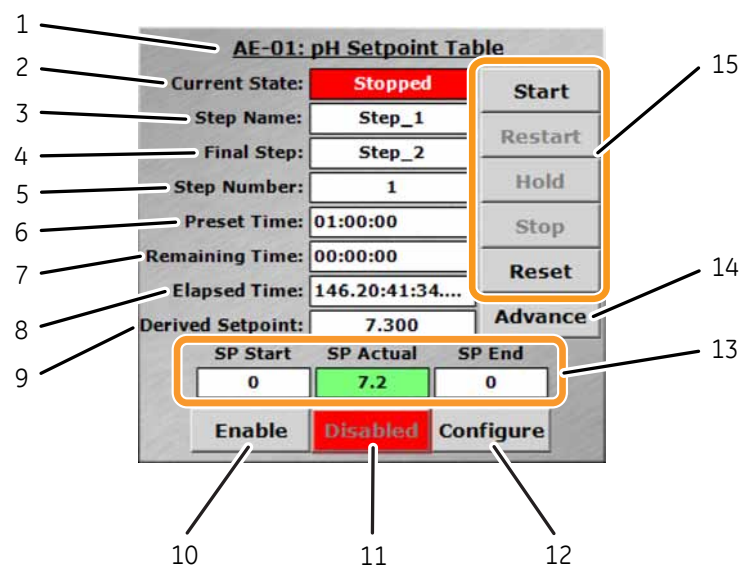
Illustration of Setpoint Table window

The following illustration shows an example of **Setpoint Table Screen 1**, displaying ten primary PID control loop setpoint tables.



Illustration of a PID control loop  
setpoint table

The following illustration shows an individual PID control loop setpoint table.



| Part | Function                                        |
|------|-------------------------------------------------|
| 1    | Identification of the PID control loop          |
| 2    | Current state of the loop                       |
| 3    | Name of the current step                        |
| 4    | Name of the final step                          |
| 5    | Number of the current step                      |
| 6    | Total execution time for the displayed step     |
| 7    | Remaining execution time for the displayed step |
| 8    | Elapsed time for the displayed step             |
| 9    | The setpoint sent to the controller             |
| 10   | Button/indicator to enable the setpoint table   |
| 11   | Button/indicator to disable the setpoint table  |

B User interface description

B.1 User interface: windows

B.1.3 Setpoint Table

| Part | Function                                                                                                                                                                                                                                                                                                          |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12   | Button to display <b>Setpoint Table Configuration Screen</b>                                                                                                                                                                                                                                                      |
| 13   | Display of start, actual and end setpoint values of the current step<br><br><b>Note:</b><br><i><b>SP Actual</b> is the current setpoint value as displayed on the PID faceplate of this parameter.</i>                                                                                                            |
| 14   | Button to allow the user to move to the next step                                                                                                                                                                                                                                                                 |
| 15   | Selection buttons to move to different reactor states: <ul style="list-style-type: none"><li>• <b>Start</b></li><li>• <b>Restart</b></li><li>• <b>Hold</b></li><li>• <b>Stop</b></li><li>• <b>Reset</b></li></ul><br><b>Note:</b><br><i>These buttons match with the buttons in <b>Batch Manager</b> display.</i> |

See [Batch Manager display, on page 292](#) for further description of **Batch Manager**.

See [Section 7.4.2 Configure setpoint tables, on page 180](#) for instructions about the use of individual setpoint tables.

---



## B.1.4 PID Face Plate

### PID Face Plate window description

**PID Face Plate** windows (**Screen 1** and **Screen 2**) are accessed from the header toolbar. These windows display all PID control loops associated with that unit and allow users to access PID control loop parameters. If there are no PID control loops to display, the screen will show a message that it was intentionally left blank.

The contents of **Screen 1** and **Screen 2** are displayed as follows:

| <i>PID Face Plate Screen 1</i>                                                                                                                                                                                                                                                  | <i>PID Face Plate Screen 2</i>                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Dissolved oxygen (DO)</li><li>• pH</li><li>• Vessel Temperature</li><li>• Agitator</li><li>• Vessel Weight</li><li>• Filter Temperature</li><li>• Auxiliary Input 1</li><li>• Auxiliary Input 2</li><li>• Blanket Temperature</li></ul> | <ul style="list-style-type: none"><li>• Mass flow controllers (MFC)</li><li>• Pumps</li></ul> |

For information about PID control, see [Appendix B.2.1 PID faceplate, on page 319](#) and [Appendix B.3 User interface: control functions, on page 336](#).

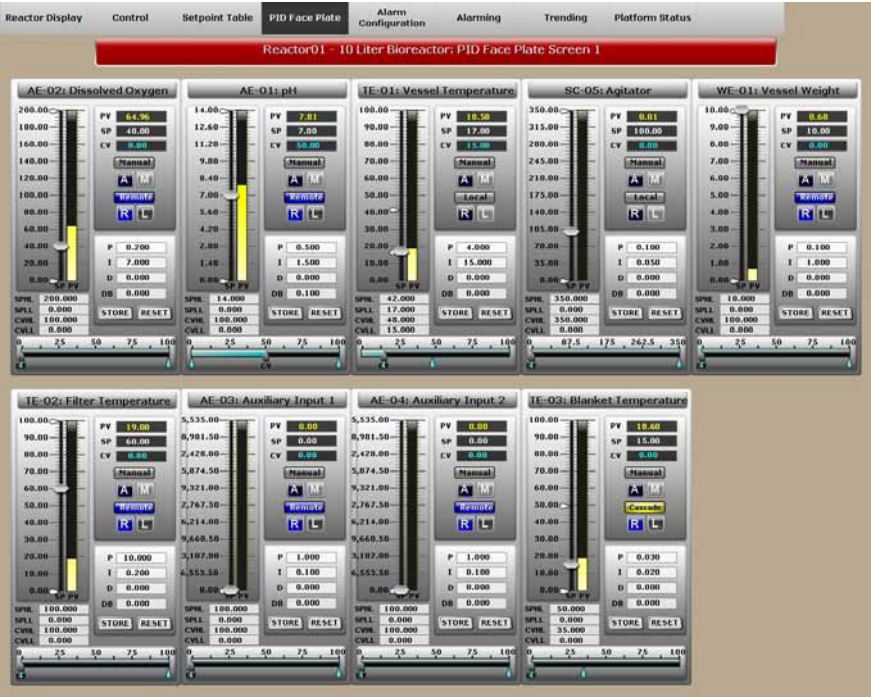
B User interface description

B.1 User interface: windows

B.1.4 PID Face Plate

Illustration of PID Face Plate window

The following illustration shows an example of *PID Face Plate Screen 1*.



For more detailed description of PID faceplates see [Appendix B.2.1 PID faceplate, on page 319](#).

## B.1.5 Alarm Configuration

### Alarm Configuration window description

**Alarm Configuration** windows (**Screen 1** and **Screen 2**) are accessed from the header toolbar. These windows display each available process variable and allow the user to configure alarm setpoints.

The following illustration shows an example of **Alarm Configuration Screen 1**.



A red text field indicates that this parameter is currently in alarmed state.

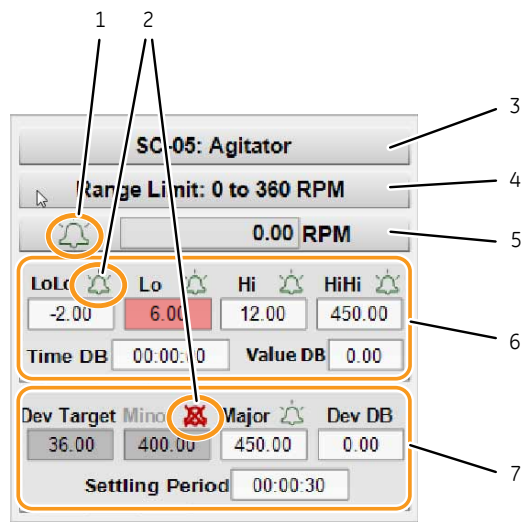
B User interface description

B.1 User interface: windows

B.1.5 Alarm Configuration

Alarm configuration for a single controlled variable

The illustration below shows the details of alarm configuration for a single controlled variable.



| Part | Function                                                                               |
|------|----------------------------------------------------------------------------------------|
| 1    | Button/indicator to enable all alarms for the controlled variable                      |
| 2    | Button/indicator to enable or disable an individual alarm; enabled and disabled states |
| 3    | Parameter tag name and description                                                     |
| 4    | Parameter input range                                                                  |
| 5    | Current value of the alarmed parameter                                                 |

| Part | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6    | <p>Range limits for the set alarm:</p> <ul style="list-style-type: none"><li>• <b>LoLo</b>, critical low limit</li><li>• <b>Lo</b>, warning low limit</li><li>• <b>Hi</b>, warning high limit</li><li>• <b>HiHi</b>, critical high limit</li><li>• <b>Time DB</b> (time deadband), the length of time a value must be outside the value deadband to issue an alarm.</li></ul> <p><b>Note:</b></p> <p><i>A parameter may deviate from the set alarm for a time shorter than <b>Time DB</b> without causing an alarm.</i></p> <ul style="list-style-type: none"><li>• <b>Value DB</b> (value deadband), an interval around the set alarm value where the alarm is active.</li></ul> <p><b>Note:</b></p> <p><i><b>Value DB</b> will keep an alarm active until the parameter value is within the value deadband.</i></p> <p><b>Note:</b></p> <p><i>Setting the deadband values avoids the nuisance alarms, coming on and off ("chattering") when close to the limit.</i></p> |

B User interface description

B.1 User interface: windows

B.1.5 Alarm Configuration

| Part | Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7    | <p>Parameter deviation from the setpoint:</p> <ul style="list-style-type: none"><li>• <b>Dev Target</b> (deviation target - current setpoint of the PID control loop)</li><li>• <b>Dev Target Minor</b>, the allowed deviation limit from a parameter setpoint before a warning alarm is issued.</li><li>• <b>Dev Target Major</b>, the allowed deviation limit from a parameter setpoint before a critical alarm is issued.</li><li>• <b>Dev DB</b> (deviation deadband), a value interval around the setpoint where the alarm is not active.</li></ul> <p><b>Note:</b></p> <p><i>Dev DB will keep an alarm active until the parameter value is within the deviation deadband.</i></p> <ul style="list-style-type: none"><li>• <b>Settling Period</b>, the length of time a setpoint change is allowed to take without issuing an alarm</li></ul> <p><b>Note:</b></p> <p><i>By defining the <b>Settling Period</b> you can prevent the deviation alarm being issued when you make a sudden change to a setpoint.</i></p> |

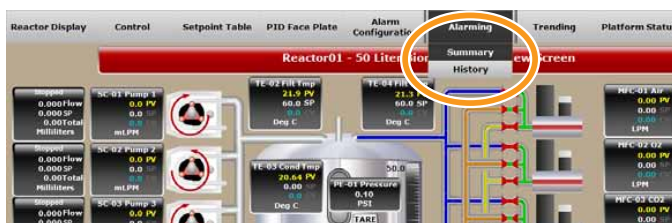
A red text field indicates that this parameter is currently in alarmed state.

See [Section 7.5.1 Set and acknowledge alarms, on page 188](#) for instructions on how to configure alarms.

## B.1.6 Alarm Summary and Alarm History

### Alarming menu

**Alarming** option on the header toolbar shows a drop-down menu with available choices **Alarm Summary** and **Alarm History**.



### Alarm Summary and Alarm History tables

The following figure shows an example of table contents that is presented in both **Alarm Summary** and **Alarm History** windows.

| TimeLCT              | AlarmComment                                       | Name                              | Value | Limit | State      | Class | Type | Priority | Group      |
|----------------------|----------------------------------------------------|-----------------------------------|-------|-------|------------|-------|------|----------|------------|
| 10:19:25 03-Nov-2015 | Reactor01 - PEB1: Bag Pressure Critical High Alarm | R01BagPressure.CriticalHighAla... | OKAY  | FAULT | UNACK_RTN  | OSC   | OSC  | 500      | aReactor01 |
| 10:19:13 03-Nov-2015 | Reactor01 - PEB1: Bag Pressure Critical High Alarm | R01BagPressure.CriticalHighAla... | FAULT | FAULT | UNACK_ALRN | OSC   | OSC  | 500      | aReactor01 |
| 10:17:58 03-Nov-2015 | Reactor01 - PEB1: Bag Pressure Critical High Alarm | R01BagPressure.CriticalHighAla... | OKAY  | FAULT | UNACK_RTN  | OSC   | OSC  | 500      | aReactor01 |
| 10:17:54 03-Nov-2015 | Reactor01 - PEB1: Bag Pressure Critical High Alarm | R01BagPressure.CriticalHighAla... | FAULT | FAULT | UNACK_ALRN | OSC   | OSC  | 500      | aReactor01 |

The following elements are displayed in the table:

| Element             | Description                                                                    |
|---------------------|--------------------------------------------------------------------------------|
| <b>TimeLCT</b>      | Displays the time when the alarm was activated.                                |
| <b>AlarmComment</b> | Displays a comment associated with alarm condition.                            |
| <b>Name</b>         | Displays the tag name or data point of the component that is in alarmed state. |
| <b>Value</b>        | Displays the value which triggered the alarm.                                  |
| <b>Limit</b>        | Displays the value which was exceeded to cause the alarm.                      |

## B User interface description

### B.1 User interface: windows

#### B.1.6 Alarm Summary and Alarm History

| Element              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>State</b>         | <p>Displays the current state of the alarm. The following states are possible:</p> <ul style="list-style-type: none"><li>• <b>UNACK</b>: The parameter that is in alarmed state and has not been acknowledged by the user. The text blinks alternately in red and green color.</li><li>• <b>UNACK_ALM</b>: The parameter that is in alarmed state and has not been acknowledged by the user. The text is displayed in steady red color. This state is visible only in <b>Alarm History</b> window.</li></ul> <p><b>Note:</b></p> <p><i>It refers to an unacknowledged alarm that has disappeared from <b>Alarm Summary</b> window because the user has disabled the alarm while it was an alarmed state. Prior to disabling the alarm, the user did not acknowledge it.</i></p> <ul style="list-style-type: none"><li>• This state is visible in the alarm and event history window. <b>UNACK_ALM</b> means that the parameter is in alarm, and the alarm is not acknowledged. This could happen if the user disabled the alarm while it is in alarm, because the alarm would disappear from the status window (it is disabled) but the alarm prior to being disabled was never acknowledged.</li><li>• <b>UNACK_RTN</b>: The parameter that was in alarmed state at some time point but has now returned to normal state. It has not been acknowledged by the user. The text is displayed in steady blue color.</li><li>• <b>ACK</b>: The parameter that is in the alarmed state and has been acknowledged by the user. The text is displayed in steady black color.</li></ul> |
| <b>Current Value</b> | <p>Displays the current value of the parameter.</p> <p><b>Note:</b></p> <p><i>This information is displayed only in the <b>Alarm Summary</b> window.</i></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Class</b>         | <p>The following classes are possible:</p> <ul style="list-style-type: none"><li>• Discrete alarms (for example on/off alarms)</li><li>• Value alarms (deviation from a parameter level)</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Type</b>          | <p>Displays the codes for alarm condition. For detailed explanation, see the table below.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |



| Element                | Description                                                                                                                                                                                                                        |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Priority</b>        | Characterizes the severity of the alarm. The priority range is 1-999. The highest priority is 1.<br><br><b>Note:</b><br><i><b>E-Stop Active</b> is a priority 1 alarm. All other alarms on the system are priority 500 alarms.</i> |
| <b>Group</b>           | The logical location the alarm originated from (for example, system platform, a reactor, or any other system).                                                                                                                     |
| <b>Acknowledged By</b> | The user name of the person who acknowledged the alarm.<br><br><b>Note:</b><br><i>This information is displayed only in the <b>Alarm History</b> window.</i>                                                                       |

## Alarm condition codes

The codes for alarm condition (**Type**) are described in the following table.

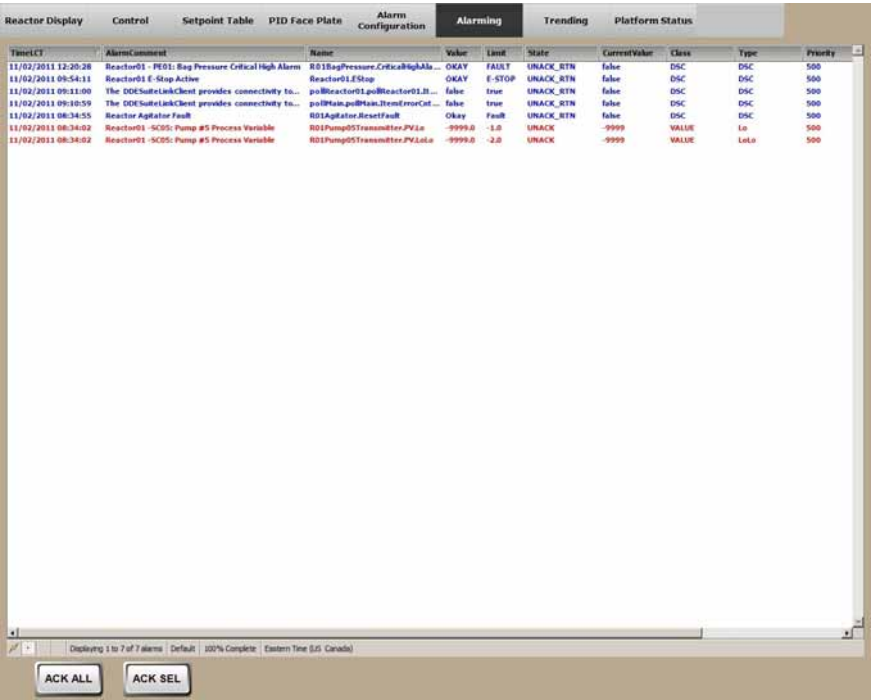
| Alarm type code | Alarm condition                                                                                                                                                                  |
|-----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DSC</b>      | Discrete (possible states on or off)                                                                                                                                             |
| <b>LoLo</b>     | Variable: critical low limit                                                                                                                                                     |
| <b>Lo</b>       | Variable: warning low limit                                                                                                                                                      |
| <b>Hi</b>       | Variable: warning high limit                                                                                                                                                     |
| <b>HiHi</b>     | Variable: critical high limit                                                                                                                                                    |
| <b>MAJDEV</b>   | Major deviation                                                                                                                                                                  |
| <b>MINDEV</b>   | Minor deviation                                                                                                                                                                  |
| <b>OPR</b>      | Operator: shows the user name of the operator who made a change to a value in the control system.<br><br><b>Note:</b><br><i>This information is shown only in event records.</i> |

See Wonderware manufacturer's manual for more information about alarms, alarm states, and alarm handling, including alarm producers and consumers. The help is available in **Start:All programs:Wonderware:Books:InTouch Alarms and Events Guide**, if installed at recommended location.

Alarm Summary window

The **Alarm Summary** window is accessed from header toolbar by choosing the **Alarming:Summary** option.

**Alarm Summary** displays the summary of all currently active alarms with a date and time stamp and alarm status. When an alarm has been acknowledged by the user and the parameter value is not in alarmed state anymore, the alarm disappears from **Alarm Summary** window. It will remain available in **Alarm History** window.



The buttons at the bottom of the screen have following functions:

| Button  | Description                                                                       |
|---------|-----------------------------------------------------------------------------------|
| ACK ALL | Allows the user to acknowledge all currently active alarms.                       |
| ACK SEL | Allows the user to acknowledge an individual alarm or a selected group of alarms. |

For description of other elements in **Alarm Summary** window see [Alarm Summary and Alarm History tables, on page 307](#).

## Alarm History window

The **Alarm History** window is accessed from header toolbar by choosing the **Alarming:History** option. This window displays all alarms and events associated with the process, both the active alarms and the acknowledged alarms that are not in active state anymore. The information contained in **Alarm History** window is saved in the database for storage and retrieval.

This functionality permits auditing of an entire bioreactor. In case of systems connected to FlexFactory Automation System, this functionality can be used for end-to-end audits of each step performed on any piece of equipment of the FlexFactory.

| Time/CT              | Alarm comment                                        | Name                            | Value  | Limit  | State      | Class | Type | Priority | Group      |
|----------------------|------------------------------------------------------|---------------------------------|--------|--------|------------|-------|------|----------|------------|
| 20:51:45 18-Jul-2013 | Write success - The UserDefined object provides a... | ROI01OxygenTakeRate.DegassT...  | true   | false  |            | EVENT | OPR  | 999      | aReactor01 |
| 20:51:28 18-Jul-2013 | Write access denied - User does not have permis...   | ROI01OxygenTakeRate.AbortReq... | false  | false  |            | EVENT | OPR  | 999      | aReactor01 |
| 20:51:20 18-Jul-2013 | Write access denied - User does not have permis...   | ROI01OxygenTakeRate.AbortReq... | false  | false  |            | EVENT | OPR  | 999      | aReactor01 |
| 20:14:00 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 0      | 1      | UNACK_RET  | DSC   | DSC  | 1        | engReactor |
| 20:15:58 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 2      | 1      | UNACK_ALPH | DSC   | DSC  | 1        | engReactor |
| 19:35:57 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 2      | 1      | UNACK_ALPH | DSC   | DSC  | 1        | engReactor |
| 19:35:57 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 2      | 1      | UNACK_ALPH | DSC   | DSC  | 1        | engReactor |
| 11:50:22 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 0      | 1      | UNACK_RET  | DSC   | DSC  | 1        | engReactor |
| 11:50:24 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 2      | 1      | UNACK_ALPH | DSC   | DSC  | 1        | engReactor |
| 10:50:24 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 0      | 1      | UNACK_RET  | DSC   | DSC  | 1        | engReactor |
| 10:50:24 18-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 2      | 1      | UNACK_ALPH | DSC   | DSC  | 1        | engReactor |
| 03:25:11 18-Jul-2013 | Reactor01 is Stop Active                             | Reactor01.Stop                  | E-STOP | E-STOP | UNACK_ALPH | DSC   | DSC  | 500      | aReactor01 |
| 22:44:37 17-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 0      | 1      | UNACK_RET  | DSC   | DSC  | 1        | engReactor |
| 22:44:37 17-Jul-2013 | The AppEngine hosts and schedules execution of...    | engReactor01.Scheduler.ScanO... | 2      | 1      | UNACK_ALPH | DSC   | DSC  | 1        | engReactor |
| 22:28:34 17-Jul-2013 | Write success - The UserDefined object provides a... | ROI01FerTempPID.SP1001          | 65.0   | 0.0    |            | EVENT | OPR  | 999      | aReactor01 |
| 22:28:26 17-Jul-2013 | Write success - The UserDefined object provides a... | ROI01FerTempPID.CommandBites    | false  | false  |            | EVENT | OPR  | 999      | aReactor01 |
| 22:28:26 17-Jul-2013 | Write success - The UserDefined object provides a... | ROI01FerTempPID.SP1001          | 0.0    | 65.0   |            | EVENT | OPR  | 999      | aReactor01 |
| 22:28:22 17-Jul-2013 | Write success - The UserDefined object provides a... | ROI01FerTempPID.CommandBites    | false  | false  |            | EVENT | OPR  | 999      | aReactor01 |
| 22:28:22 17-Jul-2013 | Write success - The UserDefined object provides a... | ROI01FerTempPID.CommandBites    | true   | false  |            | EVENT | OPR  | 999      | aReactor01 |
| 22:28:15 17-Jul-2013 | Write success - The UserDefined object provides a... | ROI01FerTempPID.CommandBites    | true   | false  |            | EVENT | OPR  | 999      | aReactor01 |

For description of the elements in **Alarm History** window see [Alarm Summary and Alarm History tables, on page 307](#).

The elements on the footer toolbar of **Alarm History** window have following functions:

| Element       | Description                            |
|---------------|----------------------------------------|
| <b>ALARMS</b> | Displays only alarms and hides events. |

| Element           | Description                                                                                                                                                                                    |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EVENTS</b>     | Displays only events and hides alarms.<br><br><b>Note:</b><br><i>Events are the actions which a user performs via the software system. See further explanation at the bottom of the table.</i> |
| <b>BOTH</b>       | Displays both alarms and events.<br><br><b>Note:</b><br><i>The window automatically populates with both alarms and events.</i>                                                                 |
| <b>FILTER</b>     | Allows the user to view only part of alarms or events.<br><br><b>Note:</b><br><i>See additional information at the bottom of the table.</i>                                                    |
| Text field        | Shows the start and end time of the displayed group of alarms and events.                                                                                                                      |
| <b>Start Time</b> | Allows the user to define start time point for displayed alarms and events.                                                                                                                    |
| <b>End Time</b>   | Allows the user to define end time point for displayed alarms and events.                                                                                                                      |
| <b>Apply</b>      | Allows the user to refresh the list of alarms and/or events.                                                                                                                                   |

The following user actions are recorded as events:

- Alarm setpoint change
- Control mode change
- Controlled variable change
- Mapping change
- PID parameter change
- Reactor state change
- Sequence change
- Setpoint change

The filter function allows the user to select only a relevant group of alarms and/or events for viewing. If the instrument is part of FlexFactory, the alarms and events from all additional components will be visible. By selecting the relevant system the user will be able to view only the alarms and events that concern this system.

## B User interface description

### B.1 User interface: windows

#### B.1.6 Alarm Summary and Alarm History

In case of standalone bioreactor systems, the filter list will contain any bioreactors connected to the system. Platform status and system connectivity alarms can be viewed by selecting the **All** filter.

---

## B User interface description

### B.1 User interface: windows

#### B.1.7 Trending

## B.1.7 Trending

### Trending application

The **Trending** application is an independent Wonderware program. It is accessed from header toolbar by selecting the **Trending** option.

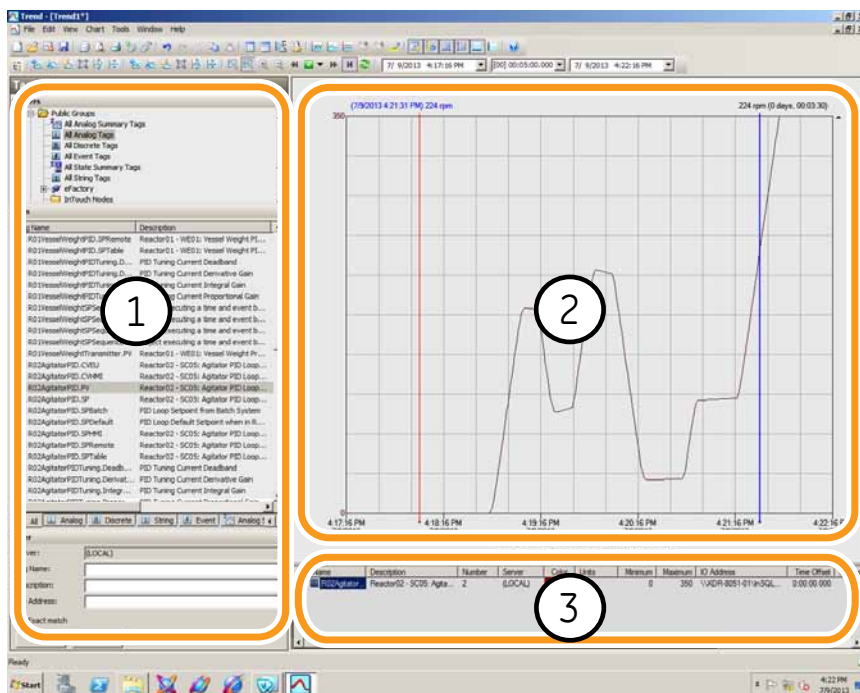
This option opens a window that displays data from any function that is monitored and/or controlled by the instrument control system. The **Trending** application allows the user to display historical and real-time data in graph format. All process parameters are recorded to facilitate a historical trend display. The data is shown by Wonderware Historian Client Trending application.

See Wonderware manufacturer's manual for more information about the **Trending** application. The application help is available in **Start:All programs:Wonderware:Books:Historian Client User Guide**, if installed at recommended location.

---

## Illustration of the Trending window

The following illustration shows an example of **Trending** window.



| Part | Name        | Function                                                                                                                                                                                                                                                                                                              |
|------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Tag Picker  | Allows selection of the variable you wish to view in the trend chart.                                                                                                                                                                                                                                                 |
| 2    | Trend chart | Displays the trend for the selected parameter over the selected time period.                                                                                                                                                                                                                                          |
| 3    | Pens pane   | Displays a list of tags selected for viewing and allows selection and editing of tag properties.<br><br><b>Note:</b><br><i>Clicking on a pen in the Pens pane will associate that pen with the vertical red and blue cursors. The cursors may be dragged left or right to read specific values at specific times.</i> |

B User interface description

B.1 User interface: windows

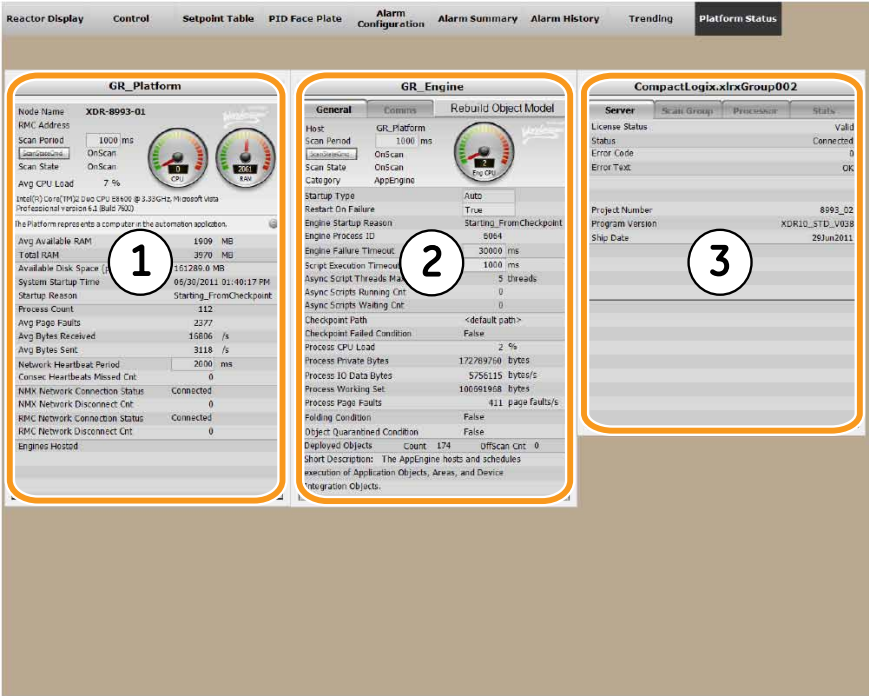
B.1.8 Platform Status

B.1.8 Platform Status

Platform Status window description

The **Platform Status** window is accessed from the header toolbar by selecting the **Platform Status** option. This window displays information about the status of the bioreactor automation control system.

Illustration of Platform Status window



| Part | Name               | Function                                                                                       |
|------|--------------------|------------------------------------------------------------------------------------------------|
| 1    | <b>GR_Platform</b> | Describes the status of the overall SCADA system.                                              |
| 2    | <b>GR_Engine</b>   | Describes the status of the sub-system responsible for accessing controller data in real time. |



## B User interface description

### B.1 User interface: windows

#### B.1.8 Platform Status

| Part | Name                             | Function                                             |
|------|----------------------------------|------------------------------------------------------|
| 3    | <b>CompactLogix</b> <sup>1</sup> | Describes the overall status and details of the PLC. |

<sup>1</sup> The term **ControlLogix** is used in some configurations.

## B.2 User interface: dialog boxes

### Introduction

This section gives an overview of dialog boxes available in Wonderware software.

---

### In this section

| Section                                   | See page |
|-------------------------------------------|----------|
| B.2.1 PID faceplate                       | 319      |
| B.2.2 Flow controlling dialog boxes       | 324      |
| B.2.3 Setpoint managing dialog boxes      | 331      |
| B.2.4 Vessel content control dialog boxes | 333      |

## B.2.1 PID faceplate

### PID faceplate dialog box

Proportional-integral-derivative (PID) control is utilized to control all reactor modules as well as most processes. Each PID faceplate contains the tuning parameters for an individual PID control loop. Process PID settings can be adjusted by a user with appropriate access rights.

PID faceplate dialog boxes can be accessed from the following locations:

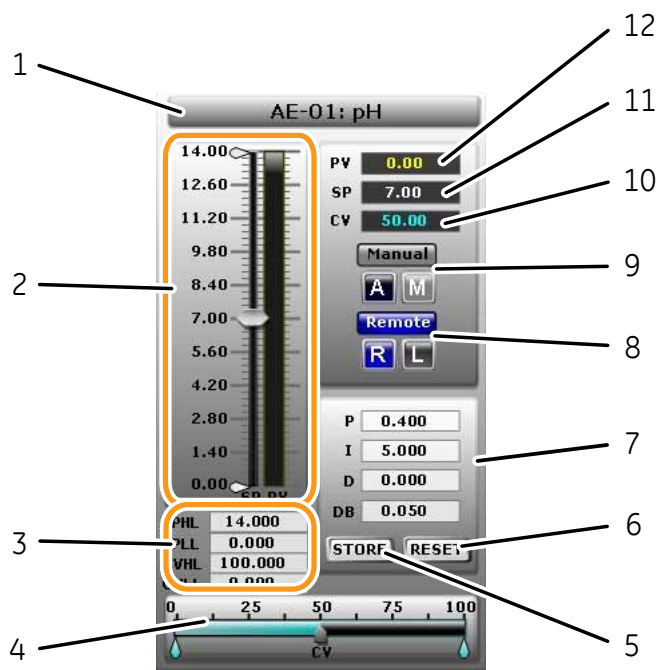
- **Reactor Display** window
- **Control** window
- or
- **PID Face Plate** windows (**Screen 1** and **Screen 2**)

by clicking the associated PID control loop overview displays.

---

Illustration of PID faceplate  
dialog box

The illustration below shows an example of a PID faceplate dialog box.



| Object | Description                                                                                                                                                                            |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | PID faceplate tag name and description.                                                                                                                                                |
| 2      | Setpoint ( <b>SP</b> ) slider and process variable ( <b>PV</b> ) display bar.                                                                                                          |
| 3      | Range defining parameters.<br><br><b>Note:</b><br><i>See <a href="#">PID control loop range defining parameters, on page 323</a> for the description of range defining parameters.</i> |
| 4      | Controlled variable ( <b>CV</b> ) slider and display.                                                                                                                                  |
| 5      | <b>Store</b> button, allows to save the PID control parameters as the default tuning parameters.                                                                                       |
| 6      | <b>Reset</b> button, allows to revert to the default tuning parameter values.                                                                                                          |

| Object | Description                                                                                                                                                                                                       |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 7      | Value entry fields for PID tuning parameters: <ul style="list-style-type: none"> <li>Proportional (<b>P</b>)</li> <li>Integral (<b>I</b>)</li> <li>Derivative (<b>D</b>)</li> <li>Deadband (<b>DB</b>)</li> </ul> |
| 8      | <b>Local/Remote</b> mode indicator and buttons.<br><br><b>Note:</b><br>See <a href="#">PID faceplate control modes, on page 321</a> for the description of PID control modes.                                     |
| 9      | <b>Auto/Manual</b> mode indicator and buttons.<br><br><b>Note:</b><br>See <a href="#">PID faceplate control modes, on page 321</a> for the description of PID control modes.                                      |
| 10     | Controlled variable ( <b>CV</b> ), text field for input and output.                                                                                                                                               |
| 11     | Setpoint ( <b>SP</b> ), text field for input and output of the set value.                                                                                                                                         |
| 12     | Process variable ( <b>PV</b> ), the measured value of the process.                                                                                                                                                |

**Note:** Operator-introduced changes to tuning parameters take effect immediately.

## PID faceplate control modes

See the following table for description of PID loop control modes.

| PID control modes | Description                                                                                                                                                                                                                                   |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Auto</b>       | The parameter is controlled by the computer control system to setpoint ( <b>SP</b> ), displayed in white on the PID faceplate.<br><br><b>Note:</b><br><i>In <b>Auto</b> mode the user may not change the controlled variable (<b>CV</b>).</i> |

## B User interface description

### B.2 User interface: dialog boxes

#### B.2.1 PID faceplate

| PID control modes     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Manual</b>         | <p>The loop is controlled by controlled variable (<b>CV</b>) value (%) entered by the user. The <b>CV</b> value is displayed in cyan.</p> <p><b>Note:</b><br/><i>The user may change the setpoint (<b>SP</b>), but the change will not have any effect on the output (<b>CV</b>) until the loop is switched to <b>Auto</b> mode.</i></p>                                                                                                                                                                                                                                                                                              |
| <b>Remote</b>         | <p>The computer control system has control of the loop setpoint (<b>SP</b>).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Local</b>          | <p>The operator has control of the loop setpoint (<b>SP</b>) in <b>Auto</b> mode or the loop controlled variable (<b>CV</b>) in <b>Manual</b> mode via the X-Station.</p> <p>When the instrument is in <b>Auto/Local</b> mode, the user can change <b>SP</b> values by entering a new value into the <b>SP</b> field or by moving the marker on the graphic bar on the left of the PID faceplate.</p> <p>When the instrument is in <b>Manual/Local</b> mode, the user can change <b>CV</b> values by entering a new value into the <b>CV</b> field or by moving the marker on the graphic bar at the bottom of the PID faceplate.</p> |
| <b>Cascade</b>        | <p>The loop is controlled by an output device of another PID loop, that provides the setpoint (<b>SP</b>) for the loop that is in <b>Cascade</b> mode.</p> <p><b>Note:</b><br/><i>The PID faceplate field <b>Remote/Local</b> is replaced by an yellow <b>Cascade</b> field when the loop is in <b>Cascade</b> mode.</i></p>                                                                                                                                                                                                                                                                                                          |
| <b>Forced</b>         | <p>May occur when a controller is mapped to a split range object. When the controlled variable (<b>CV</b>) of the master PID loop is within the configured deadband (<b>DB</b>), the controlled variable is forced to the configured split range percentage.</p> <p><b>Note:</b><br/><i>This situation is typical to pH control through split range.</i></p>                                                                                                                                                                                                                                                                          |
| <b>Setpoint Table</b> | <p>The loop setpoint control has been set via <b>Setpoint Table</b>.</p> <p><b>Note:</b><br/><i>The PID faceplate field <b>Remote/Local</b> is replaced by an orange <b>SP Table</b> field when the loop is in Setpoint Table control mode.</i></p>                                                                                                                                                                                                                                                                                                                                                                                   |

## PID control loop range defining parameters

Range defining parameters are as follows:

| Parameter                                      | Function                                                                                                                                                                                                                 |
|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Setpoint high limit ( <b>SPHL</b> )            | Prevents the control system from increasing the setpoint above the set <b>SPHL</b> . Prevents the operator from entering a setpoint higher than the defined <b>SPHL</b> value into the <b>SP</b> field.                  |
| Setpoint low limit ( <b>SPLL</b> )             | Prevents the control system from decreasing the setpoint below the set <b>SPLL</b> . Prevents the operator from entering a setpoint lower than the defined <b>SPLL</b> value into the <b>SP</b> field.                   |
| Controlled variable high limit ( <b>CVHL</b> ) | Prevents the control system from increasing the controlled variable (output) above the set <b>CVHL</b> . Prevents the operator from entering a value higher than the defined <b>CVHL</b> value into the <b>CV</b> field. |
| Controlled variable low limit ( <b>CVLL</b> )  | Prevents the control system from decreasing the controlled variable (output) below the set <b>CVLL</b> . Prevents the operator from entering a value lower than the defined <b>CVLL</b> value into the <b>CV</b> field.  |

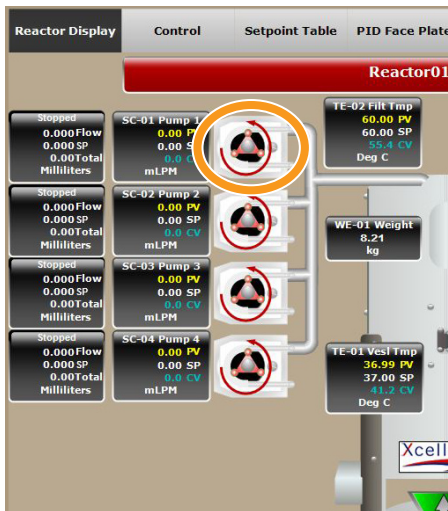
The units for **CVHL**, **CVLL**, **SPHL** and **SPLL** always match the units and ranges of the CV and SP, respectively.

**Note:** *In some cases the limits (**CVHL**, **CVLL**, **SPHL** and **SPLL**) are applied to the system at the factory. This information can be found in Factory Acceptance Test documentation.*

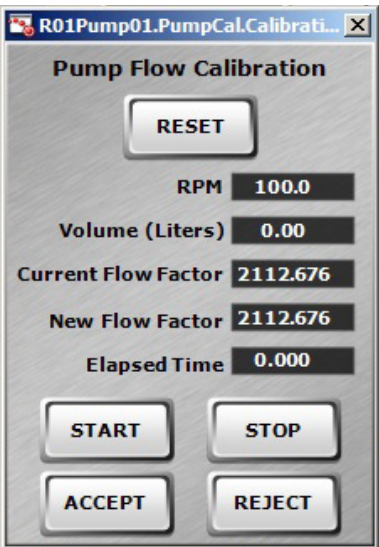
B.2.2 Flow controlling dialog boxes

Pump Flow Calibration

The **Pump Flow Calibration** dialog box can be accessed by clicking the pump icon in the **Reactor Display** window.



It allows the user to start or stop pump calibration.

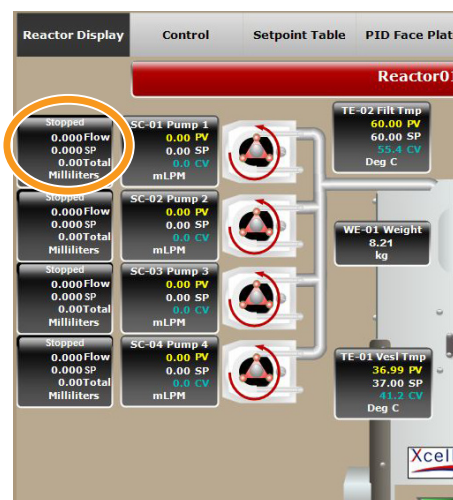




| Object                     | Description                                                                    |
|----------------------------|--------------------------------------------------------------------------------|
| <b>RESET</b>               | Allows the user to set the volume and the elapsed time values to zero          |
| <b>RPM</b>                 | Pump calibration speed                                                         |
| <b>Volume (Liters)</b>     | Data entry field for liquid volume that was pumped during the calibration      |
| <b>Current Flow Factor</b> | Flow factor prior to calibration                                               |
| <b>New Flow Factor</b>     | Flow factor after the calibration                                              |
| <b>Elapsed Time</b>        | Calibration time counter                                                       |
| <b>START/STOP</b>          | Activates or stops the pump calibration                                        |
| <b>ACCEPT</b>              | Accepts the <b>New Flow Factor</b> and finishes the pump calibration procedure |
| <b>REJECT</b>              | Rejects the calculated <b>New Flow Factor</b>                                  |

## Pump Totalizer

The **Pump Totalizer** dialog box can be accessed by clicking the pump totalizer object in the **Reactor Display** window.

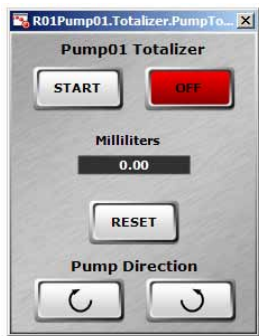


It allows the user to start or stop the flow totalizer and change pump flow direction.

B User interface description

B.2 User interface: dialog boxes

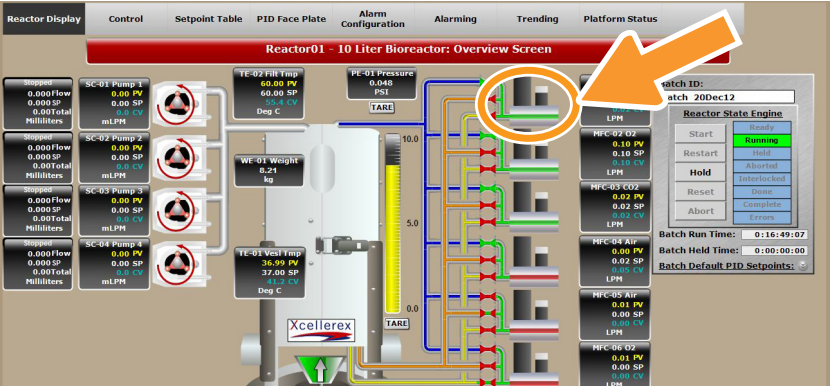
B.2.2 Flow controlling dialog boxes



| Object                | Description                                                                                                                                                                                                                                                                                                                                |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>START/STOP</b>     | Allows the user to start or stop the pump totalizer function                                                                                                                                                                                                                                                                               |
| <b>Milliliters</b>    | Shows the amount of liquid which has passed through the pump totalizer                                                                                                                                                                                                                                                                     |
| <b>RESET</b>          | Resets the volume reading ( <b>Milliliters</b> ) to zero                                                                                                                                                                                                                                                                                   |
| <b>Pump direction</b> | <div>Allows the user to set pump flow direction to clockwise or counterclockwise</div> <div><b>Note:</b><br/><i>The pumps supplied on XDR-10 Benchtop Bioreactor System are single direction pumps that only work in the counter-clockwise direction. Clicking on the clockwise arrow will have no effect on the pump direction.</i></div> |

Mass flow controller totalizer

The mass flow controller (MFC) totalizer dialog box can be accessed by clicking MFC icon in *Reactor Display* window.



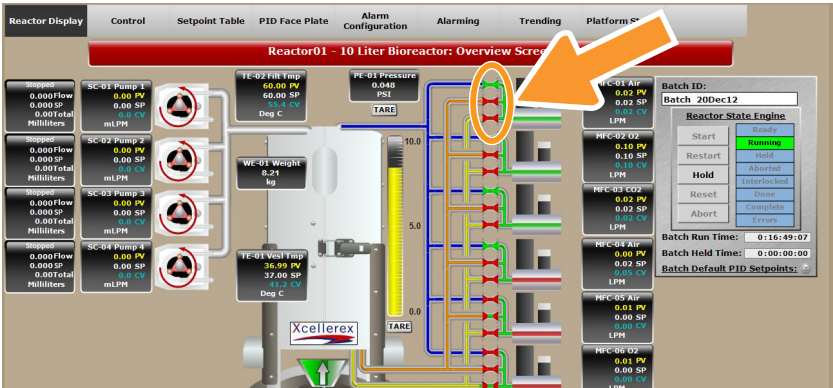
It allows the user to start or stop the mass flow totalizer and reset the mass flow totalizer.



| Object     | Description                                                                  |
|------------|------------------------------------------------------------------------------|
| START/STOP | Allows the user to start or stop the mass flow controller totalizer function |
| Liters     | Displays the amount of gas which has passed through MFC                      |
| RESET      | Resets the volume reading ( <b>Liters</b> ) to zero                          |

Flow path selection

The flow path selection dialog box can be accessed by clicking on solenoid valve icons in *Reactor Display* window.

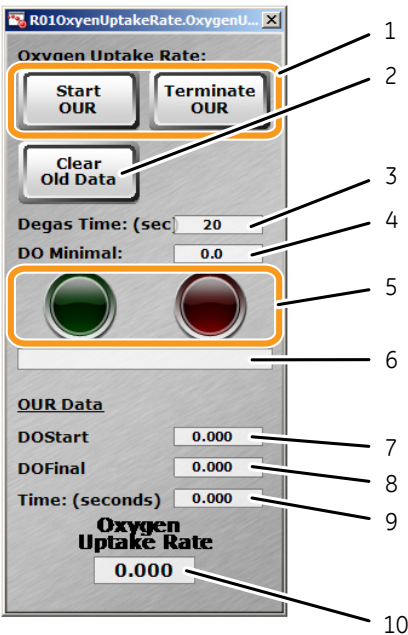


It allows the user to redirect the gas flow to a selected destination.



## Oxygen Uptake Rate

The **Oxygen Uptake Rate** (OUR) dialog box can be accessed by clicking the **Open OUR** button in the **Reactor Display** window. This function allows the user to perform a calculation of the oxygen uptake rate.



| Object | Description                                                                                                                                                                                                                          |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Buttons to start or stop the measurement of oxygen uptake rate                                                                                                                                                                       |
| 2      | Button to clear the data from previous calculation                                                                                                                                                                                   |
| 3      | Text field to enter an estimate of degas time                                                                                                                                                                                        |
| 4      | Text field to enter an estimate of minimal allowed level of dissolved oxygen (measurement target level)<br><br><b>Note:</b><br><i>This entry is in saturation fraction units, where 0.00 is 0% and 1.00 is 100% saturation.</i>      |
| 5      | Process status indicators: <ul style="list-style-type: none"><li>the green indicator is lighted if the OUR calculating process is ongoing</li><li>the red indicator is blinking if the OUR calculation request is rejected</li></ul> |

| Object | Description                                                                                                                                                                                                                                                            |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 6      | The display of the OUR calculation request status, displaying one of the following messages: <ul style="list-style-type: none"><li>• <b><i>Request Being Processed</i></b></li><li>• <b><i>Request Accepted</i></b></li><li>• <b><i>Request Rejected</i></b></li></ul> |
| 7      | The display of initial dissolved oxygen (DO) value (% saturation)                                                                                                                                                                                                      |
| 8      | The display of final dissolved oxygen (DO) value (% saturation)                                                                                                                                                                                                        |
| 9      | The display of the measurement time (seconds)                                                                                                                                                                                                                          |
| 10     | The display of calculated oxygen uptake rate (mmol/(L × h))                                                                                                                                                                                                            |

Initiating the OUR function turns the oxygen-containing sparge gas off and the PLC calculates the amount of oxygen used by the cells during a fixed period of time. This data is used to calculate the oxygen uptake rate for the current cell culture batch.

---

## B.2.3 Setpoint managing dialog boxes

### Default PID Setpoints

The **Default PID Setpoints** dialog box can be accessed by clicking on any of the text fields in the lower part of the **Batch Manager** display. The illustration below shows an example of the **Default PID Setpoints** dialog box.

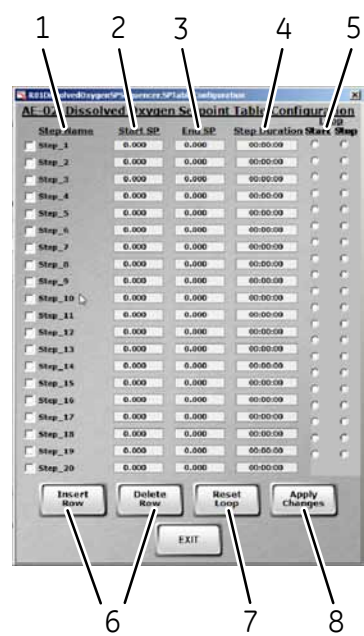
| Default PID Setpoints:    |                         |                        |       |                        |       |
|---------------------------|-------------------------|------------------------|-------|------------------------|-------|
| Main Input Devices:       | Pumps - Output Devices: | Mass Flow Controllers: |       |                        |       |
| AE-02: Dissolved Oxygen   | 49.000                  | SC-01: Pump 1          | 0.000 | MFC-01: Air            | 0.000 |
| AE-01: pH                 | 7.000                   | SC-02: Pump 2          | 0.000 | MFC-02: Oxygen         | 0.000 |
| TE-01: Vessel Temperature | 37.000                  | SC-03: Pump 3          | 0.000 | MFC-03: Carbon Dioxide | 0.000 |
| SC-05: Agitator           | 100.000                 | SC-04: Pump 4          | 0.000 | MFC-04: Air            | 0.000 |
| WE-01: Vessel Weight      | 500.000                 |                        |       |                        |       |
| TE-02: Filter Temperature | 60.000                  |                        |       |                        |       |
| AE-03: Auxiliary Input 1  | 0.000                   |                        |       |                        |       |
| AE-04: Auxiliary Input 2  | 0.000                   |                        |       |                        |       |

OKAY

The default PID setpoints are used to define the setpoints that do not change during a batch run. The setpoints typed into the text fields of the **Default PID Setpoints** dialog box will be applied at the beginning of the batch and are not changed by the control system during the run. The setpoints can be changed by the operator during the run.

Setpoint Table Configuration

The **Setpoint Table Configuration** dialog box can be accessed by clicking on the **Configure** button of a chosen PID control loop in **Setpoint Table Screen**. This dialog box allows the user to configure up to twenty separate steps to change the setpoint of the chosen parameter during a run. It is also possible to set up a loop of setpoints.



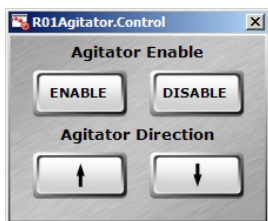
| Part | Name                           | Function                                         |
|------|--------------------------------|--------------------------------------------------|
| 1    | <b>Step Name</b>               | The name of the step                             |
| 2    | <b>Start SP</b>                | The intended setpoint at the start of the step   |
| 3    | <b>End SP</b>                  | The intended setpoint at the end of the step     |
| 4    | <b>Step Duration</b>           | The time length of a step                        |
| 5    | <b>Loop Start / Stop</b>       | Enables to set the chosen set of steps to repeat |
| 6    | <b>Insert Row / Delete Row</b> | Buttons to insert or delete a row                |
| 7    | <b>Reset Loop</b>              | The button to remove configured step looping     |
| 8    | <b>Apply Changes</b>           | The button to save defined configuration changes |



## B.2.4 Vessel content control dialog boxes

### Agitator Enable

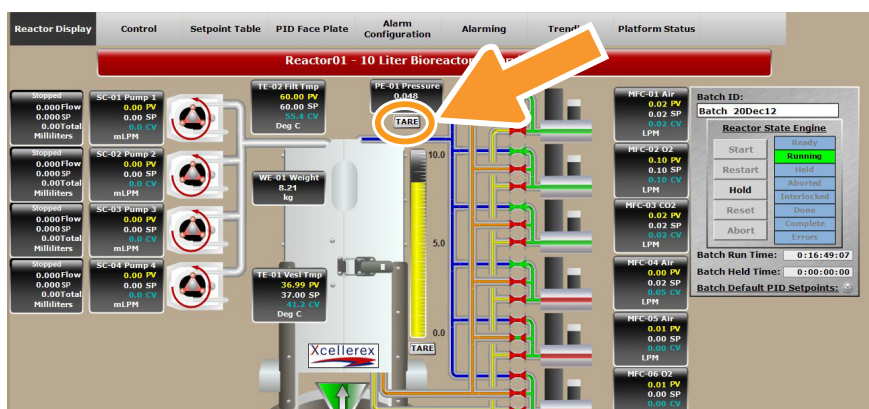
The **Agitator Enable** dialog box can be accessed by clicking the Agitator icon in the **Reactor Display** window. It allows the user to enable or disable the agitator and change the agitator direction.



| Object                    | Description                                                                                                  |
|---------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Agitator Enable</b>    | Allows the user to enable or disable the agitator.                                                           |
| <b>Agitator Direction</b> | Allows the user to choose the pumping direction: “up” arrow for pumping up or “down” arrow for pumping down. |

### Bag Pressure Tare

The **Bag Pressure Tare** dialog box can be accessed by clicking the **TARE** button next to bag pressure object in the **Reactor Display** window.



The **TARE** function sets the currently displayed bag pressure value to zero.

B User interface description

B.2 User interface: dialog boxes

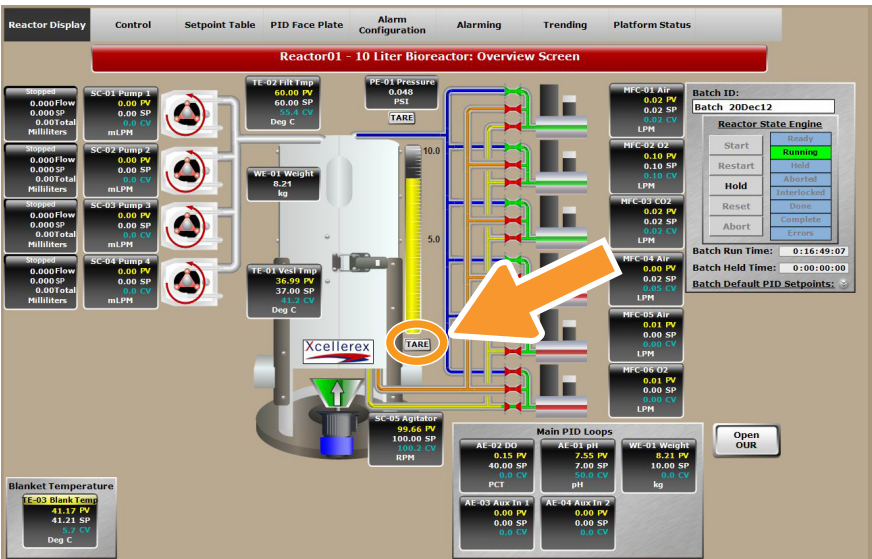
B.2.4 Vessel content control dialog boxes



**Note:** Password confirmation is needed to access the function if the bioreactor is a FlexFactory additional component.

Vessel Weight Tare

The **Vessel Weight Tare** dialog box can be accessed by clicking the **TARE** button at the bottom of reactor weight graphics display.



This allows the user to tare the reactor vessel weight. Password confirmation is needed to access this function.



## B.3 User interface: control functions

### Introduction

This section gives an overview of setting up process control and describes the functioning of some control loops.

---

### In this section

| Section                               | See page |
|---------------------------------------|----------|
| B.3.1 Configure control loops         | 337      |
| B.3.2 Examples of control loop set-up | 347      |

## B.3.1 Configure control loops

### Control loop mechanism

PID (proportional-integral-derivative) controller is a generic control loop feedback mechanism. A PID controller calculates the difference between a measured process variable and a desired setpoint. The controller attempts to minimize the error by adjusting the process control outputs.

PID controller is utilized to control all system modules as well as most processes. PID control is exerted using four control parameters:

- P - Proportional
- I - Integral
- D - Derivative
- DB - deadband

These four parameters regulate how much, how fast, and how close to the set value the control should act.

All control loops described in this chapter are PID control loops.

A control loop includes all following parts:

- The measurement apparatus
- The controller
- The final output device.

### Types of process control loops

The process control loops belong to one of the following three PID control loop types:

| PID control loop type | PID control loops                                                                                                                                                                                              |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Primary               | <ul style="list-style-type: none"><li>• Auxiliary input 1 control</li><li>• Auxiliary input 2 control</li><li>• Dissolved oxygen (DO) control</li><li>• pH control</li><li>• Volume (weight) control</li></ul> |

| PID control loop type | PID control loops                                                                                                                                                                                                                   |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Secondary             | <ul style="list-style-type: none"><li>• Agitator</li><li>• MFC: 1-4 (optionally up to 6)</li><li>• Pumps 1-3 (optionally up to 6)</li></ul> <p><b>Note:</b><br/><i>Any secondary loop can also be used as stand-alone loop.</i></p> |
| Stand-alone           | <ul style="list-style-type: none"><li>• Exhaust filter heater temperature control</li><li>• Vessel temperature control</li></ul>                                                                                                    |

Automated control of each PID control loop may be enabled or disabled as necessary. One or several PID control loops can be configured to run under the control of the **Setpoint Table**. Up to 20 changes per PID control loop may be configured and each PID control loop is configured independently.

**Note:** *Some PID control loops are factory-configured and cannot be configured by user. Please contact GE representative for more info.*

### Mapping PID control loops

Mapping a PID control loop establishes a connection between the input signal coming from a transmitter unit (for example pH) and a final control element (the output which controls the input measurement).

Mapping PID control loops is flexible by the nature of its design. Any primary control loop can be mapped to any secondary control loop. Lookup tables can be used in between primary and secondary control loops for transforming the output of the primary control loop before passing it along to the setpoint of the secondary control loop. As an alternative, any primary control loop can be sent through a split range. Split ranges are used specifically for pH control or to create a reverse acting cascade pair (see [Weight \(volume\) control, on page 349](#)).

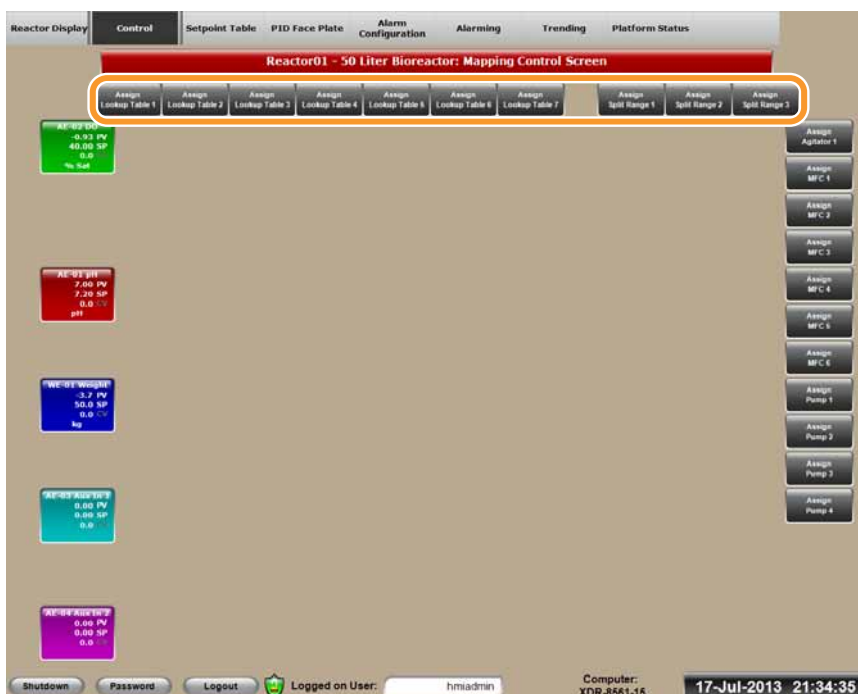
**Note:** *Factory-installed map setups and lookup table configurations are described in Factory Acceptance Test. These are examples and are not intended for use in a manufacturing bioprocess. The end user is responsible for developing appropriate values for a particular process.*

## Intermediate control elements

Intermediate control elements connect measured inputs to final control elements (for example pumps or MFCs). There are two types of intermediate control elements:

- Split ranges
- Lookup tables

Access buttons to intermediate control elements are located at the top of the **Control** screen.



### Split range

A split range is used when two outputs are utilized to control one input. The measured input is moved up by one output and down by the other output. The input is connected to the outputs by the mapping procedure. For example, pH can be regulated by increasing the CO<sub>2</sub> flow rate or by adding NaOH (pH would be mapped to CO<sub>2</sub> mass flow controller and NaOH pump).

Lookup tables

Lookup tables are used to apply a piecewise-defined function to modify the setpoint sent to the final control device (output). For example, a lookup table can be configured to make sure that a pump that delivers a solution would not slow its output until the weight control loop reaches 97.99%. Once that point is reached, the pump turns off rapidly.

Controller mapping process

The following table lists possible controller mapping options.

| The control loops...                                                                                                                                                                                           | Can be mapped to...                                                                                                                                                                                                                 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Auxiliary input 1 control</li><li>• Auxiliary input 2 control</li><li>• Dissolved oxygen (DO) control</li><li>• pH control</li><li>• Volume (weight) control</li></ul> | <ul style="list-style-type: none"><li>• Lookup tables</li><li>• Split ranges</li><li>• Directly to the devices:<ul style="list-style-type: none"><li>- Agitator</li><li>- Pumps</li><li>- Mass flow controllers</li></ul></li></ul> |

When a PID control loop is mapped to a device and is in **Remote** mode, the setpoint of the loop is determined by the input of the mapped device.

Once a device has been mapped to a PID control loop, it will appear in the same color on the screen as the PID loop it is mapped to, and it will line up with the PID control loop. Preparation for the mapping includes the following steps:

| Stage | Description                                                                                                                                                            |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Identify the parameter to be controlled (the input).                                                                                                                   |
| 2     | Identify the output(s) to be manipulated to control the input.                                                                                                         |
| 3     | If more than one output is used to control the input, identify the part of the control range to which each output is assigned. In such a case you need a split range.  |
| 4     | If the desired response of the system is not linear, arrange your existing data in a lookup table. The output and input will then be connected in a non-linear manner. |

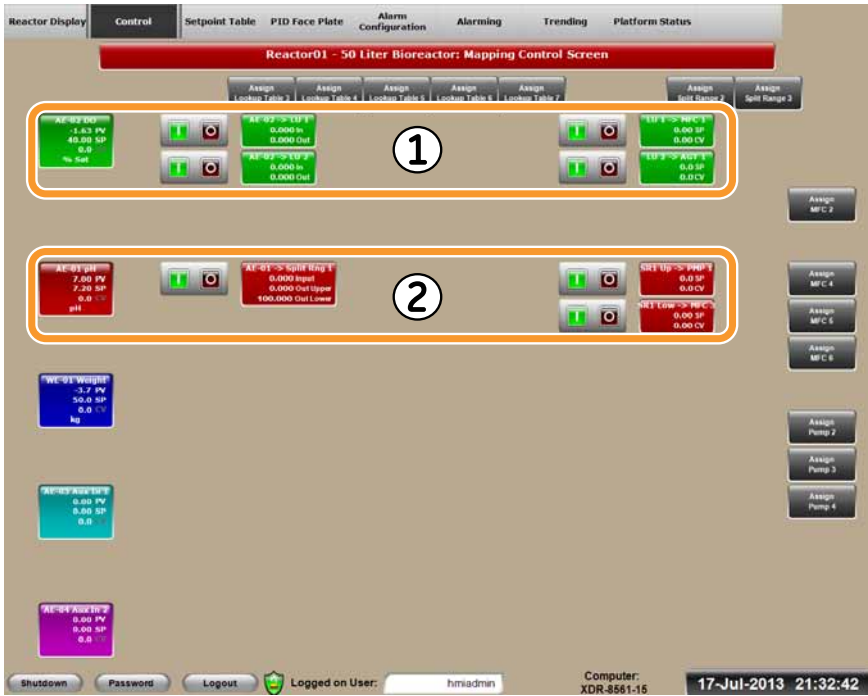


The outline of the mapping procedure is as follows:

| Stage | Description                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | Select the control element to map the PID control loop to: <ul style="list-style-type: none"><li>• an intermediate control element<br/>or</li><li>• a final control element.</li></ul>                                                                                                                                                                                                                      |
| 2     | Connect this control element to an input or output device.<br><i>Result:</i> <ul style="list-style-type: none"><li>• the input (primary controller) is mapped to an intermediate control element<br/>or</li><li>• the input (primary controller) is mapped to an output (final control element)<br/>or</li><li>• the output (final control element) is mapped to an intermediate control element.</li></ul> |

Example of mapped devices

The following image shows an example of mapped devices.



| Part | Function                                                    |
|------|-------------------------------------------------------------|
| 1    | DO control loop mapped to two lookup tables and two devices |
| 2    | pH control loop mapped to split range and two devices       |

See sections [Section 7.3.1 Map a control loop using lookup tables, on page 149](#) and [Section 7.3.2 Map a control loop using a split range, on page 156](#) in for detailed descriptions of mapping procedures.

## Lookup tables

Lookup tables offer a method for controlling primary PID control loops. A unique lookup table must be used for each secondary MFC. Lookup tables are the most common method for controlling dissolved oxygen in the bioreactor.

To access a lookup table click on a **Lookup Table** object in **Control** window. The location of one **Lookup Table** object is shown in the illustration below.

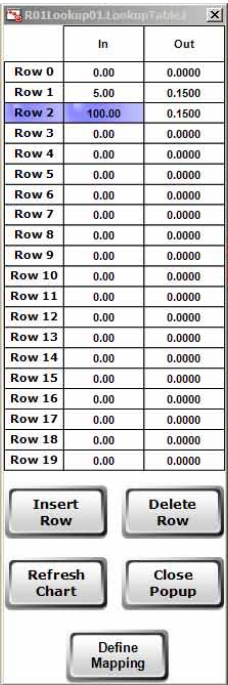


B User interface description

B.3 User interface: control functions

B.3.1 Configure control loops

The following illustration shows an example of a **Lookup Table** dialog box.



The buttons in the **Lookup Table** dialog box have the following functions:

| Button                | Description                                                                                        |
|-----------------------|----------------------------------------------------------------------------------------------------|
| <i>Insert Row</i>     | Inserts a row above the selected row                                                               |
| <i>Delete Row</i>     | Deletes the selected row                                                                           |
| <i>Refresh Chart</i>  | Updates the lookup table                                                                           |
| <i>Close Popup</i>    | Closes the dialog box                                                                              |
| <i>Define Mapping</i> | Opens the <b>Device Mapping</b> dialog box and enables to change or reset the lookup table mapping |

A lookup table is a one-to-one piecewise function which translates an input to an output. The input field to a lookup table is a CV value from a PID control loop. The output field of the lookup table becomes the setpoint for a final control element or a control variable for an intermediate control element (like a split range). This gives the possibility for communication between controlled variable output and PID control loop input even if they are in different units.

The values in the lookup table are set by the user. The output sent to a controller by a lookup table is determined proportionally by the values entered for the corresponding inputs.

## Split range

The split range is utilized for PID loop control when one primary controller must control two final control elements and each final control element does the opposite of the other. Splitting the range guarantees that the final control elements will never be running simultaneously. An example is pH control, when one controller lowers the pH and the other controller raises the pH, but they should not run simultaneously.

To access a **Split Range Setup** dialog box click on a split range object in **Control** window. The location of one **Split Range** object is shown in the following illustration.

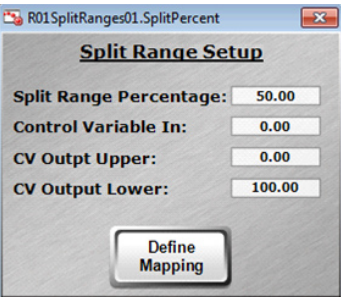


B User interface description

B.3 User interface: control functions

B.3.1 Configure control loops

The **Split Range Setup** dialog box allows the user to change or reset split range mapping and alter split range parameters. The following illustration shows an example of **Split Range Setup** dialog box.



| Object                        | Description                                                                                                                                                      |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Split Range Percentage</b> | Allows the user to change the point where the primary control loop is split to upper and lower ranges. At this point neither output has a controlled variable.   |
| <b>Control Variable In</b>    | The current controlled variable input from the primary controller.                                                                                               |
| <b>CV Output Upper</b>        | This is the controlled variable value where the <b>Split Range upper</b> will equal 100%.<br><br><b>Note:</b><br><i>This field cannot be modified by a user.</i> |
| <b>CV Output Lower</b>        | This is the controlled variable value where the <b>Split Range lower</b> will equal 100%.<br><br><b>Note:</b><br><i>This field cannot be modified by a user.</i> |
| <b>Define Mapping</b>         | <ul style="list-style-type: none"><li>Changes the device to which the split range is mapped</li><li>Resets the split range mapping</li></ul>                     |

## B.3.2 Examples of control loop set-up

### pH control

pH control loop is always set up as primary controller in a cascade loop. The acid and base PID control loops are nested loops inside the pH control loop. The output of the pH PID control loop is the setpoint of secondary controller loops, which can be either CO<sub>2</sub> PID control loop or acid/base pump PID control loop.

The following table explains some of the options available when configuring pH control.

| When...            | Then...                                                                                                                                 |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| pH value increases | base pump flow is decreased<br>or<br>CO <sub>2</sub> flow is increased (via mass flow controller)<br>or<br>acid pump flow is increased. |
| pH value decreases | base pump flow is increased<br>or<br>CO <sub>2</sub> flow is decreased (via mass flow controller)<br>or<br>acid pump flow is decreased. |

The pH PID control loop is a split range loop, where controlled variable of each half of the split range is zero at 50% output.

If the pH PID control loop is within the deadband range of the setpoint and calling for neither the base nor CO<sub>2</sub> or acid, the output of the loop is 50%. A deviation from 50% output will change the setpoint of either the top half or the bottom half of the split range:

- If the controlled variable goes above 50%, the split range upper setpoint is increased to bring the whole system to setpoint.
- If the controlled variable goes below 50%, the split range lower setpoint is increased to bring the whole system to setpoint.

When the controlled variable (**CV**) of the master PID loop is within the configured dead-band (**DB**), the controlled variable is forced to the configured split range percentage and the instrument enters **Forced** mode. The pumps remain in this state as long as the pump controlled variable is less than 10%. During this time the pump continuously switches on and off, running at 10% speed while switched on. The pump standby time is inversely proportional to the controlled variable value. When the controlled variable is above 10%, the pump operates in normal variable speed control mode.

## Dissolved oxygen (DO) control

DO control is a primary control loop. The output of the DO PID control loop is the setpoint of the secondary controller, which can be the agitator or an MFC. When DO mapping is complete, the DO may be used via **Auto/Manual** or operated via a setpoint table while performing batch operations.

Lookup tables are used when mapping MFCs to the DO control, because the output of the primary control loop is in percentage units and the setpoint of the MFCs is in SLPM. See [Lookup tables, on page 343](#) for more information.

---

## Headsweep (overlay) control

Mass flow controller headsweep (overlay) control is typically configured as a stand-alone loop, but this is not obligatory. MFC-04 is designated as the headsweep (overlay) MFC, although any MFC can be used. Headsweep (overlay) is generally used to reduce the amount of water vapor in the stream of exhaust gases. The same mapping functionality is available for headsweep (overlay) air control as for all six MFCs.

---

## Exhaust filter heater temperature control

Exhaust filter heater temperature control is a stand-alone PID control loop. The controller is accessed using **Filter Temperature** faceplate. The task of this PID control loop is to maintain the exhaust filter heater temperature at setpoint.

---

## Vessel temperature control

Vessel temperature control is a stand-alone PID control loop. The controller is accessed using **Vessel Temperature** faceplate. The vessel temperature control loop maintains the temperature of the vessel at setpoint.

---



## Weight (volume) control

Vessel weight control is a primary control loop that is mapped to secondary control loops (for example pumps) for filling, harvesting, or draining the vessel. Vessel weight control is achieved by adding, removing, or simultaneously adding and removing fluid.

| If...                                                                                                                      | Then...                                                                                                                                                                                                                                                                             |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| you want to fill or drain the vessel                                                                                       | <ul style="list-style-type: none"> <li>map the weight control loop to a single pump that adds or removes the media solution, or</li> <li>map the weight control loop to a split range, if the use of two pumps is desired.</li> </ul>                                               |
| you want to exchange media during a batch run and want to maintain the quantity of media in the vessel during this process | <ul style="list-style-type: none"> <li>set one pump to remove media from the system at a constant rate,</li> <li>set this pump in <b>Auto/Local</b> mode and provide a setpoint,</li> <li>map the second pump to a lookup table to control the weight of the bioreactor.</li> </ul> |

## Agitator speed control

Agitator speed control can be configured as a stand-alone loop or as a secondary loop in a cascade arrangement, mapped to DO control loop.

The controller is accessed using **Agitator** faceplate. Agitator PID control loop maintains the speed of the agitator at setpoint.

The following table describes agitator speed control modes.

| Mode                                              | Function                                                                                                                                                                                             |
|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Auto/Local</b>                                 | Agitator speed is controlled to the SP entered via the agitator PID faceplate.                                                                                                                       |
| <b>Manual/Local</b><br>or<br><b>Manual/Remote</b> | Agitator speed is controlled to the CV entered via the agitator PID faceplate.                                                                                                                       |
| <b>Auto/Remote</b>                                | Agitator speed is controlled to the default value in the <b>Batch Manager</b> , or in the <b>Setpoint Table</b> if this is enabled and a batch is running.<br><br>The loop is set to batch setpoint. |

# Appendix C Export and save data

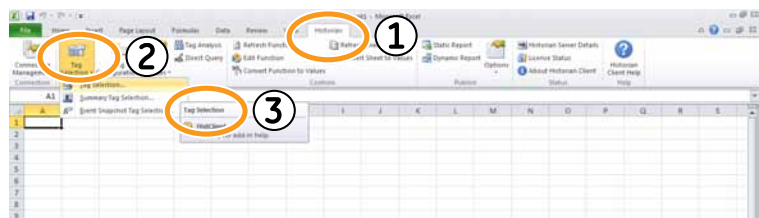
## Introduction

This appendix provides information about how to manage the collected data after a completed batch run.

## Export data to Excel spreadsheet

To export data to an Excel<sup>®</sup> spreadsheet, follow the steps below.

| Step | Action                                                                                                                               |
|------|--------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Open Microsoft Excel ( <b>Start:All Programs:Microsoft Office:Microsoft Excel</b> , if Excel is installed at the standard location). |
| 2    | Click onto a spreadsheet cell where you want your data table to start.                                                               |
| 3    | Select the <b>Historian</b> tab (1), navigate to <b>Tag Selection</b> (2) and select <b>Tag Selection</b> (3).                       |

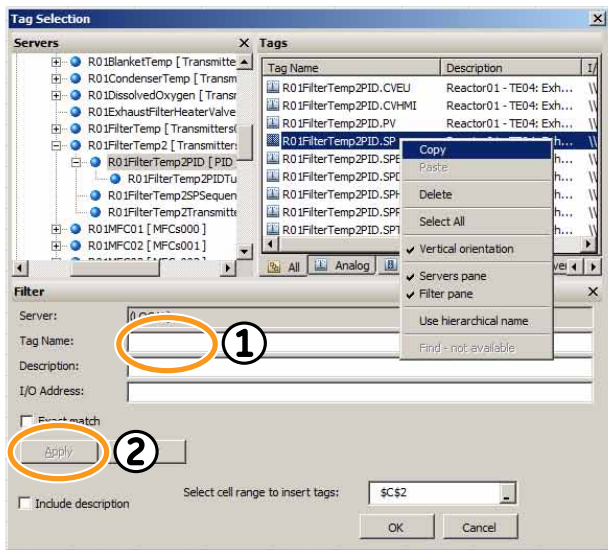


Result: A **Tag Selection** dialog box opens.

**Step Action**

4 Find the tag of the parameter that you want to export. If you know the tag name or part of the tag name, use the method below. If you do not know the tag name, use the method described in the next step.

- 1 Type the tag name directly into the **Tag Name** text field (1) and click **Apply** (2).



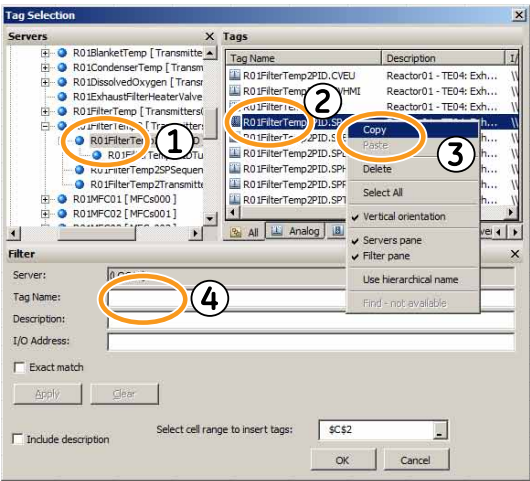
*Result:* The tag list will be updated with all tag names that match the search criteria.

- 2 Click **OK**.

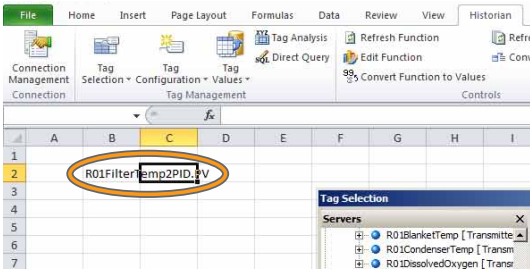
*Result:* The tag is pasted into the selected field in the spreadsheet.

Step Action

- 5 If you do not know the tag name, use the left navigation pane as described below. The list in the pane shows all objects within the current instrument configuration.
- 1 Navigate to the item of your interest in the left pane and click on it (1). The tags connected to this item will be shown in the right pane.
  - 2 Select the relevant tag in the right pane and right-click (2). A drop-down menu opens.
  - 3 Select **Copy** (3) from the drop-down menu.
  - 4 Right-click on the **Tag Name** text field, select **Paste** (4). The value will be populated into the text field.

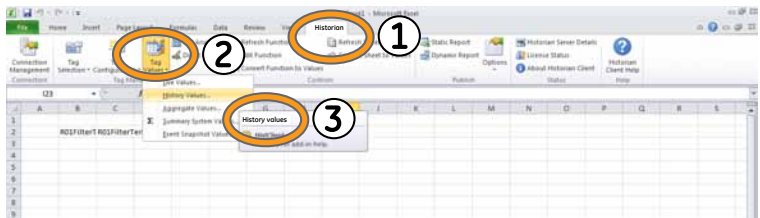


- 5 Click **OK**.
- Result:* The tag is pasted into the selected cell in the spreadsheet.

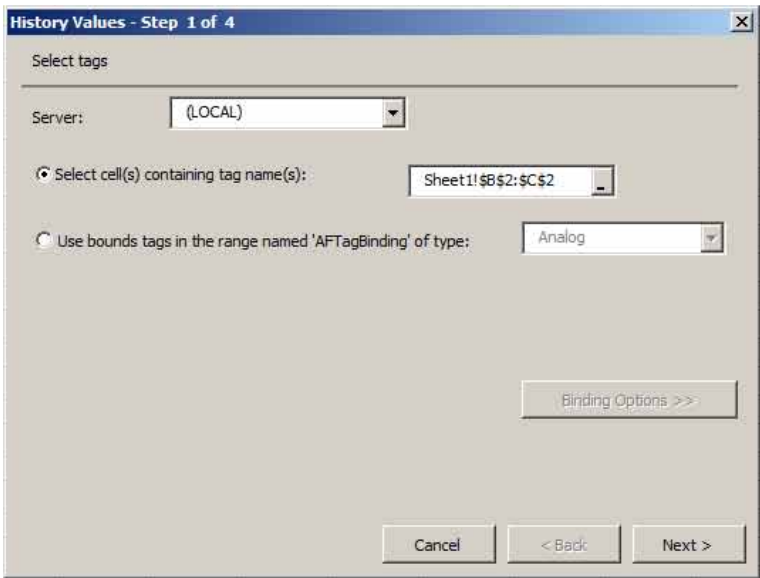


Step      Action

- 6      Select the **Historian** tab (1), navigate to **Tag Values** (2) and select **History Values** (3).

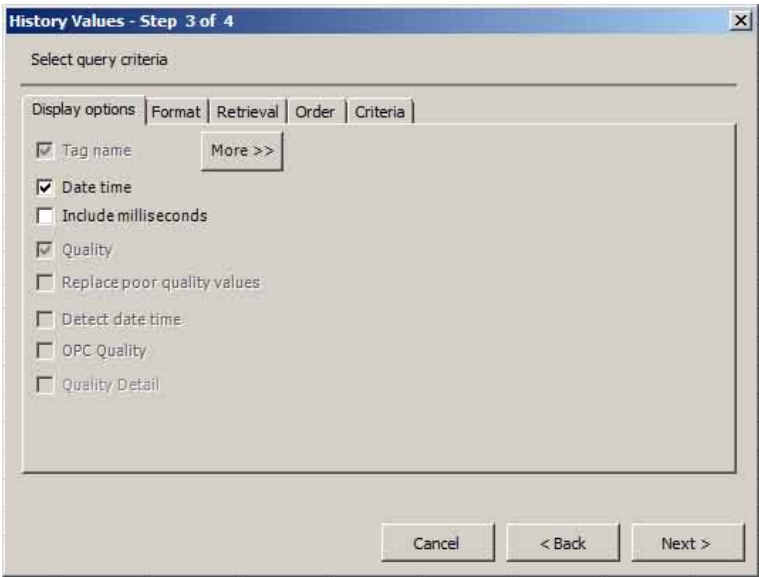


Result: A dialog box opens.



- 7      Select the cell containing the tag name in Excel spreadsheet and click **Next**.

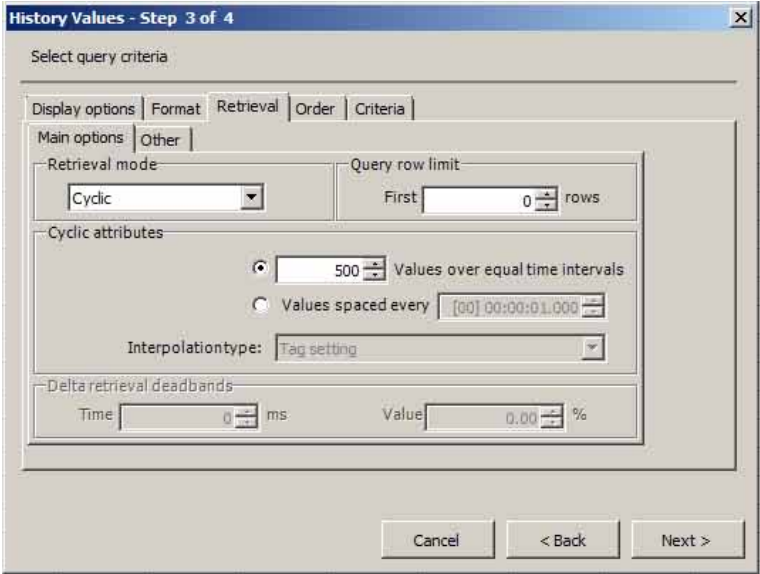
- | Step | Action                                                                                                                                                                                                                                                                        |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8    | Select the cell in the Excel spreadsheet that will be the top left corner of your output data table. Click <b>Next</b> .<br><br><b>Note:</b><br><i>Any previous data in the output area will be deleted.</i><br><br><i>Result:</i> A dialog box with multiple tabs will open. |



- 9 Select the **Display options** tab and make your choices for data output. **Date time** is displayed by default.
- 10 Select the **Format** tab and choose **Value based criteria** or **Tag based criteria**.

Step      Action

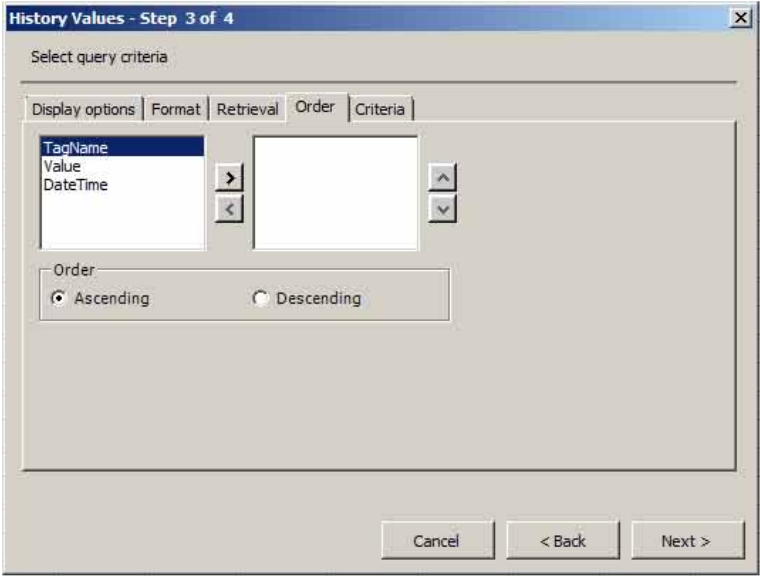
11      Select the **Retrieval** tab and make your choices.



**Note:**  
The historian function only saves data when it detects a change in the parameter that is greater than a threshold value. Please consult Excel Historian client help for more information about retrieval modes.

**Step**      **Action**

- 12      Select the **Order** tab and define the sequence of the columns in your data table.



- 13      Select the **Criteria** tab. You can limit the data collection by the search of historical values to an object, such as Batch ID. When you have made your choices, click **Next** to open a new dialog box.



Step      Action

14

Define a time range for your query. You can choose an absolute time (start time and date, end time and date) or relative time (for example, last eight hours).

15

Click **Finish** to complete the formatting of your output data table.  
*Result:* Your data will be extracted into Excel spreadsheet. Large queries might require several seconds to retrieve the data.

Based on the exported data table you can also plot a graph in Excel.

**Tip:**      *More information on working with data can be found in the application help, available in **Start:All programs:Wonderware:Books:Historian Client User Guide**, if installed at recommended location.*

Export data via OPC server

Contact your GE representative for information on configuring an OPC server on your instrument.

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For local office contact information, visit  
[www.gelifesciences.com/contact](http://www.gelifesciences.com/contact)

GE Healthcare Bio-Sciences AB  
Björkgatan 30  
751 84 Uppsala  
Sweden

[www.gelifesciences.com/xcellerex](http://www.gelifesciences.com/xcellerex)

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GE Healthcare Europe GmbH  
Munzinger Strasse 5, D-79111 Freiburg, Germany

GE Healthcare UK Limited  
Amersham Place, Little Chalfont, Buckinghamshire, HP7 9NA, UK

GE Healthcare Bio-Sciences Corp.  
800 Centennial Avenue, P.O. Box 1327, Piscataway, NJ 08855-1327, USA

GE Healthcare Japan Corporation  
Sanken Bldg. 3-25-1, Hyakunincho Shinjuku-ku, Tokyo 169-0073, Japan

