



# custom

laboratory  
reactor system



Customized Solutions - Flexible Solutions

## What are Custom Reactor Systems?

Syrris' Custom Reactor Systems are designed and built to your specifications. We specialize in systems that require large vessels (>5L), elevated pressures (>3 bar) or high temperatures (>250°C), alongside automation and datalogging.

### Custom Reactor System Benefits

- **Wide volume range:** Reactors from 100ml to 250 litres in glass, stainless steel or Hastelloy.
- **Wide temperature and pressure range:** Reactions can be heated to 500°C and pressurized up to 200 bar.
- **Safe:** Warning alarms and emergency cut-off values or actions can be defined.
- **Control:** High torque stirring including torque measurement.
- **Measured:** Dosing of gas, liquid or powder, with fully automated or manual control.
- **Pressurized:** Reactions such as fully controlled hydrogenations and carbonylations can be performed.
- **Integrated:** Can provide integrated pH and liquid control.
- **Flexible Control:** Manual or fully automated for unattended operation.
- **Easy to use software:** "Drag and drop" icons allow recipes to be created, edited and run intuitively.
- **Empowering:** Virtually any manufacturer's apparatus can be configured into a system using the software.
- **Powerful:** Apparatus such as pumps and balances can be combined in an intelligent fashion (e.g. enabling gravimetric dosing or dosing to maintain a pH).
- **Automatic data logging:** All responses such as temperature, stirrer speed, pH, mass flow, etc. can be graphically displayed in real time and are continually saved to one .csv file.



### Custom Reactor Systems

Complete systems can include reactors, stirrers, circulators, temperature probes, pumps, balances, sensors, etc. and be integrated with pH and/or liquid control. With manual operation or complete automation via the Atlas PC software, Syrris' custom reactor service will provide a highly adaptable solution for any chemistry laboratory.

With over 200 man years of combined experience, Syrris chemists and engineers manufacture the highest quality customized systems. They are assembled to your specification and rigorously tested at our facility before installation at your laboratory.

### Pre-Configured Devices

Virtually any RS232 device with ASCII communications can be configured. A selection of pre-configured devices includes:

#### Balances

Denver Pinnacle and Summit Series, Mettler PG 5001 and PM series, Oxford Top Pan, Sartorius CP and LP Series, Kern PLS 2100-2, Ohaus Ranger Count, A&D FX-iEP Series, Precisa XB

#### Circulators

Huber Ministat, Nuevo, Unistat, etc. Thermo Haake Phoenix II and DC50, Julabo F series, Lauda Proline series, Eyla PCC-7000

#### Pumps

Atlas Syringe Pump, Diaphragm: ProMinent gamma/I\*, Peristaltic: Cole Parmer Masterflex, IKA, Watson Marlow 323Du & 520Du Syrris FRX pump Piston: Scilog Chemtec Rotary/Piston: Ismatec MCP-CPF

#### Overhead Stirrers

IKA Eurostar, CAT R80D-PC, Heidolph RZR Control, OptiChem Tempstir

#### Refractometers

K-Patents PR-23

#### Pressure sensors

Mensor series 6000 digital

#### Flow Meters and Controllers

Meters: Aalborg GFM series\*, Sierra 820 series\*, Controllers: Aalborg DFC26, Cole Parmer 16 series, Ritter EDP 32 FP, Buchi BPC

#### pH meters

Atlas pH and Temperature, NodeDenver 215E and 215, Knick Portamess 913, Mettler Toledo MPH 125 pH and SevenEasy pH meter

#### Turbidity

Atlas Turbidity Probe, Mettler Toledo Trb8300\*

#### Vacuum Controller

Vacuubrand CVC2000 & CVC3000

#### Temperature sensors

Cole Parmer Digisense, J-Kem Temperature monitor, Syrris 7033 Dual channel RTD box

#### Sonocrystallization

Prosonix Sonolab SL10

#### Power supply

TTIEL302P

#### FTIR

Bruker Matrix MF

#### Powder doser

Lamda

\*With RS232 to analogue converter

Customized products - flexible solutions



### Automated High Pressure Reactors

For automated high pressure reactor requirements outside of Syrris' standard product range (Atlas 3 bar glass reactors, -80°C to +200°C up to 3 litres or 200 bar Stainless or Hastelloy reactors, -80°C to +300°C up to 450ml), Syrris offers High Pressure Custom Reactor Systems.

The requirements of the system can be defined in detail by the customer. Every system is assembled and tested at our factory before installation at the customer's facility by one of our engineers or chemists. Our systems offer unrivalled ease of use and sophisticated automation.

The High Pressure Customer Reactor Systems generally fall into one of two categories:

#### Glass High Pressure Systems

- **Vessel Volume:** 100ml to 1.6 litres
- **Temperature Range:** -40°C to +200°C
- **Automation / Logging:** Via Reactor Master PC software and/or Syrris Reactor Master series
- **Pressure Range:** Vacuum to +12.0 barg

#### Metal High Pressure Systems

- **Vessel Volume:** 100ml to 10 litres
- **Temperature Range:** -40°C to +350°C
- **Automation / Logging:** Device management and automation using Reactor Master, Reactor Master PC Software or a combination of both
- **Pressure Range:** Vacuum to 60 bar
- **Materials:** Stainless steel, Hastelloy, titanium



#### Features common to both

- **Heating / Cooling:** Jacket utilizing re-circulator
- **Lid Design:** Wide range of port options to suit your application
- **Agitation:** Overhead stirring: 50 to 2000 RPM (optional torque measurement)
- **Agitator Types:** Anchor, retreat curve, 4 blade impellor etc. in glass, PTFE, stainless steel etc.
- **Temperature Measurement:** Reactor contents, jacket inlet temperature etc.
- **Liquid Feed:** Volumetric dosing, gravimetric dosing
- **Gas Feed:** Pressure control, gas dosing, gas uptake monitoring, etc.
- **Other:** Condensers, distillation assemblies, re-circulation, IR, pH measurement and control, turbidity, conductivity, calorimetry, etc.

The following modes of operation are possible for both types of pressure reactor systems:

- **Automatically Maintain a Pressure:** By using the Atlas Pressure Control Module a consistent pressure to the reaction is maintained over the reaction period.
- **Pressure Control with Mass Flow Monitoring:** Maintain a pressure and monitor mass flow. Ideal for gas uptake monitoring.
- **Mass Flow Control:** Dose a known quantity of gas using the mass flow controller.
- **Off Gas Monitoring:** Monitor off-gases with mass flow meters.
- **Manual or Automated Gas Selection:** All of the above modes of operation are compatible with the Atlas Gas Selection Module.



**Automated Atmospheric Pressure Reactors >5L**

For automated atmospheric pressure reactor requirements outside of the range of Atlas Systems (50ml to 5 litres) Syrris offers Custom Reactor Systems. These systems are fully customizable, i.e. they can be defined in detail by the customer.

Each system is fully assembled and tested at our factory before installation at the customer's facility by one of our engineers or chemists.

**Automated Atmospheric Pressure Reactors >5L:**

- **Vessel Volume:** 5 litres to 250 litres
- **Temperature Range:** -40°C to +200°C
- **Automation / Logging:** Device management and automation using Reactor Master, Reactor Master PC Software or a combination of both
- **Pressure Range:** Vacuum to +0.5 bar
- **Heating / Cooling:** Jacket utilizing re-circulator (optional vacuum jacket)
- **Agitation:** Overhead stirring: 50 to 2000 RPM (optional torque measurement)
- **Lid Design:** Wide range of port options to suit your application
- **Agitator Types / Materials:** Anchor, retreat curve, 4 blade impellor etc. in glass, PTFE, stainless steel etc.
- **Liquid Feed:** Volumetric dosing, gravimetric dosing
- **Outlet Valve:** Temperature compensated zero dead volume rising stem bottom outlet valve in chemically resistant PTFE
- **Gas Feed:** Low pressure purge, gas sparge, gas evolution monitoring, etc.
- **Other:** Condensers, distillation assemblies, re-circulation, IR, pH measurement and control, turbidity, conductivity, calorimetry etc.

**Case Study 1**

An automated reactor system with two interchangeable reactors of 5 litre and 10 litre volumes. Designed for use in the flavours and fragrance industry.

**Customer Application:**

- Data logging of speed and torque of overhead stirrer
- Temperature dependent automated gravimetric dosing
- One lid and stand to fit two interchangeable vessels



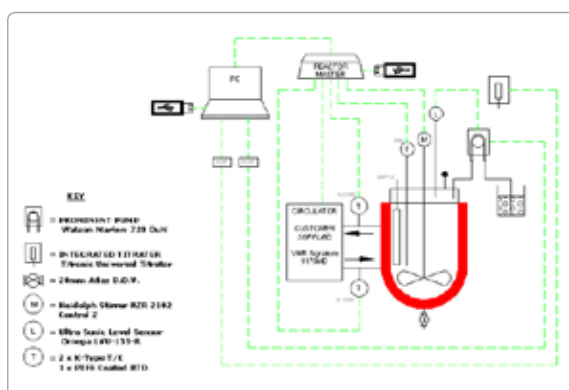


### Case Study 2

20 litre automated synthesis system for the defense industry. This included high torque stirring, volumetric liquid addition and temperature monitoring and logging.

#### Customer Application:

- Process requires exact temperature control (large scale/fast flow rate quench on standby)
- Atmospheric glass reactor (up to 200°C)
- Twin head high flow Peristaltic Pump
- Level sensor to quench cool for safety reasons
- pH titration
- Baffles



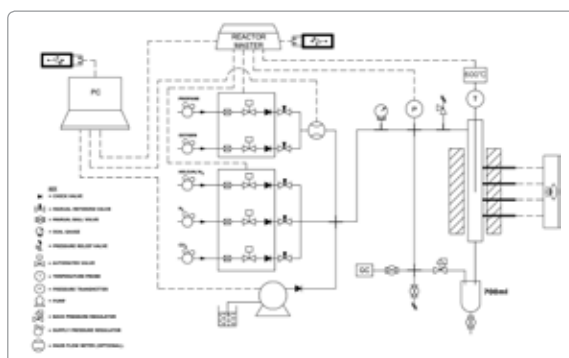
### Case Study 3

High pressure (200 bar) and high temperature (500°C) continuous flow reactor.

Features: 5 gas feeds (automatically selected), one liquid feed, mass flow meter, take off for Gas Chromatography, catalyst bed, 4 optical probes (supplied by customer), full data logging and automation.

#### Customer Application:

- Use on-line UV spectroscopy (4 x probes) to monitor heterogeneous catalyst mechanisms
- Catalyst performance and degradation levels monitored
- Catalysts were being developed for use in industrial hydrogenation, alkylation and hydro-treating pilot-scale reactors



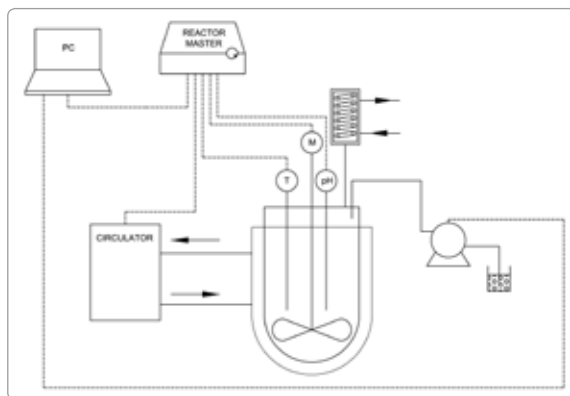


**Case Study 4**

An automated, 100 litre single jacketed glass reaction system (-20°C to +200°C) with temperature dependent gravimetric dosing. Features included full data logging, automation and distillation condenser.

**Customer Application:**

- 100 litre single jacketed reactor
- Process temperature from -20°C to +200°C
- Custom pH probe
- Liquid feed and pH control
- Automation and logging

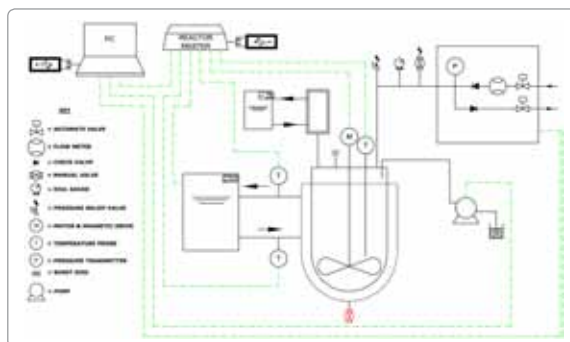


**Case Study 5**

5 Litre Stainless Steel Oil Jacketed Reactor - operating at pressures up to 40 bar and at temperatures up to 250°C with high torque stirring.

**Customer Application:**

- Distillation column and condenser
- Volumetric liquid dosing
- Pressure control with gas selection
- Gas mass flow meter
- Torque monitoring
- High performance circulator





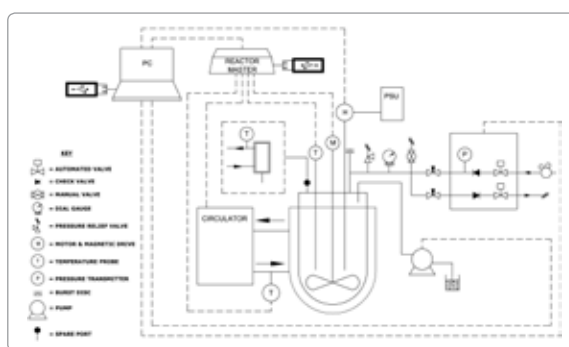
### Case Study 6

1.5 litre high pressure (60 bar) and high temperature (350°C) stainless steel jacketed reactor system with calorimetry.

Features: Automated pressure control (using the Atlas Pressure Control Module), high torque overhead stirring with torque feedback, mass flow meter, power compensation calorimetry, heat flow calorimetry and high pressure liquid dosing.

#### Customer Application:

- Polymerizations under pressure
- Understanding kinetics and calorimetry of some polypropylene polymerizations



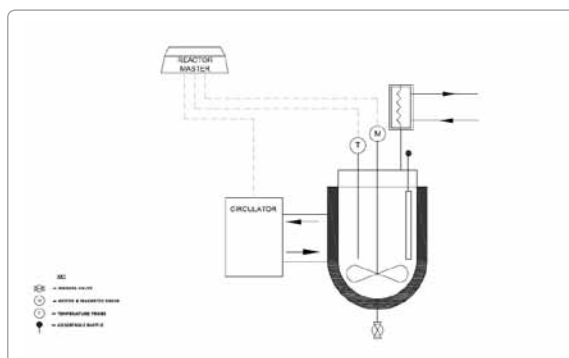
### Case Study 7

20L, vacuum jacketed, reactor with interchangeable stirrer configurations. The system includes high torque stirring and is for use in a pharmaceutical industry pilot plant.

Features: High performance condenser and oil jacket temperature measurement. Can be upgraded to full automation by adding a Reactor Master and PC software.

#### Customer Application:

- Reaction optimization
- Process development





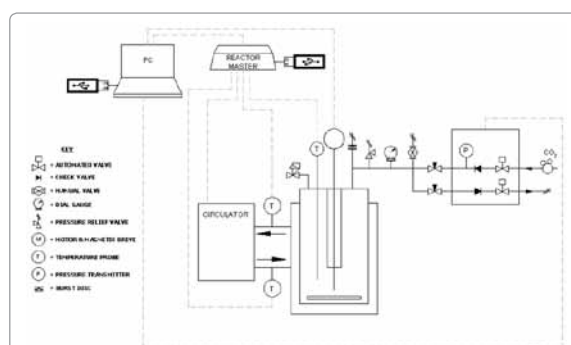
### Case Study 8

300ml, stainless steel, oil jacketed, reactor with operating temperature of up to 200°C and pressures up to 200bar for the petrochemical industry. The system has data logging and full PC-controlled automation.

Features: Coriolis flowmeter to measure mass, density and temperature.

#### Customer Application:

- Measurement of deformation of polymer samples under supercritical conditions
- Supercritical carbon dioxide work



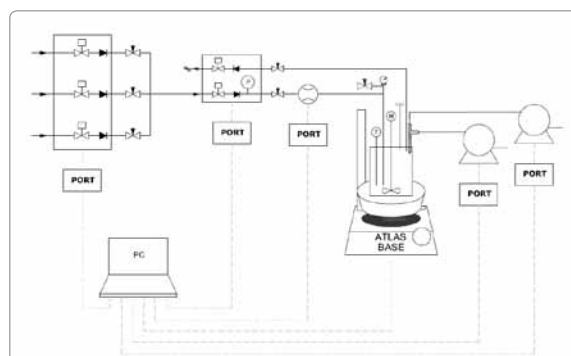
### Case Study 9

100ml, stainless steel, jacketed reactor, pressurized using high purity helium for reactions up to 200bar and 250°C for the petrochemical industry.

Features: Automated pressure control (using the Atlas Pressure Control Module), dual liquid feeds, volumetric dosing, gas selection and a mass flow meter.

#### Customer Application:

- Removing hydrocarbons from water
- Addition of water to oil water mixtures
- Pressurization using an inert gas





## Automating Existing Systems

Reactors already owned by customers can be upgraded to perform automated experiments, even without a PC. Choose the Atlas Syringe Pump for automated reagent dosing and/or the Reactor Master for automation and data logging of temperature, stirring and reagent addition. The Reactor Master PC Software converts existing reactors into a totally controlled laboratory reactor.



### Reactor Master Basic

2200515

The Reactor Master Basic automates jacketed reactor systems from other manufacturers and logs data without the need for PC software. Circulators, (e.g. Julabo, Huber, Haake, Lauda etc.) stirrers, (e.g. Heidolph, IKA, Chemglass etc.), thermocouples and RTDs from virtually any manufacturer can be controlled by the twist and click knob. Data can be viewed in real time and downloaded to a USB memory stick as a .csv file.

The circulator, overhead stirrer and thermocouples are connected to the rear of the Reactor Master Basic. The circulator temperature and stirrer speed can be set using the twist and click knob and displayed on the LCD screen. It is also possible to set stirring and temperature profiles to run in a totally automated fashion.

#### A Reactor Master Basic System contains:

Description	Part Number
Reactor Master Basic	2200247
<b>Options</b>	
Circulator Cable	(see page 98)
Stirrer Cable	(see page 98)

**Reactor Master Pro****2200516**

The Reactor Master Pro retains all the benefits of the Reactor Master Basic but also has the following additional benefits:

- Reaction temperature control (not just circulator temperature)
- Ability to use Atlas RTD sensors
- Ability to use Atlas Turbidity sensors
- Ability to use Atlas pH sensors
- Ability to use Atlas Pressure sensors
- Ability to upgrade to PC software (to control other manufacturer's apparatus)

A better reaction temperature is achieved by "closed loop" (PID) control of the reactor temperature sensor and the set point of the circulator (rather than simple "open loop" setting of a circulator bath temperature).

Connection of Atlas RTDs, pH and turbidity probes is possible via a node extension.

Feature	Reactor Master Basic	Reactor Master Pro
Data logging	✓	✓
Data download to USB memory stick	✓	✓
Compatible with data analysis software	✓	✓
Control of thermoregulator temperature	✓	✓
2 x Thermocouples sockets	✓	✓
PID control of reaction temperature	✗	✓
2 x RTD sockets	✗	✓
Upgrade to full PC software control possible	✗	✓
pH meter compatible	✗	✓
Turbidity sensor compatible	✗	✓

**A Reactor Master Pro System contains:**

Description	Part Number
Reactor Master Pro	2200248
<b>Options</b>	
Circulator Cable	(see page 98)
Stirrer Cable	(see page 98)
Reactor Master Software	2600004
Atlas Syringe Pump	2200072
Atlas Syringe Pump XL	2200376

**Syringe Pump****2200072**

The Atlas Syringe Pump is a versatile volumetric dosing and/or sampling system. It allows 2 independent refilling flows, one continuous flow, reaction sampling, intelligent control of pH and temperature dependant dosing. It consists of 2 syringes and multi port valves and can be controlled from the front panel, by a Reactor Master, or the Reactor Master PC software.

See the Atlas Syringe Pump and Syringe Pump XL (pages 27-28) for more information.



## Reactor Master Software

2600004

Reactor Master Software is an easy to use PC based application for control and analysis of experiments. Whole systems including stirrers, circulators, RTDs, pumps, balances etc. can be configured using virtually any manufacturer's apparatus. The "drag and drop" interface means recipes can be created, changed and saved with the click of a mouse.

The Reactor Master Pro (2200248) can control reaction profiles and log data. The Reactor Master Software (which can operate with or without the Reactor Master Pro) provides whole system control, configuration and analysis allowing sophisticated experiments to be performed. Almost all RS232 controlled apparatus and analogue sensors can be connected to the software via a simple Port (2101020) which plugs into the computer's USB connection. This allows automation of any compatible laboratory apparatus with full recipe control.

Running reactions from the Reactor Master Software allows all responses such as temperature, stirrer speed, pH and mass flow to be continuously monitored and graphically displayed in real time. Data can also be used to trigger other actions e.g. a pump and a balance can be combined to perform gravimetric dosing. Apparatus is configured (including alarms and emergency control) using a simple "drag and drop" interface. Recipes can be created, changed and saved with the click of a mouse. Recipes can be run, paused or stopped and all experimental parameters may be altered 'on the fly' during the experiment. All reaction data is continuously logged to .csv data files making analysis easy.

Virtually any RS232-enabled device with ASCII communications can be configured, the current list of pre-configured devices is below:

### Balances

Denver Pinnacle and Summit Series,  
Mettler PG 5001 and PM series, Oxford  
Top Pan, Sartorius CP and LP Series,  
Kern PLS 2100-2, Ohaus Ranger  
Count, A&D FX-iEP Series, Precisa XB

### Circulators

Huber Ministat, Nuevo, Unistat, etc.  
Thermo Haake Phoenix II and DC50,  
Julabo F series, Lauda Proline series,  
Eyela PCC-7000

### Pumps

Atlas Syringe Pump,  
Diaphragm: ProMinent gamma/I\*,  
Peristaltic: Cole Parmer Masterflex,  
IKA, Watson Marlow 323Du & 520Du  
Syrrix FRX pump  
Piston: Scilog Chemtec  
Rotary/Piston: Ismatec MCP-CPF

### Overhead Stirrers

IKA Eurostar, CAT R80D-PC, Heidolph  
RZR Control, OptiChem Tempstir

### FTIR

Bruker Matrix MF

### Refractometers

K-Patents PR-23

### Pressure sensors

Mensor series 6000 digital

### Flow Meters and Controllers

Meters: Aalborg GFM series\*, Sierra  
820 series\*,  
Controllers: Aalborg DFC26, Cole  
Parmer 16 series, Ritter EDP 32 FP,  
Buchi BPC

### pH meters

Atlas pH and Temperature,  
NodeDenver 215E and 215, Knick  
Portamess 913, Mettler Toledo MPH  
125 pH and SevenEasy pH meter

### Turbidity

Atlas Turbidity Probe, Mettler Toledo  
Trb8300\*

### Vacuum Controller

Vacuubrand CVC2000 & CVC3000

### Temperature sensors

Cole Parmer Digisense, J-Kem  
Temperature monitor, Syrris 7033 Dual  
channel RTD box

### Sonocrystallization

Prosonix Sonolab SL10

### Power supply

TTIEL302P

### Powder doser

Lamda

\*With RS232 to analogue converter



**Reactor Master COM Port Software**

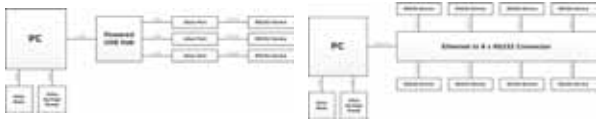
**RD2600023**

The Reactor Master COM Port Software has the same functionality as Reactor Master Software (2600004) with the exception that it uses RS232 connection directly to the PC rather than via an Atlas Port (2101020). Although more difficult to set-up, this is favoured (both technically and because it becomes more cost effective) when 4 or more RS232 devices are required. Choose the regular Reactor Master Software (2600004) when up to 3 RS232 devices are to be used.

Due to the nature of setting up the Reactor Master COM Port Software, it is recommended that this is performed by Syrris engineers on a PC purchased from Syrris (2200599). The Reactor Master COM Port Software is designed for use with the following part: Ethernet to 8 RS232 Ports for use with COM Port Software and Set Up (2200351).

	<b>Reactor Master Software</b>	<b>Reactor Master COM Port Software</b>
Ease of set up?	Easy	Requires Syrris Engineer
Control of 1-3 RS232 Devices	Less Expensive	More Expensive
Control of 4+ RS232 Devices	More Expensive	Less Expensive

How?



# Syrris Batch Reactor Range

	atlas automated synthesis system	globe reactions made easy	custom laboratory reactor system
<b>Automated Jacketed Reactor</b> 50ml to 5L, -90°C to +250°C, Vacuum to 3 bar	●	○	x
<b>Manual Jacketed Reactor</b> 50ml to 5L, -90°C to +250°C, Vacuum to 3 bar	○	●	x
<b>Automated Jacketed Reactor</b> >5L, >250°C or >3 bar	x	x	●
<b>Reaction Calorimeter</b> 100ml to 2L, -40°C to +150°C, Vacuum to 3 bar	●	x	x
<b>Manual or Automated Round Bottom Flask/Vial Reactor</b> 50ml to 2L, -40°C to +330°C, Vacuum to atmospheric	●	x	x
<b>Automated Pressure Reactor</b> 100ml to 450ml, -40°C to +330°C, Vacuum to 200 bar	●	x	x

**Key:** ● Ideal    ○ Possible    x Not Suitable

## atlas

automated  
synthesis system

Atlas is a revolutionary range of modular products, which can form a wide range of lab reactors. Atlas offers manual or automated control of one or many reactions at a time with volumes from 5 litres to 1ml in jacketed reactors, flasks or vials.

Find out more at: [www.syrris.com/batch-products/atlas-overview](http://www.syrris.com/batch-products/atlas-overview)



## globe

reactions  
made easy

Globe is a jacketed chemical reactor system that saves time, money and space. It has been designed by chemists to offer the ultimate ease of use and reaction flexibility.

Find out more at: [www.syrris.com/batch-products/globe-chemical-reactor](http://www.syrris.com/batch-products/globe-chemical-reactor)



**Syrris is the world's most advanced provider of laboratory scale chemistry systems.**

**Syrris' network of offices in the UK, USA, Japan, India and Brazil plus over 35 distributors worldwide offer local service and support.**

**Contact us now at:  
[www.syrris.com](http://www.syrris.com)**



**Download Syrris' Batch Chemistry Reactors Catalogue**

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